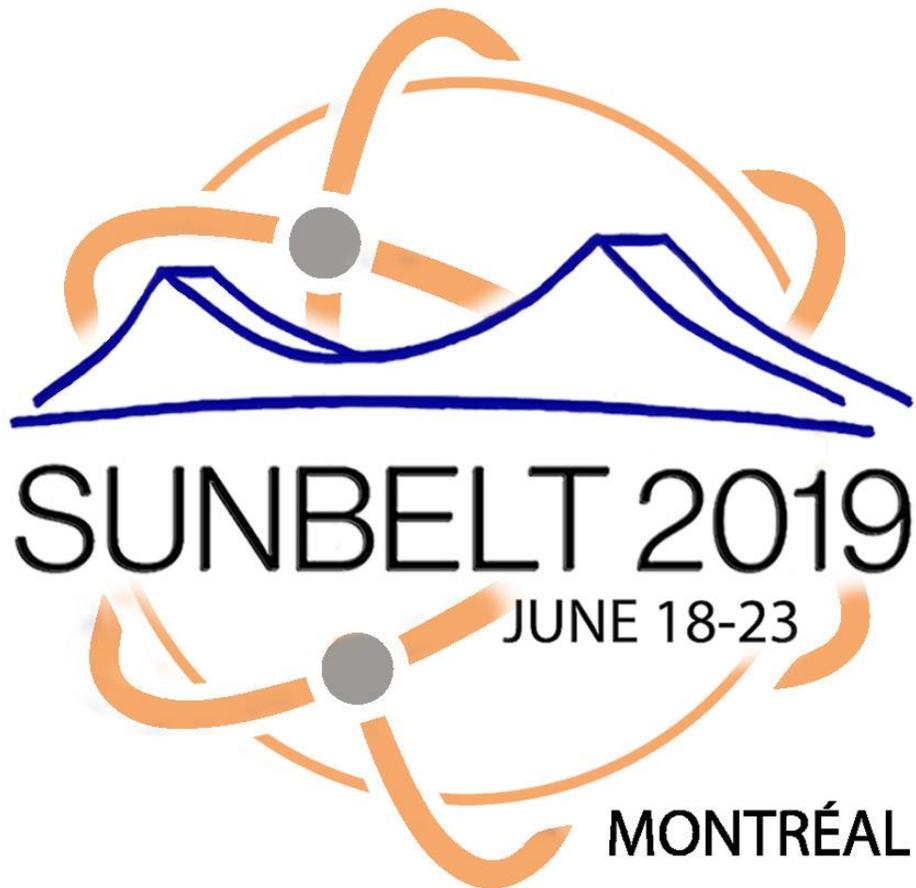


# Oral Presentation Abstracts



**A Comparison of Model-based Treatments of Tie Non-response**Chong Min Kim<sup>1</sup><sup>1</sup>Gyeongin National University of Education

Social network analysis using statistical models is useful for analyzing endogenous and exogenous effects of social networks. Particularly, it is useful for grasping the actual condition of the whole network and analyzing social selection effects. However, it is difficult to collect complete network data without any tie non-response, which may affect bias and standard errors of endogenous effects: Specifically, inaccurate strength of relationships, unstable degree centrality measures, biased reciprocity measures and clustering coefficients. In most social networks studies, the tie non-response constitutes a serious problem. However, popular software treats only the completely observed network data, or assumes that the missing network values are not removed but are not present. This kind of analysis as a complete case method results in the loss of serious information and eventually to reduction in the statistical power. Nevertheless, the study on model-based treatments of tie non-response is relatively in progress compared to other treatments. Therefore, the purpose of this study is to compare the results of model-based treatments of tie non-response and provide useful information about model-based treatments of tie non-response. In particular, I will compare three model-based procedures such as Bayesian exponential random graph models, stationary stochastic actor-oriented models, and latent space models with multiple imputation method under a simulation study.

To conduct the simulation study, first, I will generate the simulated tie non-response data based on the empirical elementary teachers' advice networks. Specifically, in a small size (30 teachers) school, the missing actors as tie non-response are assumed to be from one actor to ten actors. Additionally, teacher characteristics data are assumed to have no missing attribute values, unlike the network data, considering only the teachers' gender, grade, and leadership position. Additionally, based on the previous research, it is assumed that the density is .10 and .05, the reciprocity is 30% and 50%, and homophily effect is 50% and 70%, and the triad is assumed to be 30%. Second, I will consider three missing data mechanisms based on previous studies: 1) missing completely at random, 2) missing at random related to the covariate, and 3) missing not at random related to high out-degree. Third, I will treat missing social network data based on three model-based multiple imputation methods in both the most basic network models(density, reciprocity and homophily) and the more complex network model(geometrically weighted edgewise shared partner). Finally, I will compare the results of 240 complete social network simulation data analysis with focus on bias and standard errors of the estimates of endogenous effects.

This study will be significant in providing appropriate information on model-based treatment methods of missing social network data. This information can be used to estimate reliable coefficient values and to help in making correct statistical decisions by treating appropriate tie non-response.

**A continuous time spatial network model for analyzing bike sharing systems**Tin Lok James Ng<sup>1</sup>, Andrew Zammit-Mangion<sup>1</sup><sup>1</sup>University of Wollongong

Bike-sharing systems allow users to rent bicycles for short trips by accessing a dock within the system to unlock or return bicycles. Such systems, which aim to fill in public transit gaps and to reduce congestion and air pollution, have been growing in number and popularity in major cities across the world. In recent years, bike-sharing data sets have been made available to the public, allowing the analysis of the transportation dynamics, and how it relates to where people live and where they work. For example, the bike-sharing data provided by Capital Bikeshare Washington

D.C. includes start date and time of a trip, its duration, starting and ending stations, etc. Such continuous time relational data can be naturally represented using a network structure with time-stamped edges, where the vertices of the network are the stations and the edges are the time-stamped trips between each pair of stations.

Although statistical models have been developed to analyze bike-sharing data, existing methodologies typically require discretization of the time domain, and do not take into account the spatial information of the bike stations. However, such discretization may be arbitrary and the lack of consideration of spatial information can lead to inferior predictions. We develop a parsimonious continuous time spatial network model to address these shortcomings. A spatio-temporal process is incorporated in the model to represent how likely a bicycle is unlocked at each station across time, while the interactions between those stations are modeled using a stochastic block structure. The developed model can capture the spatial and temporal variations of bike-sharing activities as well as clustering of the bike stations. Statistical inference of the model is performed using a Bayesian approach to estimate the process and the block structure. Bike-sharing activities between stations and across time can be both visualized and simulated from the estimated model. The developed model is also applicable to other types of continuous time relational data that contain spatio-temporal information.

### **A Field Guide to Social Support On and Off Line: The View from East York**

Anabel Quan-Haase<sup>1</sup>, Barry Wellman<sup>2</sup>, Molly-Gloria Harper<sup>3</sup>

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We examine how Canadians living in the East York section of Toronto obtain support from their personal networks. Just as we have had to deconstruct social support and role relationships to understand its component parts, we now deconstruct how different sorts of digital media play socially supportive roles. Drawing on the theoretical framework of social affordances, we examine to what extent digital media intersects with receiving and giving of social support.

We draw on 101 interviews conducted in 2013-2014 to shed light on the support networks of East Yorkers and discern what types of social support people exchange in different age groups.

Our findings show that not much has changed since the 1960s in terms of the the role relationships that East Yorkers have (siblings, etc.) and the types of support mobilized via social networks: companionship, small and large services, emotional aid, and financial support. Despite the transition to the digital age, we find that the same categorization of support types discovered in Wellman & Wortley (1990) still function today, both in-person and online.

What has changed is how digital media interweave in complex ways with different relations to mobilize support. Digital media activated a wide range of ties for support, but also played a central role in the maintenance over time of weak and latent ties that are temporarily dormant, yet become active again when need arises.

### **A Gender Based Analysis of the ArcticNet Research Network**

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In 2004, ArcticNet was established under the Network Centres of Excellence Program and to date represents Canada's single largest commitment to climate change research in the Canadian Arctic. The accomplishments of ArcticNet are noteworthy, including over 2,700 peer-reviewed publications. Notwithstanding these accomplishments, there has been significant gender disparity in network participation and academic output. In this research, we take a gendered based approach to analyze ego-nets of ArcticNet researchers' using the co-authorship network,

containing 1,255 collaborators. The main objectives of this ongoing research are to (i) identify the gender composition of the network by membership type and publications, and (ii) examine structural differences in ego-nets between genders. Results show that although ArcticNet female collaborators occupy the majority of positions up to post-doctoral studies (i.e. graduate students 59% female, N=246), most highly ranked positions in this research network are occupied by male collaborators (i.e. investigators 79%, N=246). In terms of publications, 46% involve both male and female co-authors, whereas 45% male only publications and only 9% are female only papers. Female collaborators in ArcticNet, have statistically significant smaller ego-networks ( $M_{\text{females}} = 7.24$ ;  $M_{\text{males}} = 11.77$   $p < 0.01$ ), less reach ( $M_{\text{females}} = 97.50$ ;  $M_{\text{males}} = 124.99$   $p < 0.01$ ), less often in brokering positions ( $M_{\text{females}} = 7.24$ ;  $M_{\text{males}} = 11.77$   $p < 0.01$ ), and generally with lower centrality scores - Freeman's total and betweenness degree centrality scores. Furthermore, there are statistically significant differences in terms of ego-alter similarity between genders, with females showing heterophily, whereas males show homophily. These findings, supplemented by causal and longitudinal research, can provide further insights into some of the underlying patterns that reinforce challenges of reaching gender parity in academic circles.

### **A Generic and Flexible Analysis Framework to Categorise Social Support Networks**

Sébastien d'Oreye de Lantremange<sup>1</sup>, Sébastien Combéfis<sup>1,2</sup>, Hélène Garin<sup>3</sup>, François Wyngaerden<sup>3</sup>, Pablo Nicaise<sup>3</sup>, Vincent Lorant<sup>3</sup>

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Being able to understand the possible structures of social support networks (SSN) of patients with severe mental illness (SMI) can help to better understand the relationship these SSNs have with care delivery issues. For such patients, care coordination, care personalisation and patient involvement in care are indeed three important factors that can have an impact on the quality the cares provided to them. This presentation is about an analysis framework that can be used to analyse database of SSNs, compute structural and dynamic graph metrics, and classify them according to simple decision trees. The framework is built on the capabilities of two technologies: the graph-oriented database engine Neo4j, a NoSQL paradigm specifically targeted to store and analyse graphs, and R, a programming language specialised in data analysis. The proposed framework has been tested on the "Morpheus" dataset which consists of SSNs collected from SMI patients with the Bidart classification in six network types. The first observations of the obtained classification shows that the Bidart classification could not be relevant for SSNs from SMI patients as it classifies networks as regular dense ones, which is intuitively wrong. Another configuration of the proposed framework made it possible to directly test another decision tree that results in a more relevant classification. To conclude, the presentation show how the proposed generic analysis framework can be used to efficiently classify SSNs based on a decision tree whose branches are decisions based on metrics computed on the networks. The flexibility of the framework makes it possible for a researcher to conveniently test simple classification rules and interpret the obtained results. Future work includes enriching the framework with other classification techniques than the simple decision tree.

### **A linguistic analysis of the relationships of brokerage and closure structures with social support exchanges on an online breast cancer forum**

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The Internet is used extensively by people seeking health information and emotional support. Online support forums are particularly important for patients wishing to communicate with others about their circumstances and obtain health information. Previous research found that people

lacking social support and experiencing negative affect are most likely to participate in online discussion, through which they empower themselves, and reduce stress and depression. However, much of online support research has been based on self-reported data derived from small samples. The current study sought to expand the scope of our understanding of health support behavior by conducting a large-scale network analysis. In this study, we investigated cancer survivors' interactions on an online breast cancer support forum, focusing on how the network structures of brokerage and closure relate to the types of support received and to the language used in posts and replies. Data came through the extraction of 1,443 members' network and posts on the Cancer Survivor Network, resulting in 27,248 threads and the 336,151 replies they received.

Regression analysis was conducted to examine the associations among users' network broker and closure structures, their language use, and types of social support received from their peers. Forum members' language use was examined using automatic linguistic analysis on Linguistic Inquiry and Word Count, a software that measures grammatical and psychological dimensions in text records. We found that forum members' brokerage and closure levels were positively correlated with the use of positive affective words in their posts. In addition, poster's brokerage level was positively related with the number of replies received, as well as the percentage of cognitive processing words in received replies. Closure level was positively related to the percentage of emotional words in received replies.

This study contributes to the literature in theoretical, methodological, and practical ways. Theoretically, the results support the general proposition of social capital such that forum members in broker and closure roles were more likely to use positive language indicative of their well-being. The results also provide evidence that different network positions fostered different types of support in the community. Specifically, people bridging unconnected users were more likely to receive informational support whereas people in closely knit groups were more likely to receive emotional support. This finding allows for a better understanding of the formation of online social capital as well as the mechanisms underlying the outcomes brought by social capital. Methodologically, we unobtrusively web-scraped the network connections and language use of the entire forum. This macro approach effectively addresses recall inaccuracy, data subjectivity, and sampling bias. Finally, this study also provides practical insights for health practitioners and forum designers who utilize social networks to facilitate support among patients. Specifically, algorithms could be developed to analyze forum users' network structures and digital footprints in the community, and then suggest potential friends to make best use of one's online network. In conclusion, this study enhances our understanding of the pathways by which the network structures influence the flow of resources that ultimately lead to subjective well-being.

### **A Multi-faceted Investigation into the Development of Renaissance Humanism**

Aaron Fleisher<sup>1</sup>

<sup>1</sup>University of Florida

This research uses textual analysis and social network analysis to demonstrate elucidate the complex development of the bedrock for modern Western thought, Renaissance Humanism. Scholars communicated through letters and manuscripts, epistolary networks, before the advent of modern publishing in the early 16th century. Those epistolary networks show the development and geographic flow of Renaissance Humanism over hundreds of years. Classical Greek and Latin literature was at the heart of Renaissance Humanism. The language Humanists used emulated Classical Latin and Greek style as Western European scholars encountered it. The syntax and vocabulary along with references to authors provide data for a multi-faceted approach for socio-cultural and historical investigation. Initial findings taking advantage of syntactic and

semantic textual analysis, and analysis of 1- and 2-mode networks dig into the dynamics of the Humanist mindset as it developed.

### **A multilevel network approach to institutional entrepreneurship: The case of French public-private partnerships**

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This paper looks at the effect of ideological, normative judgments of key institutional entrepreneurs on the structure of multilevel socio-economic networks promoting new public policy. Substantively we focus on a population of financiers, industrialists, public servants, and professionals involved in negotiating long term (30 years) public procurement contracts in France, the so-called 'public-private partnerships' between public authorities and private consortia. We measure the extent to which these actors' judgments about who (taxpayers? private businesses?) should incur specific risks associated with these contracts have an effect on the structure of two different kinds of networks: an advice network between these key players and a contract network between the organizations in which these individuals are affiliated. Multilevel ERGMS show how sharing specific ideological, normative judgments shapes these actors' exchanges and alignments of advice taking and contracting activities, including cross-level effects in this system. We argue that these multilevel network models help us propose a new approach to institutional entrepreneurship.

### **A Network Approach to Malware Variant Similarity Analysis**

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Malware used in cyber-attacks is a critical problem in cyber security, and attribution of malware from particular threat groups is important to enable more effective remediation and other response. While it is estimated that hundreds of thousands of new samples are produced every day, the vast majority of these samples are just variants of previously seen malware. It is important to determine which malware is simply a transformation or variation of something previously seen, to analyze samples belonging to the same malware family, and to identify which malware is novel requiring further investigation.

Similarity analysis approaches based on fuzzy hashing and other techniques produce a compact representation of a file that enables a distance metric for comparing how similar two files are. These similarity scores can be used to produce a matrix of pairwise comparisons for a given population of malware. Simple thresholds identify which samples are most related to each other, but network techniques can identify other relationships between samples, especially samples within a known malware family.

In this work, we examine network techniques and models that use metadata features of the sample malware binaries as nodal attributes to analyze the similarity relationships found by three candidate similarity analysis tools. While edge attributes such as similarity score will be used to establish the malware network structure, the nodal attributes will be used in an exponential random graphical model to determine which of the more than one thousand metadata features predict the likelihood of the similarity analysis tool finding a tie. We will explore the use of more sophisticated network analysis clustering techniques, such as the truss algorithm and irreducible backbone, to find additional and more reliable similarity relationships once the statistically significant features of the sample binaries are exposed. We will describe a methodology and then outline the experimental results on various malware populations.

**A Network Text Analyses Approach to Form Formation**David Dekker<sup>1</sup>, Ju Sung Lee<sup>2</sup>, Adina Nerghe<sup>3</sup><sup>1</sup>University of Greenwich, <sup>2</sup>Erasmus University Rotterdam, <sup>3</sup>Royal Dutch Academy of Sciences

In this paper, the use of Network Text Analyses (NTA) to empirically trace the emergence of organizational forms is discussed. This process is key in theories of the population ecology of organizations. In this pursuit, we conceptualize an organization as a set of dependencies described by words in specific linguistic structures. Considering a population of organizations allows one to empirically derive statistical semantic similarity relations between organizations based on linguistic structures. These similarity relations reveal organization clusters in dependency networks. Subsequently, over time these reveal the traces of clusters' dynamics. This emergence of form occurs at an audience level and does not require any assumptions on the individual level as assumed in organizational ecology theory. Yet, the forms can be lead back to the individual or sub-audience level by looking at the sources of the linguistic structures. An example applies the presented approach to investment management decisions. A first step in evaluating an investment object is to establish a set of comparable organizations. Younger organizations (e.g., start-ups and accelerators) may greatly change orientation and adapt strategic plans to the needs of customers, hence changing the set of comparable organizations. Our NTA-approach allows for the tracing of the dynamic composition of similarity clusters to which investment objects belong.

**A network-based research paradigm for social-ecological systems: Causes, cases and contexts.**Garry Robins<sup>1</sup><sup>1</sup>University of Melbourne, Swinburne University

The big question confronting social network research is: how do different social systems produce different global outcomes? This question is particularly acute for *Social Ecological Network Analysis (SENA)* because the ultimate goal is to intervene structurally at local levels so as to enhance system level outcomes such as resilience and sustainability.

This presentation presents theoretical and methodological challenges facing SENA in moving beyond single case studies heavily laden with local context. It is based on the work of a collaborative group of 19 scholars from different scientific disciplines and locations. From this work, I discuss key advantages and important constraining factors in applying network-based research to social ecological interdependencies.

For us, a social ecological system is represented as a multilevel network comprising distinct social and ecosystem levels, with interdependencies within and between the social and ecological systems – a *social ecological network*. Current network methodologies such as ERGMs and SAOMs can be applied to such networks to produce novel results about the prevalence of local structures and processes. But effective, sustainable environmental governance requires a good understanding of the causes and consequences of this complex pattern of interdependencies, and needs to relate local structures to global outcomes.

We argue two key advances are needed to build the new but currently rather scattered field of SENA into a coherent research paradigm: (i) a typology of causal assumptions explicating the causal aims of any given study of a social-ecological system; (ii) unifying research design considerations about how to conceptualize exactly *what* is interdependent, through what *types* of relationships, and in relation to what *kinds* of environmental problems. Research design for SENA needs an appreciation that many environmental problems draw from a set of core challenges that re-occur across different contexts and scales. We illustrate a *comparative heuristic* to leverage case-specific findings of social-ecological interdependencies to generalizable, yet context-sensitive, theories based on explicit assumptions of causal relationships.

**A New HOPE: Held-Out Predictive Evaluation (HOPE) for Exponential Family Random Graph Models**

Nolan Edward Phillips<sup>1</sup>, Fan Yin<sup>2</sup>, Carter T. Butts<sup>2</sup>

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In the context of statistical models for networks with complex dependence, model selection and evaluation can be inherently difficult due to the relational nature of the data. In particular, many well-established statistical tools for selecting between models assume conditional independence of observations and/or conventional asymptotics, and their theoretical foundations are often questionable in a network modeling context. While simulation-based approaches to model adequacy assessment are now widely used, there remains a need for procedures to quantitatively compare model performance, and to select among competing models. Here, we propose to address this issue by developing a predictive evaluation strategy for exponential family random graph models that is similar to cross-validation. Our approach builds on the held-out predictive evaluation (HOPE) scheme introduced by Wang et al. (2016) to assess imputation performance. We systematically hold-out parts of the observed network to: evaluate how well the model is able to estimate the held-out data; identify where the model performs poorly based on which data are held-out, indicating e.g. potential weaknesses; and provide graph level summary statistics that can be used for model selection. As such, HOPE can assist researchers in improving models by indicating where a model performs poorly, and by quantitatively comparing predictive performance across competing models. The proposed method is applied to two well-known data sets to illustrate its usefulness.

**A passive monitoring tool using patient co-presence networks enables earlier detection of nosocomial infections**

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Nosocomial infections are a significant burden on the health care system. The effectiveness of current methods to detect these infections is constrained by some combination of high cost, long processing times, non-specificity to a single infectious disease, and imperfect accuracy; diagnostic tests which ameliorate one or more of these problems can lead to better patient outcomes.

Although contact tracing is a tool used to identify at-risk individuals for infection, there are several improvements on it which can be made in tandem with a patient's electronic medical record. These improvements stem from the capturability of co-presence in a hospital ward, where co-presence is defined as the number of hours a focal patient and a patient with clinically-suspected infection spend in the same hospital ward. This information, collected in near-real time, has many advantages that complement the potential downsides of standard microbiological testing.

We therefore examine to what extent the quantity of co-presence of a focal patient with other patients clinically-suspected of being infected, defined by the number of hours the focal patient and patient with clinically-suspected infection spent in the same hospital ward, can predict subsequent nosocomial infection in the focal patient. We do so for five infectious diseases: *C. difficile*, *E. coli*, MRSA, *Pseudomonas spp.*, and norovirus.

We use a retrospective cohort of all 133,304 eligible in-patients between 2011 and 2015 in a single UK county, who were in the hospital for at least 48 hours. Although retrospective, we limit the data to reflect what would be available prospectively. The UK county, including four in-patient hospitals, covers a catchment area comprising 678,000 people, and the dataset includes almost all resident hospitalizations of this population.

To examine the predictive power of co-presence for subsequent infection, we construct egocentric co-presence networks for each patient at the time they receive a microbiological test, indicating suspicion of infection. These are static networks, with edge weights equal to the number of hours each patient spent with a patient receiving a microbiological test. Co-presence time is then used to predict the alter's infection status across all possible cutpoints. For true positives, we also calculate the amount of time that a patient's infection may be detected earlier if they are administered a microbiological test at the time they first cross the threshold of the prediction tool.

Across the five infectious diseases, AUROC ranges from 0.92 to 0.99. The index test has optimal cut-points between 25 and 59 hours of co-presence, and could lead to detection of true positives up to an average of one day earlier.

These findings show that the co-presence networks of patients in hospitals provide important information about a patient's health while they remain in the hospital. This information can be leveraged in real-time by configuring hospital administrative data to monitor co-presence with individuals clinically-suspected of infection.

### **A Permutation Test for Ecological Competition**

Jingwen Zhong<sup>1</sup>, Matthew Brashears<sup>2</sup>

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Ecological competition models, adopted from biological ecology, have been used to study a variety of social entities such as voluntary organizations and musical preferences (e.g., McPherson 1983; McPherson & Ranger-Moore 1991; Mark 1998). Previous research has argued, and presented evidence to support, the idea that competition between social entities is the underlying mechanism that gives rise to the observed patterns; familiarity with music or recruitment into organizations is a function of competition between these entities. However, despite the popularity of ecological approaches, demonstrating the effects of competition is more challenging than has previously been recognized. As a result, it is quite likely that support for ecological models, including the Blau space model, has been over-stated.

We propose a new test in which the observed pattern of association is tested against null models constructed through permutation. The permutation-based approach, applied to affiliation matrices, disrupts the associations driven by competition while leaving other aspects of the underlying distribution intact. For each permuted dataset, the statistics thought to measure competition can be computed; by repeating this permutation process, we can generate a distribution of the competition metrics that ought to be observed if the null hypothesis were true. The observed test statistic is then compared to this null distribution to identify whether competition appears to shape the observed data over and above what we would expect from random associations. We apply this approach to a specific case, the Blau space ecological affiliation model, relying on the K correlation (McPherson 1983) that originally served as evidence of organizational competition. The test results strongly suggest that either the K correlation is not a reliable indicator of ecological competition, or that ecological competition is not a significant element in shaping organizational recruitment.

The permutation test we propose is a useful approach to validate indices for measuring or indicating the ecological competition. And it provides a way for examining whether observed patterns can be presented as evidence supporting theoretical arguments about the competitive relationship between social entities. We conclude by discussing the need for more rigorous metrics when applying ecological concepts to social, and especially social network, outcomes.

**A Review of Network Studies of Corporate Boards**

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The resource provision role of board of directors is important for a company for many reasons. 'Interlocking directorates' explains how a link between two boards, based on one individual having a position on both boards, is a valuable source of information and resources (Davis, 1996; Mizruchi, 1996). Individual directors can thus act as information and influence channels between the companies, both explicitly and implicitly, leading to business opportunities and partnerships, access to capital and strategic imitation such as acquisitions (Haunschild, 1993).

Whereas interlocking directorates takes a relational approach, capturing the directly linked context of the company, the board-to-board interlocks can be added up, forming a board network. A network perspective on boards, and board interlocks, thus enables a view of the company board as embedded in a structure of other boards, linked directly and indirectly by shared board members. This is an important complement to the importance attributed to individual directors' characteristics, or the heterogeneity within a board.

Research on interlocking directorates has often used publically available data from government or stock-market records, or the companies themselves. The relatively easy access to secondary data has enabled analysis of rather large empirical data sets. However, this paper argues that the research on board networks has not made use of the opportunities for extensive empirical studies, but is biased from a much too narrow delimitation of the networks. The research predominantly relies on data on large companies, often listed on a stock market or a specific industrial sector, and often in the USA. The bias in sampling naturally leads to biased findings, as most companies are not large, publicly traded, or American.

Through a literature review, focused on papers with empirical studies of board networks, this paper looks for methodological and analytical approaches to study board networks. Regarding study design, it compares sample size, sample definition and data sources. Analytical aspects compared include which measurements and methods for analysis are used, what the level of analysis is, and whether network dynamics are considered. Using tools and measures from social network analysis (SNA) opens up a wide array of possible variables to capture the aspect of board networks that is of relevance to company performance and survival. Which measures that are used to describe the network or roles of nodes has a great impact on what aspects of the network that are emphasized, and how network theory is related to management theory. Moreover, companies and board appointments are not static, but change over time. If, and how, the dynamics of board networks have been studied is also covered by this review paper.

**A small world for big problems? A big data journal to journal network analysis on the evolution of all citations in web of science over time (1997-2017)**

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It is empirically well established that scientific production has grown exponentially over the last decades. And, as science is inherently relational, its resulting citation network has grown with it. It is however less clear how other structural properties of the scientific network evolved with it. As the number of actors in the scientific field increases, its tendency for clustering, hierarchy, centrality, connectivity and degree assortativity will inevitably also evolve. This evolution has potentially a big impact on the production and dissemination of knowledge. According to network science it is a proper balance between a general tendency for clustering (specialization) and a relatively low average shortest path (cross-community relations) that creates the ideal conditions for the creation and diffusion of innovative ideas. This might be especially relevant in today's

complex society, where tackling the biggest societal challenges requires scientists both to develop specialized knowledge and to interact across structural and social boundaries.

In this paper, we want to investigate how the characteristics of the scientific network have changed. More specifically, we focus on network descriptives and small world properties of the entire scientific field over the last two decades (1997-2017) and discuss the possible consequences on the development and transfer of new knowledge.

Empirically, we scraped the entire journal to journal citation network in web of science from 1997 to 2017 (21 years). The yearly journal to journal citation networks range from 6,930 to 11,978 nodes, and the total number of edges sum to 17,708,016. Besides this network data, we collected information on discipline, publisher, impact factors, language, country and open access status. We use the journal attributes to get a better understanding of the evolution of cross-boundary ties over time.

By studying the entire journal to journal network, we get a better understanding – among others - on how its growth in size might influence the future of innovation and knowledge development in the current century of complexity. Did the exponential growth of the scientific field leave enough room for cross-community ties? Or is clustering taking the overhand of reach, leading to a danger of lock-in and putting a break on innovation in knowledge production?

### **A social and semantic network analysis of future: Comparing Korean and Western perception of future.**

Jang Hyun Kim<sup>1</sup>

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We're talking about future in terms of climate change, the fourth industrial revolution, and Anthropocene. However, when we talk about it, are we on the semantically same page? Asian perception of future has been different from that of western culture, whilst rare studies systematically analyzed the differences. Past studies reported that Asian perception of future do not recognize diverse versions of possible futures, however, western perception of futures focused on possible scenarios of futures rather than risk-laden single version of future. This study employs semantic network analysis to aggregate and analyze media coverage, social media texts, and scholarly articles on future in Korean and English. Also, social network analysis of cited figures in media coverage on future is conducted. Who are referenced most and why are they relied on more than others? Are there any cross-cultural differences in semantic portrayal and social construction of future or plural versions of futures? Results indicate both cross-textual (media vs. social media vs. scholarly research) and cross-cultural (Korean vs. Western) differences of future perceptions. Limitations and suggestions for future research will be addressed.

Key words: Future, Futures, Social Construction, Semantic Networks, Social Networks.

### **A study of structural and compositional changes in the ego networks of Hungarian returning migrants**

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The current paper explores changes in the ego networks of highly-skilled Hungarian migrants associated with their return to their country of origin. The eastern enlargement of the EU in the 2000s, together with the establishment of common European labour market, completely redrew mobility patterns within Europe. It induced a significant flow of migrants from the post-socialist countries of Central and Eastern Europe to the high-income countries of Western and Northern Europe. However, migration is rarely a unidirectional move. In fact, return migration to the CEE region is on the rise as 20-50% of emigrants are known to leave their host country within 5 years

of their arrival (OECD, 2008). Without doubt, migration is one of the most significant changes an individual can experience in his social and geographical context, which alongside the associated life course transitions, can heavily impact the evolution of personal networks.

Thus, pre-and post-return ego networks of 34 returnees have been obtained through face-to-face interviews, where returnees reflected on their return experiences and changes in their social networks. As a result, two ego-networks of each interviewee was generated, overall consisting of more than 2000 alters, including information on geographical location, nationality, gender, age, length of relationship with ego, emotional closeness, kind of resources provided to ego and the type of relationship between ego and alters.

Both tie level changes and network level changes were investigated. Firstly, multi-level modelling techniques were used to explore which ties were the most likely to be added to or dropped from the networks and to determine how emotional closeness of alters' changed over time. It was found that geographical location seems to play no role in the changes in the relationship between ego and his/her alters. Instead, other characteristics, such as the length of relationship, the age of returnees, the kind of relationship between ego and alter and time passed since return contribute significantly to tie-level changes in the ego-networks of returnees. Secondly, overall compositional and structural changes (Small et al, 2015) were assessed. *Transformation* of the networks, where more ties were added than dropped, was observed in half of the cases, while *substitution*, *expansion* and *refinement* were also present roughly equally in the other half of the cases. While ego networks in general became less constrained, grew in effective size, and became more homophilous in terms of their geographical location and nationality, changes in their density varied according to the kind of structural change the network has gone through. Lastly, it was also found that returnees' subjective feeling of post-return embeddedness is strongly linked to changes in the availability of embedded resources in their personal networks, with a perceived loss in resources contributing to feeling less embedded in the post-return society.

### **A Systematic Review of Network Data Collection in Developmental Psychology**

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Although an expansion of longitudinal network analytic techniques has led to the rapid growth of social network analysis in developmental psychology, critical reflection on network data collection methods has not kept pace. In this presentation, I will describe the results of a systematic review that takes stock of the network data collection procedures in developmental psychology, highlighting *where* network data are collected, *who* network data are collected on, *what* types of network data are collected, and *how* network data are collected.

**Method:** The empirical articles included in the review were drawn from a literature search of 30 journals that were indexed in the Incites Journal Citation Reports "Psychology, Developmental" category with an impact factor 2.0 over in 2016. Each journal was independently searched for articles that contain the phrase "social network" and any of a set of related key words that are common in papers using network analysis. The resulting 727 articles were screened to determine whether they included an (1) empirical study that involved (2) network data & analyses on (3) children or youth ages 0-18 years old or adults who interact with children or youth (e.g., teachers/parents). Application of these inclusion criteria resulted in a final sample of 185 articles.

**Where are network data collected?** Although the articles reviewed represent network data collection efforts in 15 different countries, the majority focused on samples in the United States (62.2%). Most articles examined networks in school-based settings, but there was variation in whether networks were bounded at the classroom (40.5%), grade (30.8%), school (17.8%), or district (0.5%) level.

**Who are network data collected on?** It was most common for articles to include network data collected on early adolescents, ages 10-14 (78.9%). Adolescents (ages 15-18; 47.3%) and children ages 5-9 (27.6%) were also commonly represented. However, very few articles focused on young children (ages 0-4; 3.8%) or families or caregivers (4.9%). Additionally, the percentage of articles that both properly reported response rates and included network data with response rates over 80% has stayed relatively low throughout the years, ranging from 0% in 1987-1992 to 19.3% in 2011-2018.

**What types of network data are collected?** The articles reviewed collected network data on a range of relationships, often employing fixed choice designs that limited the number of relationships a respondent can report (51.4%). Articles typically focused on positive relationships including friendship (54.6%), affiliation (40%), important persons (7.6%), and liking (8.6%). Although less common, some articles also focused on negative relationships like disliking (4.9%) or aggression (1.1%).

**How are network data collected?** Despite the availability of a range of data collection methods, most articles relied on self-report (76.2%) or peer report (26.5%) surveys or interviews. Observation (2.2%), or archival (0.5%) methods were quite rare.

**Future directions.** I will focus on challenges and recommendations for network data collection in developmental psychology, with particular attention to gaps in data collection methods and practices related to response rates and fixed choice designs. A full working paper can be accessed at: [https://msu.edu/~jneal/neal\\_network\\_review.pdf](https://msu.edu/~jneal/neal_network_review.pdf)

### **A typology of Github repositories based on structural properties of pull request interaction graphs**

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With more than 31 million user accounts and over 100 million code repositories hosted, Github has established itself as the most important platform for collaborative software development. Open source software affects everyone through the many software applications we use on a daily basis. Quality, design and vulnerability of the final code base depend on how the production process is organized. Furthermore Github is an example of a decentralized, digital work environment, a setting that is commonly regarded as the workplace of the future.

In this work we investigate the following research questions:

Are there distinguishing patterns of cooperative interaction that define a typology of projects on Github?

What are their signifying features and how do corresponding interaction graph's structural properties relate to social theory?

How do different project types compare in terms of group membership hierarchy, repository popularity, code productivity and project stability?

To answer these questions we focus on how code review is incorporated on Github through the mechanism of pull requests (PR).

We limit the study to projects that are not forks of other projects and only examine projects for which in a time frame of six month (09/2016 - 03/2017) 8 to 21 users were involved in successful pull requests. These typical group sizes are sufficiently large to introduce collaboration challenges, yet small enough for repository interactions representative of task groups as opposed to larger organizational entities.

For our analysis we construct directed graphs for each repository where edges signify successful PRs and point from the submitter to the user who reviewed and merged the code.

From the created PR-graphs we derive signature vectors of 12x5 features which are based on distributions at the node level. They include information about neighbors, ego-nets, clustering and reciprocity. The captured information can be linked to multiple social theories including Coleman's Social Capital, Burt's Structural Holes, Heider's Balance and Homan's Social Exchange. We then construct a new graph in which nodes correspond to repositories and the edge weights are determined by the distance between respective signature vectors.

Subsequently we use Louvain clustering to identify a stable solution of five clusters which constitutes a group typology for repositories on Github.

We then study how the found group typology reflects on other quantities of interest.

Popularity: We look at the number of stars given to a project by users on Github.

Hierarchy: we look at distributions of flow hierarchy and page rank.

Productivity: We look at the number of successful pull requests per group member.

Resilience: We study what percentage of pull requests would be affected by the removal of the most active users.

Temporal stability: We train a support vector machine to predict the cluster type and apply the model to the PR-graphs obtained for the same repositories one year later in time to check whether projects still belong to the same cluster and to calculate transition rates among clusters.

Our analysis shows significant differences between group types and thereby provides valuable insights on how to effectively organize collaborative software development.

### **Abstraction and Gender Bias in Dissertation Writing (1980-2010)**

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Do gendered expectations in the use of concepts impact the structure of semantic networks? Recent studies show that one dimension of how academic language gets gendered is that men tend to use more abstract terms than women. This might reflect the social function of abstraction as a jurisdiction claiming tool. Scholars use abstraction not only to solve problems but to lay claim over them. We tested how shifts of gender balance in a discipline's student body affect the social function of abstraction. To this end, we built a series of networks that represent hierarchies of abstraction between nouns used in Education dissertations defended between 1980 and 2010. These networks proxy abstraction as relations of semantic entailment, whereby "a term  $v$  is distributionally more general than  $u$  if  $u$  appears in a subset of the contexts in which  $v$  is found." Then we modelled the evolution of this hierarchy as a function of gendered-biased use of concepts. This bias is measured as a log odds ratio between the chances that a term is key in dissertations written by female students against the term being distinctive for male students. Preliminary results show that higher levels of abstraction correspond to less gendered concept use. This relation holds over time, as the distribution of gendered concept use fails to change over time.

### **Access to Ethnic Social Capitals for Members of Subordinated Ethnic Status Groups**

Bonnie H. Erickson<sup>1</sup>

<sup>1</sup>University of Toronto

For members of subordinated ethnic groups, two kinds of social capital are important. One valuable form of social capital is occupationally diverse ties to members of the dominant ethnic group, ties which can be useful in gaining access to good positions in social settings in which dominant group members have more power. That is, diverse ties to dominant group members help members of subordinated groups to get good jobs in mainstream labour markets and to be active in mainstream politics. Another valuable form of social capital is occupationally diverse ties

to members of one's own group. In-group ties can be useful in getting a job in an ethnic enclave economy, in connecting people to organize for action on matters of group interests, and in gaining effective social support for stresses related to the group's subordinate position.

It is therefore important to know how much of each kind of social capital subordinate ethnic group members have, and how they get it. Research on this topic is thin because very few studies actually measure both kinds of ethnic social capital, and the few that do have been limited to special populations such as entrepreneurs. This paper reports on a survey using random samples of three ethnic groups in Toronto: the dominant White group and the two largest non-White groups, Black and Chinese. The two ethnic social capitals are measured using a variation on the classic position generator. Where the original position generator asked respondents to report whether they knew anyone in each of a set of occupations varying in occupational status, this study's version asks questions of the form "do you know a social worker who is White? Who is Black? Who is Chinese?"

Both groups have less occupationally diverse ties to the dominant White group than White respondents have, though only modestly less, a pleasant finding that may reflect Toronto's multicultural social life. Both groups have richly diverse ties to members of their own group. In terms of both dominant group social capital and in-group social capital, the Black and White groups are equal.

However, they gain their similar levels of social capitals in dissimilar ways. The reasons are cultural. The first reason is that their ancestral homelands have different cultural dispositions concerning ways to meet people, for example, different levels of activity in voluntary associations. Voluntary associations are powerful sources of social capital, and Black people in Toronto are more active than Chinese people. The second reason is different immigration histories. Black people started coming to Canada in large numbers earlier than Chinese people, were less highly selected for good education and good work experience, and hence had less of the cultural capital useful in getting good educations and good jobs in Canada. Education and work are also good social settings for meeting people, and the Chinese are ahead in these arenas. This combines with the Chinese cultural preference for making useful ties in school and work.

### **Adolescents' cross-gender friendships and identity fit in STEM**

Emily N. Cyr<sup>1</sup>, Hilary B. Bergsieker<sup>1</sup>

<sup>1</sup>University of Waterloo

Domain-specific identity fit is a key antecedent to career decisions (Schmader & Sedikides, 2018). Indeed, feeling that we can achieve our values, authentically express ourselves, and socially belong in STEM (science, technology, engineering, & math) is associated with progress toward a career in this domain (Cheryan et al., under review; Diekmann et al., 2017).

Adolescent attendees of 58 STEM-focused summer camps ( $N = 535$ ; median age = 12 years; age range = 9 to 15 years; 46% female), completed measures of current and predicted future identity fit, self-efficacy, interest in high school courses and careers, and similarity to career professionals, for both STEM and non-STEM. Participants also reported egocentric directed friendship ties to each fellow camp attendee ("one of my best friends", "one of my friends, but not a best friend", "not my friend", "I don't know him/her"). Within each camp, this sociometric data was aggregated to compute the proportion of other boys and other girls who nominated each participant as a friend (or best friend), creating two distinct measures (in-ties from boys and in-ties from girls could both have a value from 0 to 1).

Consistent with past work, participants reported high gender-based homophily, with boys and girls each reporting 5 to 8 times more same-gender best friends than different-gender best

friends. Furthermore, boys and girls both reported that 69% of the different-gender names on their list were totally unknown to them (compared to 40%-44% of same-gender names).

Multilevel models nesting participants within camps revealed that, regardless of network position, boys tended to report stronger outcome measures than girls. Further, cross-gender ties had no consistent associations with outcome measures -- however, being nominated by boys was associated with benefits for boys, and being nominated by girls had negative associations for girls. Specifically, even when controlling for in-ties from girls (to account for overall popularity), friendship nominations from boys were significantly positively associated with boys' STEM efficacy, current and predicted future identity fit in STEM, interest in STEM high school courses and careers, and (marginally) similarity to STEM professionals. However, friendship nominations from boys were not related to boys' reported interest in non-STEM courses or careers. Conversely, friendship nominations from girls (while controlling for boys' nominations) were exclusively and *negatively* associated with girls' interest in STEM careers and girls' sense of similarity with STEM professionals. Finally, the cross-level effect of camp cross-group density was not associated with girls' or boys' individual outcome measures.

These results have implications for gender-segregated educational and social programming for adolescents: Encouraging girls to have individual cross-gender friendships may be a potential mechanism to encourage girls toward STEM careers without negatively impacting boys.

### **Adversarial perturbations for identifying strategies toward biasing the perceptions of power and influence in social networks**

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Node impact in social networks is usually evaluated via centrality metrics. Calculating these metrics assumes reliable and accurate network data. In this work, we identify optimal adversarial network perturbations to such data that result in observed metrics to fulfill an adversary's objective. Here, the objective is to boost or diminish the true relevance of a node. This work is inspired by the application of adversarial attacks in machine learning and computer network security. Our technique can be applied to assess the robustness or vulnerability of network structures and metrics to adversarial attacks, to identify patterns used by malicious domains in altering search engine rankings in hyperlink networks, and to find network-level changes that social media designers can use to stymie the spreading of fake-news.

We aim to identify optimal perturbations in a network such that nodes appear in or disappear from the top k% nodes of a network (ranking defined in terms of centrality metrics). The set of adversarial moves include the addition or deletion of nodes or edges. Each move is associated with a cost (heuristic value), and each adversary has a cost-budget.

Our preliminary experiments on empirical and simulated network data reveal the following patterns: a) betweenness centrality can be optimally decreased by removing adjacent edges for all network topologies (random, scale-free, small-world, cellular), and b) closeness centrality can be optimally decreased by adding a node to a friend of a friend in scale-free networks. Additionally, the number of solutions and solution types to the adversarial perturbation problem vary based on network topology, allowed move set, and the adversary's budget. For example, it might be easier for a node to perform an adversarial move within instead of outside its ego-network, which is reflected in the costs of each move. Also, if global perturbations are allowed, then multiple solutions exist for an adversarial perturbation when the aim is to move the adversary node with low degree centrality to be among top degree centrality nodes. However, for other centrality measures, a fewer number of solutions exist.

In the future, we aim to extend the role of an adversary from a single node to a community of nodes. We also aim at finding more efficient search strategies and extending the framework to scale to larger graphs and search-space configurations. Our research is leading to the development of an open-source Python framework, which facilitates searching for adversarial moves. The framework uses a multi-threaded architecture to efficiently execute an exhaustive search through moves on user-provided network data. The experiments can be configured to constrain the search to an allowable set of perturbation moves; each of which is associated with a fixed cost, maximum allowable move budget, and target function to be optimized.

This work was sponsored in part by the Army Research Laboratory under Cooperative Agreement W911NF-17-2-0196. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Army Research Laboratory or the U.S. Government.

### **ADVICE NETWORK DYNAMICS IN TIMES OF CHANGING UNCERTAINTY**

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In this study we develop a model to explain the dynamics of advice seeking under changing conditions of uncertainty. In particular we focus on an acquisition event. We build on a theory of advice seeking that draws from prospect theory and expectancy theory. We theorize that immediately after an acquisition there is more uncertainty about who knows what, but over time individuals become more aware of where expertise resides within the organization and they change their advice seeking network based upon this increased awareness. We build upon advice seeking theory and the framework developed by Nebus (2006), drawing from expectancy theory (Vroom, 1995) as the basis of decision making under relatively certain conditions and from prospect theory (Kahneman & Tversky, 1979) for decision making in an uncertain environment. Within this framework our model examines four micro-processes of advice seeking: 1) reciprocity, which is the tendency for an individual to seek advice from those individuals that seek advice from them (Gouldner, 1960); 2) preferential attachment, which is the tendency for people to seek advice from those individuals that are already sought for advice by others (Barabási & Albert, 1999); 3) transitivity, which is the tendency to form relationships with “friends of friends” (Heider, 1946; Newcomb, 1961); and 4) boundary spanning ties (Lomi et al., 2014), in our case in a different legacy organization. We theorize that under conditions of higher uncertainty regarding who knows what these tendencies will be prominent, but over time as uncertainty diminishes these tendencies will diminish.

To test our hypotheses we use data over four time periods in a consulting firm that had undergone an acquisition. Transferring complementary market and product-based knowledge between legacy firms was one important rationale underlying the acquisition. In the studied case context, high uncertainty about who knows what existed in the first period following the acquisition. In addition, a major event such as an acquisition alters existing work processes and results in individuals reassessing their advice relationships or lack of them with all individuals within a firm. After the acquisition individuals were encouraged to create new advice ties by senior management and specific events took place to promote awareness of who knew what in the newly integrated organization. To analyze the longitudinal network data we use a stochastic actor-based model that allows us to model the interdependencies in the network data and how they change over time (Ripley, Snijders, Boda, Vörös, & Preciado, 2017; Snijders, van de Bunt, & Steglich, 2010).

Our results indicate that immediately after the acquisition individuals have a tendency to seek advice based upon reciprocity, preferential attachment and legacy firm boundary spanning ties.

However, over time these tendencies diminish. Surprisingly, transitivity does not play a significant role, which suggests the decision-making process underlying advice seeking might be more transactional than socially based. Our findings add to theories on the process of advice seeking under conditions of uncertainty, on knowledge transfer processes in mergers and acquisitions, and the knowledge based view of the firm.

### **Alliance and opposition in a multimodal political network**

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In this paper, I present two approaches to a network analysis task in the study of American politics. In U.S. campaign finance, individuals give to candidates participating in elections for specific seats. Existing approaches to the analysis of donor networks rely on one-mode projections of this network, focusing only on ties between donors and the candidates they support. This leaves aside valuable information because donors may give money against the cause of candidates they oppose nearly as often as they give money towards the cause of candidates they support. The federal U.S. system is also remarkably regional, but a one-mode approach necessarily begins with the assumption that any relevant properties of political geography will be captured in measures of distance in policy space. This interest in relations of opposition as well as support, and spatial as well as social distance, motivates node-level quantities of interest in each of three modes. I present two possible alternative methods of analysis and compare preliminary results from attempts to pursue each approach. The first is a multilevel model of pairwise opposition between donors, estimating the probability that two donors might back opposing candidates in the same election as a function of donor, candidate, and election characteristics. The second uses bootstrap sampling to estimate the same quantities of interest, comparing observed estimates against those generated according to a null model in which ties are preserved but the characteristics of donors and candidates have been assigned at random. I compare the relative strengths and weaknesses of each approach, and conclude with suggestions for researchers approaching similar tasks in other problem domains.

### **An agent-based network model of HIV transmission: the impact of age bounded analysis and age mixing assumptions on the evaluation of HIV pre-exposure prophylaxis**

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**Background:** HIV pre-exposure prophylaxis (PrEP) is an effective and safe intervention approved for use by adults and adolescents. Previous modeling studies have evaluated the potential impact of PrEP interventions on the HIV epidemic among adult men who have sex with men (MSM) and adolescent sexual minority males (ASMM) with results indicating that a significant number of infections could be averted within each population. However, the sexual networks comprising these two populations are not distinct. There are inherent dependencies between these populations which are not captured in age-bounded simulations which may be important for the evaluation of the impact of PrEP on the HIV epidemic. This project evaluates the potential impact

of PrEP interventions among both adult MSM and ASMM and highlights the impact of including inter-population network dynamics.

**Methods:** An agent-based network transmission model was built using the EpiModel platform, which relies on the *statnet* suite of modeling tools. The networks were estimated using separable temporal exponential random graphs models (STERGMs). From the epidemic simulation, we estimated the number of HIV infections averted, the percent of infections averted (PIA), and changes in incidence and prevalence for a population of 13-39-year-old MSM. PrEP was implemented among adult MSM age 19-39 following CDC guidelines, which rely in part on network conditions (e.g., known positive main partner, multiple partners of unknown status). A program of PrEP implementation among sexually active 16-18 year-old ASMM was then added to the adult-focused program.

**Results:** The implementation of a PrEP program for adult MSM following CDC guidelines with 40% coverage resulted in 29.0% (95% Credible Interval (CrI): 24.0%, 34.4%) of infections being averted among all MSM (adult and ASMM) over 10 years, reducing prevalence from 23.2% (95% CrI: 21.4%, 24.5%) to 17.0% (95% CrI: 15.7%, 18.0%). For ASMM specifically, the adult-focused PrEP program reduced mean prevalence from 6.0% (95% CrI: 4.0%, 8.3%) to 4.3% (95% CrI: 2.3%, 6.5%). The addition of a PrEP program targeting 16-18 year old ASMM with 30% coverage increased the PIA to 29.9% (23.6%, 35.0%) among all MSM and further reduced prevalence among ASMM to 3.8% (95% CrI: 2.0%, 6.0%).

**Conclusion:** Our model that considers integrated networks across age boundaries confirms many of the findings from previous analyses that used age-restricted populations while also introducing several new insights. For example, we find that PrEP use among only adult MSM may have as large or even a larger impact on HIV incidence among ASMM than a PrEP intervention specifically targeting ASMM. We discuss the urgent need for more network data for adolescent ASMM, despite the challenges in obtaining it.

### **An analysis of the consequences of the General Data Protection Regulation on social network research**

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In the last decade online social networks have become a major source of data for computational social scientists, providing new opportunities but also raising new questions related to the potential misuse of computational methods when applied to personal information. On the 25th of May 2018 the General Data Protection Regulation (GDPR) came into force as the new and improved piece of legislation regulating how natural persons should be protected with regards to the processing of their personal data. The GDPR has been welcomed as a progressive step towards rectifying the glaring power imbalance in current mass digital data collection by entities that develop, maintain and control access to digital infrastructures, and while it is a European regulation its principles are worthy of consideration even for researchers outside the Union processing data from non-EU subjects, as these principles highlight general fundamental issues to be considered when processing personal data.

Several papers have already been published to examine the impact of the GDPR on research in general and on specific research fields. However, none have addressed the implications of the GDPR for computational social scientists working with network analysis, where data processing differs from other quantitative approaches. For example, as discussed by Borgatti and Molina, respondent anonymity is not an option if we want to know who is talking about whom, which is necessary to define edges in the network. Other problems we will discuss include the difficulty of sending information to millions of users through a third-party API that does not allow it, the

problems in pseudonymizing the data as soon as possible in a continuous network monitoring process performed with pre-GDPR software tools, the interpretation of concepts such as "manifestly made public data" and "publicly accessible areas", the problem of removing data by user request not knowing what impact this will have on network statistics, the practical impossibility of guaranteeing respondent anonymity, the inclusion of data about individuals not included in the study, as well as more general issues related to data protection emerging when social network analysis is applied to large-scale networks of social relations derived from social media data.

The presentation will be organized along the main steps and problems of a typical social network analysis process. We start by discussing approaches to data collection, also highlighting the differences between data collected directly from the data subjects or indirectly, such as through social media Application Programming Interfaces (APIs). We also discuss topics such as consent, data anonymization, profiling, and storage of the networks, highlighting the cases where the application to social network research is unclear or problematic.

### **An ego-centric analysis of the social support of Ghanaian international graduate students in Canada**

1. Emmanuel Kyeremeh<sup>1</sup>, 2. Godwin Arku<sup>1</sup>, 3. Evan Cleave<sup>2</sup>

<sup>1</sup>1. Western University, <sup>2</sup>3. University of Toronto - Mississauga

Globally, Canada remains an important educational destination choice for most international graduate students. The attractiveness of Canada's educational system is due to the relatively less stringent requirements such as English language waiver for some countries, availability of funding opportunities, opportunity to transition to permanent resident after graduation, overall quality of education and the perception of Canada as a safe place. Currently, there are more than 370,000 international students enrolled in various Canadian institutions. However, for international students to succeed academically and socially, scholarly work suggest that there has to be the availability of various forms of social support. Yet till date, very few studies within the Canadian context have interrogated the sources of social support among international students and how it contributes to their social and academic integration. Relatively little is known about the characteristics of individuals within their networks and how these shapes the type of social support available to them. This is concerning for a number of reasons. First, over the past two to three decades, international graduate students have been targeted by policy makers in Canada to help maintain its global talent competitiveness and to help address its demographic challenges. Second, international students by virtue of their different exposure tend to provide global perspectives to issues discussed in the classroom, increase the diversity within the institution, assist domestic students, other international students, faculty, and staff to learn and develop intercultural communication skills as well as generate revenue for the various institutions.

To contribute to the existing scholarship on international student's social support, we examine the structure and composition of the personal networks of international graduate students from a global south (Ghana) to identify the social support available within these networks and how it affects their social and academic integration in Canada. In particular, we examine whether their individual attributes, dyadic and supradyadic characteristics explain the type of support they receive. Specifically we address the question, what type of ego and network characteristics affect alters provision of social support? To answer this question, we draw from data on 103 ego-centric networks collected from Ghanaian graduate students pursuing various degrees in 10 Canadian universities using an online survey. Preliminary findings suggest that international students derive social support from their family, as well as friends and other students from the same country of origin. Results also indicate that international students with heterogeneous networks consisting

of domestic students, other international students, and academic advisors are likely to receive various forms of support than their counterparts with a more homogeneous network, thereby ensuring a better social and academic integration. The paper ends with some pointers for policy considerations.

### **An Examination of Egocentric and Whole Networks in a Sample of Women Recovering from Addiction and Victimization**

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Substance use disorders (SUDs) and domestic and sexual violence victimization (DSV) among women co-occur at high rates. Positive social support from personal ties is found to be a critical source of resiliency for those in recovery, especially among women with histories of DSV. Research finds that sober living homes (SLHs) can be spaces that both promote and support recovery through social relationships. Much of the research examining the link between social support and SUD recovery focuses on perceptions of social support as they relate to abstinence. Few studies look at how the structuring of social support networks can encourage recovery, particularly in SLH communities. Social network analysis offers a novel alternative to examining the role of social support in recovery by capturing the complexity of social ties that individuals have both outside and inside of SLHs. Thus, the current study will use social network analyses to explore the role of social support in SUDs recovery in both egocentric (personal) social networks and whole (the SLH community) social networks. Data for this study come from approximately 60 women residing in three SLHs in the Southwest. Study measures include substance use (collected through the Addiction Severity Index), egocentric network data (collected using the Important People Inventory), and whole network data (collected by asking participants to list the women in the SLH community that have had the most influence on them and their recovery). Data analyses will present the setting, individual, and dyad characteristics of the network ecologies. Modeling procedures will be employed to determine if and how social network characteristics (both personal and whole) relate to the propensity and/or frequency of adjustment variables (e.g., depression) while accounting for the impact of covariates (e.g., demographics). The findings will be discussed relative to previous research and theory on women's recovery from addiction and victimization. Moreover, the implications for sober living homes and other network-based interventions will be discussed.

### **An experimental comparison of alter-to-alter tie elicitation: Participant-aided sociogram versus traditional dyadic census**

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The dyadic census serves as the gold standard for eliciting alter-to-alter ties during egocentric network interviews. However, this approach is burdensome because it requires a question regarding the presence or absence of each potential connection between alters. Therefore, the number of questions increases rapidly with the addition of each alter. The participant-aided sociogram approach was developed to help alleviate this burden by visualizing alters and allowing participants to draw connections between alters. Recently, this approach has been further improved by digitizing the participant-aided sociogram approach to reduce burden on both the participant and the interviewer. The current study evaluated one implementation of the digitized participant-aided sociogram, Network Canvas, against the traditional dyadic census approach. Two name generators were used to elicit alters: 1) alters who were close social contacts and 2) roommates that lived in the same dorm room, apartment, or house. Participants (n = 60) were

randomized to complete Network Canvas or a dyadic census first, but reported alter-to-alter ties using both approaches. We examined the correlations of the networks across methods for each tie time and also utilized a series of linear mixed effect models to examine if the density of alter-to-alter connections varied across the two methods. Results indicated the networks were highly correlated with a mean correlation of 0.764 for close social ties and 0.904 for roommates. However, for close social tie density ( $M = 0.23$ ,  $SD = 0.14$ ), networks captured via Network Canvas were significantly less dense ( $b = -0.059$ ,  $p = 0.001$ ). For roommate tie density ( $M = 0.04$ ,  $SD = 0.06$ ), the two methods did not significantly differ ( $b = 0.001$ ,  $p = 0.671$ ). While preliminary, these results indicate that participant aided sociograms may elicit fewer alter to alter connections relative to a dyadic census. Accordingly, researchers should explore wording and interviewer prompts to maximize participant accuracy and continue to monitor the quality of data being collected. Furthermore, future research should examine factors that may influence participant accuracy across these methods. Finally, these findings can be used to inform future design decisions and affordances within the Network Canvas software suite in effort to maximize the reliability and validity of this approach against more traditional methods.

### **An exploration of communities of practice in the STEM teacher context**

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The STEM teacher workforce in the United States is of critical importance to equipping the next generation of knowledge workers to compete in an increasingly competitive national and global economy. Yet, it faces a host pressing challenges, including a teacher shortage, pervasive job dissatisfaction, and high turnover, problems largely attributable to working conditions within schools and districts. These problems are exacerbated in “high needs” districts characterized by a high proportion of individuals living below the poverty line and/or a high percentage of teachers teaching outside of the content areas of their training. In these areas in particular, workplace relationships are an important aspect of the work environment because they can provide knowledge, skills, and social support in the midst of difficulty. Conversely, negative relationships with peers can amplify the challenges of working in such schools. The social network perspective, a relational lens emphasizing the structure and composition of ties, is aptly suited to examine these important professional relationships. In this study, we take a social network approach to investigate the professional relationships of STEM teachers working primarily in “high needs” districts. We define a community of practice (CoP) as the overall ego network of professional interactions that revolve around a shared craft. In our empirical setting, the ego is the teacher, and the CoP is the ego network of professional relationships that revolve around teaching content and/or pedagogy. Analyzing a sample of 120 STEM teachers from five different geographic regions, we identify gender, age, prior work experience, and the site of Noyce teacher preparation as key antecedents to CoP properties. We discuss the implications of these observations for theory and practice, and offer directions for future research.

### **An Exponential Random Graph Analysis of the Canadian Climate Change Policy Collaboration Network**

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The Advocacy Coalition Framework (ACF) holds that belief homophily is the primary driver of collaboration in policymaking networks (Jenkins-Smith et al. 2014; Weible & Sabatier, 2011; Henry, 2011; Sabatier & Jenkins-Smith, 1993). This makes the ACF ideal for studying collaboration

in environmental policy (Litfin, 2000). In this paper, we use an Exponential Random Graph Model (ERGM) approach to analyze collaboration network data from a study of climate change policy networks in Canada. ERGM approaches are useful for examining how (endogenous) micro-structural network processes (e.g. transitivity, popularity, or reciprocity) affect the likelihood of tie formation between network actors. These processes are important for advocacy coalitions in that they shape actors' ability to 'cluster' together based on shared beliefs and policy positions to form coalitions (Wagner & Ylä-Antilla, 2018; Ylä-Antilla et al., 2018; Lusher et al., 2013; Laumann & Knoke, 1987). Moreover, they facilitate building consensus/trust required for effective policymaking (Ibid). Our analysis speaks directly to the ACF's central proposition regarding homophilous beliefs: if collaboration ties are more strongly associated with homophilous beliefs of alters, then the ACF is supported; if collaboration ties are more strongly associated with micro-structural network processes, then the ACF is challenged. We present our results and discuss key implications.

### **Google matrix analysis of Wikipedia networks / Analyse des réseaux d'articles Wikipédia à l'aide de la matrice de Google**

Célestin Coquidé<sup>1,2</sup>, Guillaume Rollin<sup>1,2</sup>, José Lages<sup>1,2</sup>, Dima Shepelyansky<sup>2,3</sup>, Justin Loye<sup>1,2</sup>

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L'Encyclopédie, initially conceived by Diderot and d'Alembert, aggregates the whole available human knowledge and make it accessible to all Citizens. Consequently, L'Encyclopédie is one of the most powerful catalyst of modern development of science and society. The knowledge transfer process have been considerably accelerated with the dawn of Wikipedia, the free online collaborative encyclopedia, which now supersedes Encyclopedia Britannica in size and even in accuracy of articles devoted to many scientific domains. Presently, Wikipedia contains more than 280 linguistic editions representing different and complementary cultural views on Human knowledge. This huge amount of encyclopedic data encodes also hidden information about how different cultures and societies are entangled. Nowadays, the efficient extraction of such a type of hidden information is one of the great challenges of the Big Data. With this aim, we applied Markov chains and Google matrix methods to analyze the directed networks of hyperlinked Wikipedia articles, for different linguistic editions. Wikipedia networks belong to the class of scale-free real networks which the WWW is a paradigmatic example. We used various algorithms (PageRank, CheiRank, and 2DRank) to rank articles within a given linguistic edition. As a peculiar example, using automatic extraction of PageRanked articles devoted to Universities and College, we obtained the Wikipedia Ranking of World Universities (WRWU) by analyzing the Wikipedia networks of 24 linguistic editions representing about 60 percent of World population and about 60 percent of the total Wikipedia articles in all languages. Stinkingly WRWU measures efficiently the academic excellence of Universities as well as, e.g., the Academic Ranking of World Universities (ARWU) of the Shanghai Jiao Tong University. Contrarily to the composite nature of the ARWU (Noble Prizes counting, number of articles in Nature, ...), the WRWU is based on statistical grounds treating on an equal footing all the cultures (represented by various linguistic editions) and all the academic disciplines. We showed that besides measuring the academic excellence, the WRWU measures also the societal, historic and regional importance of Universities. Previously, with the same techniques, a ranking of top figures in Human history according to Wikipedia have been proposed. We showed that these kind of global rankings highlight interactions and entanglements between cultures. For each of theses global rankings, network of cultures have been extracted allowing to identify the most influent cultures accordingly to these networks. The recently developed method of the reduced Google matrix allows us to determine hidden links among entities of a given community in Wikipedia. In

particular, we have successfully applied this method to Wikipedia networks, e.g., to infer hidden interactions between universities and countries probing then the global influence of universities, to determine hidden links between diseases, drugs, and pharmaceutical companies allowing to study the epidemiology of infectious diseases and cancers, and allowing drug prescription by Wikipedia for specific diseases, ...

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L'Encyclopédie, initiée par Diderot et d'Alembert, agrège l'ensemble du savoir humain disponible et le rend accessible à tous les Citoyens. Ainsi, L'Encyclopédie est l'un des plus puissants catalyseurs du développement moderne de la science et de la société. Le processus de transfert de connaissances s'est considérablement accéléré avec l'avènement de l'encyclopédie en ligne collaborative Wikipédia. Celle-ci supplante maintenant l'Encyclopedia Britannica tant en volume qu'en exactitude des articles associés à de nombreux domaines scientifiques. Actuellement, Wikipédia est décliné en plus de 280 éditions linguistiques représentant autant de points de vue culturels différents et complémentaires sur le savoir humain. Cette colossale quantité de données encyclopédiques renferme des informations cachées qui peuvent nous renseigner sur la façon dont sont intriquées les cultures et les sociétés. De nos jours, l'extraction de ce type d'informations cachées est l'un des grands défis des Big Data. Dans ce but, nous appliquons des méthodes issues des chaînes markoviennes et de la matrice de Google pour analyser les réseaux dirigés constitués des articles «hyperliés» de Wikipédia. Ces réseaux Wikipédia appartiennent à la classe des réseaux réels, invariants d'échelle, dont l'exemple paradigmatique est le World Wide Web. Nous avons utilisé plusieurs algorithmes (PageRank, CheiRank, et 2DRank) pour classer les articles des différentes éditions linguistiques. Par exemple, en utilisant l'extraction automatique des articles consacrés aux «établissements d'enseignement supérieur et de recherche» parmi les articles Wikipédia classés en fonction du PageRank, nous avons obtenu le palmarès mondial des universités selon Wikipédia (WRWU). Pour l'établir nous avons analysé les réseaux Wikipédia de 24 éditions linguistiques couvrant environ 60% de la population mondiale et environ 60% des articles Wikipédia toutes langues confondues. Étonnement, le classement WRWU mesure aussi efficacement l'excellence académique que le classement de l'Université Jiao Tong de Shanghai (ARWU). Contrairement au classement composite ARWU (nombre de prix Nobel + nombre d'articles parus dans Nature + etc), le classement WRWU repose sur des bases statistiques traitant sur un même pied d'égalité l'ensemble des cultures (intrinsèquement encodées dans les différentes éditions linguistiques) et des disciplines académiques. Nous avons montré qu'en plus de mesurer l'excellence académique, le classement WRWU mesure aussi l'importance sociétale, historique et régionale des universités. Précédemment, usant des mêmes techniques, un classement des personnages historiques selon Wikipédia a été proposé. Nous avons montré que ces types de classements globaux mettent en exergue les interactions et les intrications entre cultures. Pour chacun de ces classements globaux, le réseau des cultures a été construit permettant d'identifier les cultures les plus influentes selon Wikipédia. La méthode récemment développée de la «matrice de Google réduite» nous permet de déterminer les liens cachés entre les entités d'une communauté donnée d'articles Wikipédia. Sans être exhaustif, nous avons appliqué avec succès cette méthode, par exemple, pour inférer des interactions cachées entre les universités et les pays mesurant ainsi l'influence mondiale des universités, pour déterminer les liens cachés entre maladies, les médicaments et les compagnies pharmaceutiques étudiant ainsi l'épidémiologie des maladies infectieuses et des cancers, et permettant de prescrire selon Wikipédia des médicaments pour les maladies, ...

### **Analyzing Anthropology: A Network Analysis of the Conference Programs of the American Anthropological Association**

Jeffrey Johnson<sup>1</sup>, Christopher McCarty<sup>1</sup>

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The first annual meeting of the American Anthropological Association was held in 1902. The printed conference programs provide a window into the evolution of anthropology as an intellectual, scientific, and scholarly pursuit. The programs have been digitized and now provide an interesting corpus of text in which changes and dynamics within anthropology can be examined. This paper provides several analyses of all available programs since 1902. We provide an analysis of changes in the study and salience of social structure (e.g., kinship, social networks), a network analysis of anthropological collaborations over time, and the evolution of theoretical, epistemological, and methodological trends through an analysis of program indexes as two mode data.

### **Application of Social Network Analysis to inform an occupational health and safety program in healthcare**

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Social Network Analysis (SNA) has provided powerful insights in public health. However, its utilization in occupational health and safety (OHS) remains limited. We will discuss a multi-stage research project conducted at a small, rural hospital in Oregon, USA that applied SNA theories and methods to inform the strategies to reduce patient-assist injuries, a significant problem that increases the risk of disability, that lowers the quality of patient care and that inflicts costs through workers' compensation claims and turnover.

In the first research stage, we administered a baseline employee survey in 2016 that included the following statement "please nominate from the employee roster as many of your unit co-workers whom you consider for advice or any other type of help regarding safe patient handling." We analyzed the baseline survey (n=38) to determine the extent to which peer-based support for safe patient handling correlated with leading safety outcomes (e.g., behaviors, turnover). We found that workers who nominated more peers as sources of safe patient handling or advice or that had more reciprocal nominations used patient-transfer equipment more frequently than those employees with fewer sources of advice. We also found that employees at the periphery of the network also had a higher risk of quitting during the following year than employees with higher network centrality.

In the second stage, we analyzed the baseline survey to identify workers with outstanding peer nominations who could be recruited to participate in the OHS program. Based on the theory of opinion leadership, we identified salient workers per several network centrality measures (e.g., in-degree, out-degree, betweenness) and then examined whether these workers had higher scores on several appropriate safety and interpersonal measures that substantiate their peer-based leadership. Opinion leaders (n=6) were then invited to volunteer as "Safety Champions" who were expected to influence and advocate for safer practices and conditions. Of the six opinion leaders, four accepted this invitation, who then were further trained on ergonomic and leadership skills. Safety champions were encouraged to model safety behaviors (e.g., use patient handling equipment), to provide feedback to peers and supervisors about safety conditions and to report safety incidents. Also, safety champions convened on a quarterly basis with hospital leaders to define actions to improve safety conditions.

The third stage consisted of a 12-month program evaluation. We administered a follow-up employee survey and analyzed secondary data (e.g., injury claims and incidents reporting). Survey results showed that the program was successful in increasing safety behaviors (e.g., use of equipment), and secondary data indicated that the program was effective increasing reporting of

safety incidents and reducing injuries. We are also currently analyzing survey data to determine whether network characteristics also changed after the program was implemented (results that we will be able to present at the conference).

In summary, we will discuss how SNA was instrumental for the success of an OHS program that was boosted pre-existing supportive relations among peers as a strategy to reduce patient-assist transfers.

### **Approximate Bayesian Computation for ERGMs via Copula model**

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Bayesian inference for Exponential Random Graph Models (ERGMs) used to be an extremely challenging task due to the intractability of both the likelihood and posterior normalizing factor, and is currently handled by an approximate version of exchange algorithm as conventional MCMC algorithm is not applicable. Such algorithm is asymptotically exact but computationally demanding and require extra tuning. In this work, we propose to explore the possibility of adapting approximate Bayesian computation (ABC) methods to ERGMs. As a consequence of curse of dimensionality, conventional ABC methods can be inefficient even for model with moderate number of parameters. We adopt the importance sampling ABC algorithm, followed by marginal adjustment technique, to estimate bivariate posterior for each pair of parameters. These pairwise posteriors are then combined using Gaussian Copula to approximate the joint posterior. The proposed method is flexible to accommodate all kinds of state-of-the-art regression techniques at the adjustment stage, and more general types of Copulas can also be used to improve the approximation. We apply the presented method to real social network data and compare its accuracy and efficiency to that yielded by the most recent version of approximate exchange algorithm implemented in Bergm package.

### **Are China's Belt and Road and Other Eurasian Infrastructure Initiatives Quietly Remaking the Global Order?: A Social Network Analysis**

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China's Belt and Road Initiative (BRI), announced in late 2013, has been feared by many as China's attempt to remake the global order through massive infrastructure investment across Eurasia. Though China has been unclear in its objectives for BRI and some have already written it off as overly ambitious, it is clear that China is already investing in and collaborating heavily on infrastructure projects with almost every country in Europe and Asia. However, as other regional powers like the European Union, Russia, Japan, and India vie for influence across the Eurasian continent and compete by collaborating and investing in Eurasian nations, is there any evidence that the impact of China's engagement is unique among these powers? Using centrality measures to analyze a network of nations collaborating on infrastructure initiatives, as well as a network of foreign investment, it is clear that China far outpaces other powers in terms of spending, connectedness, and likely even influence, in nations across Eurasia. In this network of infrastructure projects collaboration, smaller nations collaborate to gain investment, expertise, and information, while "powers," like China and the European Union, collaborate to maintain their position by exerting influence and countering rivals' influence over smaller, weaker nations. Findings suggest that, not only does China collaborate more broadly than other regional

powers, but that the more authoritarian a government is, the more well-connected it is to China and other like-minded governments, all while participating democratic powers sit at the fringes.

### **Are high aspiring ethnic minority students afraid of ‘acting White’? Ethnic origin, school performance and popularity among classmates in Germany**

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Despite disadvantages in academic achievement and low socioeconomic background, various studies demonstrate that immigrant parents and students have high educational aspirations on average than non-immigrants in the US, Canada and Europe (e.g. Jonsson & Rudolphi 2011, Kao & Tienda 1995, Krahn & Taylor 2005, Salikutluk 2016, van Tubergen & van de Werfhorst 2007). The mismatch between educational aspirations and achievement has been labeled as attitude-achievement paradox (Mickelson 1990) or aspiration paradox (Salikutluk 2016). While recent studies dealt with reasons for ethnic minority students’ ambitious educational plans (e.g. Salikutluk 2016, Teney et al. 2013, Tjaden & Hunkler 2017), it remains an open question why ethnic minorities fail to translate their aspirations into corresponding achievement. One possible explanation offered in the literature is ethnic minorities’ fear of ‘acting White’ (Fordham & Ogbu 1986). In the US, mixed findings about Black and Latino students worrying about being bullied and excluded from their peer group if they improve their school performance inspired a controversial debate (cf. Cook & Ludwig 1997, Ogbu 2004, Tyson et al. 2005). In this study we take in a social network perspective to investigate, whether this argument applies to ethnic minority students in Germany and if high aspiring ethnic minority students are afraid of being accused of ‘acting White’ by their peers and thus do not engage in school and schoolwork. We want to test this assumption by analysing if well-performing ethnic minority students are less popular and excluded by their ethnic peer group in class.

For our analyses we use German data emanating from the Children of Immigrants Longitudinal Survey in Four European Countries (CILS4EU, Kalter et al. 2016). In the first wave, school surveys were conducted with fourteen-year-old students and their classmates to gather rich information about adolescents’ situation in school, their families and their peers. The data also include information about positive ties (e.g. friendship) and negative ties (e.g. bullying) between classmates. We utilize multilevel network models for longitudinal social network analysis (Snijders et al. 2010, Snijders 2017) to test if ethnic minority students who are among the top performers in class are less often nominated as best friends and more often bullied by same-ethnic origin peers and spent less time outside of school together with same-ethnic origin classmates. Our preliminary results show that successful ethnic minorities are not avoided by their classmates. In contrast to the theoretical argument, we find a slightly positive effect of school performance on being nominated as friends by ethnic minority peers. Overall, we find no evidence for Fordham and Ogbu’s thesis: ethnic minority students in Germany seem to value efforts in school, which is inline with the generally high academic motivation of ethnic minorities (Becker & Gresch 2016; Salikutluk 2016).

### **Assembling the Academic Team: analyzing semantic similarity between researchers to map research topic networks**

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Anecdotally, the organic emergence of research collaboration is often a chaotic process of convenient spatiotemporal convergence bounded by discipline, department, and university. Co-

authorship networks provide an empirical illustration of the scientific fragmentation caused by this process, showcasing a scarcity of collaboration across these boundaries when interdisciplinary and translational science initiatives are absent. On the other hand, groundbreaking research is often born of the interdisciplinary projects which transcend these boundaries. As a result, academic administrators, funding agencies, and scholars of science have been increasingly interested in the development of interventions promoting 'team science', the convergence of like-minded researchers across different disciplines, departments, and universities. Applying a TextRank model to Web of Science article abstracts, we identify a limited set of keywords (ten to twenty) that best represent the research topics for each of 14,000 researchers affiliated with the University of Florida, in any department, college or discipline. Latent semantic analysis, a popular form of topic modeling employing singular value decomposition, then allows us to construct networks representing the topic similarities between these researchers based on extracted keywords. We present a brief overview of this approach to topic network generation alongside results from a series of Exponential Random Graph Models which examine to what extent topic similarity is influenced by different types of previous collaboration (e.g., publication and grant collaboration), administrative barriers (e.g., between departments and colleges), and disciplinary area. An interesting application of this method is the selection of potential targets of interventions to promote team science, such as pairs or groups of authors who show a high degree of topic similarity but have never collaborated in the past, or are affiliated with different departments.

### **Assessing the Informational Comparison of 15 Different Relationship Questions over 12 Countries and 9 languages**

Zack W. Almquist and<sup>1</sup>, Bryce Barlett<sup>1</sup>

<sup>1</sup>Facebook Inc.

In this talk we compare the differences in information obtained through role relations, social support, social exchange and social affect questions to evaluate the consistency of evaluations for tie strength through a survey on Facebook and Instagram users in 12 countries and 9 languages. These evaluations are relevant for evaluating the cross-cultural consistency of questions that have been (or could be used) as network generator questions. We recruited 26,339 participants who were surfaced 3 friends from either their Facebook or Instagram account where we then asked them an additional network generator question based on role relations. We analyze the resulting personal information through Item Response Theory lens to understand which questions generate a comparable amount of information cross culturally. We find that 9 questions generate comparable levels of information and 6 questions (primarily for exchange and affective questions) appear to be much more limited across country and language. Further, we find that a combinations of questions allow for fine grained distinctions of individuals personal networks across cultural contexts.

### **Authors in the field of SNA: Derived networks and temporal analysis**

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The presentation is a part of analysis of bibliographic data about the field of SNA. The study is based on the analysis of articles from the Web of Science Clarivate Analytics data base containing the keyword "social network\*", as well as those published in the main journals in the field. The first part of the data set was collected in 2008, and the collection of networks obtained out of it was labeled SN5 and was used as a challenge data for the Sunbelt 2008 Vizards Session (7,000+

papers). The second part consisting of 60,000+ papers published in the last ten years was collected in June 2018. Thus, the updated data set which is being analyzed includes 70,000+ publications with a complete description.

From the collected data the citation network and two-mode networks linking articles with authors, keywords and journals were constructed. In the analysis we are following and improving on the already proven scheme used in earlier studies (Kejžar et al., 2010; Batagelj and Cerinšek, 2013, 2014; Batagelj et al., 2014, 2017, etc.). The approach to temporal network analysis (proposed by Batagelj and Praprotnik, 2016) was applied on large bibliographic networks for the first time.

The obtained derived networks allow analyzing the co-authorship, collaborativeness, and citations among authors. We identified the most active authors and, using islands approach, groups of collaborating/citing authors. Based on keywords and journals networks we provide descriptions of selected groups of authors. The methods used were extended to temporal versions of networks providing an insight into the dynamics of relations.

### **Avoidance, antipathy, and aggression: a three-wave longitudinal network study on negative networks, status, and heteromisos**

Mathijs Kros<sup>1</sup>, Eva Jaspers<sup>1</sup>, Maarten van Zalk<sup>2</sup>

<sup>1</sup>Utrecht University, <sup>2</sup>University of Osnabruck

This study is concerned with explaining the existence of negative ties, using three waves of social network data collected in three secondary schools in the Netherlands, amongst a total of 227 first-year pupils. Based on research on dislike relationships amongst university students, it has been suggested that negative networks generally are less dense, less transitive, and less reciprocal than positive networks (Everett & Borgatti, 2014; Harrigan & Yap, 2017; Yap & Harrigan, 2015).

However, previous research has typically not considered how different types of negative ties may differ from one another, and whether the same theoretical mechanisms explain why people dislike, avoid, or assault someone. To tackle this, we study three categories of negative ties within one and the same sample: avoidance, antipathy, and aggression. We argue that these three types of negative ties differ from one another in how costly and how observable they are by others, with implications for how common, transitive, and reciprocal these negative ties can be expected to be. We subsequently use this typology to test hypotheses, derived from ideas about status, that are specific to avoidance, antipathy and aggression.

Our second contribution to the literature on negative networks is to have a closer look at the role of the migration background of pupils. Ethnicity is a particularly relevant sorting tool in classrooms, influencing who becomes friends with whom (McPherson, Smith-Lovin & Cook, 2001), and possibly also who dislikes, avoids, and victimizes whom (Tolsma, Van Deurzen, Stark & Veenstra, 2013; Verkuyten, 2003). Ethnicity is particularly relevant for high school pupils as their ethnic identity starts to take shape during adolescence (Phinney, Lochner & Murphy, 1990), and the school setting offers a lot of opportunity for interethnic relationships to form (Wölfer, Hewstone & Jaspers, 2018).

We use RSiena to analyse our data, to capture network dynamics and take period effects into account.

**Avoidant attachment styles are related to higher centralization of personal networks of managers in Quebec (Canada)**

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<sup>1</sup>Universidad de Sevilla

In this study, we analyze the relationship of adult attachment style with the structural properties of personal networks and the social capital of 67 managers of the province of Quebec (Canada). Through cluster analysis we detect two differentiated relational profiles. Secure attachment is associated with comparatively small dense networks of strong ties, while avoidance attachment style is related instead to wider and centralized networks, with more weak ties. There were no significant differences in satisfaction with the professional career related to the attachment style. However, satisfaction with the career showed a significant relationship with the centralization of the personal network. Adult attachment styles introduce individual differences in the properties of personal networks and the social capital of managers. This approach, based on the individual pattern of affective attachment, is promising in an area of research that has focused almost exclusively on the influence of personality traits. Secure attachment is associated with the development of strong relationships and cohesive groups. Interestingly, the deployment of extensive personal networks, with a variety of weak ties and access to high status contacts, was associated with higher scores in the avoidance dimension. This could connect some forms of non-secure attachment with the demands of top management positions.

**Being single with many friends: Trade-off between close non-kin and spousal ties in social support**

Mia Ruijie Zhong<sup>1</sup>, Claude Fischer<sup>2</sup>

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Spouses play a crucial role in sustaining people's well-being in western societies, and the positive effects are more salient with men, especially the older cohorts (Durkheim 1951; Cable et al. 2013). However, in the contemporary era, adults live for extended periods un-partnered, experience divorces, and live long enough to be widowed (Davis 1983). During people's time without spouses or romantic partners, they depend more on others for social support. To what extent do alternative relationships compensate them for the missing spouse or partner?

This study addresses this possible "trade-off" mechanism between spousal ties (marriage and partnership) and close non-kin ties in people's social networks. We ask to what extent do spouse-like ties and close non-kin ties substitute for one another in providing social support for egos' physical and mental health. This question speaks to the long-standing research tradition about the interaction between family and social networks dating back to Elizabeth Bott's classic work (1957). Beyond the concern over social support and well-being, this issue addresses the debate over whether marriage is a "greedy institution" that pulls people away from independent ties or an institution that extends people's ties by introducing new linkages (Kalmijn 2003, 2012; Gerstel and Sarkisian 2006).

This study uses wave one cross-sectional dataset from the University of California Berkeley Social Network Study (UCNets; see Fischer and Lawton 2017), which consists of detailed data about social networks, health and life transitions of 20-30 year-olds and 50-70 year-olds in the San Francisco Bay Area. We measure the number of close non-kin ties by aggregating the alters listed in the name generators whom respondents describe as non-kin and as "close." We use linear regressions to model the effects of having spouses or partners and the effects of having close non-kin ties on people's self-rated health, self-reported loneliness, and overall satisfaction with their social networks. By including the interaction terms of having spousal ties and having close non-

kin ties, we test the possibility of having “trade-off” between these two kinds of relationships. The analyses are run in two gender groups and two age groups separately.

Results show that the “trade-off” between spousal ties and close non-kin ties exists in women’s satisfaction with their social networks. Unmarried and un-partnered women with about 10 close non-kin connections are equally satisfied with their social lives as if they were in marriage or partnership. For males and more generally the elderly, the supportive role of spouses and partners on their well-being is so active that even having more than 24 close non-kin ties could only approach to the benefits of marriage and partnership on self-rated health and network satisfaction. The importance of spouses and partners in reducing loneliness for males and generally the elderly is unsurmountable regardless of the number of their close non-kin ties. These results draw attention to the well-being and social life of men, especially senior men outside wedlock or partnership. This study offers new insights into the theoretical issue around the dynamics and balance between people’s family life and social life.

### **Beyond Dyads and Triads: A Comparison of Tetrad Motifs across 20 Social Networks**

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Previous social science research analyzes the micro-level features of larger networks by considering how relational ties connect small subsets of two to three actors (i.e., dyads and triads). Significantly less work examines how tetrads, or configurations of four nodes, pattern our social world. Yet through examining the local structures of tetrads, researchers can gain insights about network processes (e.g., clustering, hierarchy, bridging) that are not observable from solely considering dyads and triads. In the current project, we consider the prevalence of 199 directed tetrads across 20 social networks. Our 20 networks represent five unique relationship types including friendship, co-sponsorship, Twitter, advice seeking, and email. By comparing the observed networks to randomly generated networks, we specifically look for those tetrads that occur more frequently than expected, or *network motifs*. Across all five network types, we find evidence for 20 four-node network motifs. Several of the motifs we uncover suggest that the networks in our sample are patterned by a complex system of hierarchy where actors simultaneously reinforce and expand upon the existing patterns of stratification. While many motifs imply a rigid, hierarchical structure, others suggest that there are occasional opportunities for social mobility and advancement. Additionally, we find important differences in tetrad prevalence across the social network genres we study. For example, tetrads that suggest a tendency to bridge structural holes are common in some genres, but not in others. In sum, we argue that researchers can gain theoretical insight by studying four-node motifs in social interaction, and these observations can help explain why we occasionally observe unexpected patterns of dyads and triads (e.g., asymmetric dyads, intransitive triads). Furthermore, patterns of tetrads can inform how we parameterize our models in statistical social network analysis.

### **Beyond the “lonely” social worker: using SNA tools and methods to assess the professional connections within an Italian community of social workers**

[Andrea Salvini](#)<sup>1</sup>

<sup>1</sup>University of Pisa

The paper aims to present the results of a survey on the professional community of social workers in a large Italian public institution called “ASL Toscana Nord-Ovest”, for a total of 190 social workers working in the social and public health field.

The objective of the survey was twofold: the first was to evaluate the level of collaboration and professional exchange among social workers, the second was to assess how the level of those

professional interconnections exercises a influence on professional self-efficacy. All the social workers were given a questionnaire containing two different name generators: with the first, interconnections among all 190 social workers were elicited, while with the second, for each social worker, the set of professional relationships that they establish with other professionals in the exercise of their daily activities, were detected. It was thus possible to reconstruct two structural levels in which the professional interactions of social workers are placed: on the one hand the complete network of interconnections within the community to which they belong; on the other level, the ego-networks through which each social worker "increases" its "social capital" through the construction of ego-networks that are instrumental to their daily professional performance.

It was thus possible to calculate several descriptive measures through the usual structural parameters offered by SNA tools and methods, which made it possible to know the density, reciprocity and transitivity of the collaboration and exchange networks, both internal and external to the professional community.

The results show how the distribution of these parameters is sensitive, as it was logical to expect, to the position that each social worker holds within the public organization, both considering the territorial differences, and the thematic Units in which they perform the own daily activity. It is interesting to note that social work is a profession in which the tendency to build networks of collaboration with professions other than their own (for example with psychologists and physicians) is more developed. In other words, the propensity of social workers to build continuous and meaningful relationship with other social workers is comparatively low, and this obviously calls into question the concept of "professional community".

Using inferential SNA tools, it was possible to confirm that social workers who show more consistent levels of professional interaction both inside and outside the professional community, have higher levels of self-efficacy, are able to better cope with work stress, show higher levels of job satisfaction and a positive view of the organizational climate.

The results of the survey - which is the first in Italy on this subject - show how it is necessary to make a radical change in the way in which the figure of the social worker has been thought up until now; generally speaking he or she is not educated and trained to develop his daily activity in interaction and collaboration with other professionals, finding himself too often "alone" to cope with a huge workload, mainly oriented to building dyadic relationships with services users. This substantial "loneliness" of the social worker can instead be reduced and overcome through the promotion of collaborative dynamics of interconnections both with other social workers and with other professionals, through the construction of "communities of practices", able to increase the effectiveness of the professional activity, for the benefit of both workers and the local community.

### **Birds of Mixed Feathers: Modeling Multiracial Identity and Network Structure**

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<sup>1</sup>University of California, Irvine

The rapid rise of the U.S. multiracial population, particularly among youth, poses many challenges in how to conceptualize and measure intergroup relations, (e.g., racial/ethnic homophily, cross-race friendships). There is a tradeoff between accurately representing the multifaceted nature of racial identity and analytic tractability. Thus, the approach researchers take has ramifications for understanding and monitoring changes in network selection, group cohesion, and cross-race interactions. Our goal is twofold: (1) to identify different methods of handling multiracial youth in network studies, and (2) to evaluate their consequences for model performance and inferences regarding intergroup relation processes. Toward this end, we ask the following questions regarding friendships among multiracial youth: whether sharing at least one racial/ethnic identity

with a peer increases their likelihood of being friends (partial homophily); whether multiracial friends serve as bridges to cross-race friendships through partial homophily and triad closure; and, whether multiracial youth are isolated from monoracial friend groups. We also test whether multiracial youth select multiracial friends even when they do not match on some (or any) racial/ethnic identities. Data come from the Teen Identity Development and Education Study (TIDES), which includes friendship nominations and self-classified race/ethnicity among youth in two diverse U.S. schools (N's = 2136, 1055; multiracial = 34%, 17%). We use an exponential random graph model (ERGM) to evaluate how various specifications of multiracial identity affect friend selection. We discuss how this approach can be extended to other attributes that are not mutually exclusive, and the substantive implications of leveraging multiracial identities in understanding friendship networks.

### **Board Processes, Director selection and risk-taking behaviour of firms**

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Extant literature shows board of directors as internal control mechanism of corporate governance responsible for determining the appropriate levels of exposure to risk for a firm. To this end, risk-taking and governance focus on three different attributes. The first set of attributes relates to selection of directors (using characteristics like gender, experience and compensation) and its impact on the risk-behaviour of firms. The second set of characteristics is the board structure that looks at board size, composition, presence of audit committees to understand risk-taking behaviour of firms. The third set of attributes looks at behavioural dynamics and board processes to capture relationships between executive-non-executive directors, board meeting effectiveness and director busyness. The literature on risk-taking behaviour of firms have two key limitations. First, while each of the three sets of attributes helps understand the risk-taking behaviour of firms, they do not conclusively explain the firms' risk-taking. Risk-taking is a function of complex relationships between board structure, director characteristics and board processes that takes into account the subtle behavioural dynamics between the directors that develop over time. Another key limitation of studies in the risk-taking scholarship is that they look at firms as isolated units not considering the embeddedness of the firms in inter-organisational relationships. To overcome these two limitations, this paper uses the Italian interlocking directorate network from 2007-2016 and looks at these three contributory elements of board effectiveness as a conceptual framework comprising director characteristics, board characteristics and firm characteristics to understand the behavioural and network dynamics of director selection and the impact on the risk-behaviour of firms. More specifically, this research seeks to (a) ascertain the board processes and structures before and after the financial crisis of 2008/09 (b) ascertain how these processes and structures have changed after the introduction of the Italian interlocking ban 2012 (c) examine the board decision-making in relation to risk behaviour.

This study contributes to understanding the relationship between corporate governance and risk-taking behaviour of firms embedded in interorganisational networks as exercised through the processes, structure and behaviour of boards of directors. It contributes to showing a causal relationship between director selection and how this explains the risk-taking decisions of firms by clearly distinguishing the sociological processes of selection and influence using a two-mode network of directors and firms. Using the Stochastic Actor Oriented Methodology (SAOM) the findings show that while formal structures of the board explain risk-taking to a certain extent, the risk-taking behaviour of firms are more complex and influenced by subtle factors of network dynamics and pervasive network structures in which firms are embedded. Consequently, at the board level, risk management is, to a great extent, a sociological process, as opposed to being a

procedural factor that is idiosyncratic and is characterised by constructive interactions and relationships between board members.

Keywords: Risk-taking behaviour, Interlocking directorates, SAOM

“This abstract is related to Corporate Networks”

### **Bonds for Life? About stability in personal networks**

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Network research recurrently shows that personal networks are highly dynamic. Over time, people lose many ties, including very close ones, and replace them with new contacts. But still: some bonds are ‘for life’. I describe and explain who the individuals are who have such stable contacts and what characterizes these stable relationships. Is it a matter of investment, relationship intensity, obligation, preference, meeting opportunity, or just ‘fate’? In other words, what are important conditions for stable personal relationships?

Knowledge about stability in personal network members will provide a better understanding of the dynamics of personal networks and the social resources people have at their disposal over the life course. I examine stable bonds in the personal networks of more than 400 Dutch panel survey respondents of whom we have very detailed longitudinal information about their personal networks and changes therein between the years 2000 and 2017.

### **Bridging collaboration gaps in wildfire-prone social-ecological systems**

Matthew Hamilton<sup>1</sup>, A. Paige Fischer<sup>2</sup>, Lorien Jasny<sup>3</sup>, Alan Ager<sup>4</sup>

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Recent research highlights the important of alignment of the structures and processes that span social and ecological components of environmental governance systems. Such social-ecological alignment can improve resilience to disturbance or enable adaptation to rapid environmental change. For example, in wildfire-prone landscapes, risk mitigation outcomes may hinge upon collaboration among organizations whose jurisdictions are interdependent due to wildfire transmission. In one such landscape—the Eastern Cascades Ecoregion of Oregon, USA—prior research found that organizations that jointly managed lands where fires ignited and spread tended to avoid interacting with one another. This tendency highlights the potential key role for third-party organizations to bridge such “collaboration gaps” by brokering between organizations that do not interact despite their joint management of wildfire-prone lands. In this study, we estimated an exponential random graph model (ERGM) to test hypotheses about the characteristics of organizations that may facilitate alignment of social and ecological networks through their roles as brokers. We developed custom ERGM terms that measured brokerage between certain dyads (e.g., between organizations that are interdependent due to patterns of wildfire transmission and joint land management) and that allow specification of the attributes of the broker. We found that organizations that 1) lacked authority to manage land themselves and 2) were concerned with hazards that play out over shorter time scales play a potentially crucial role in improving wildfire risk governance outcomes by bridging collaboration gaps. We highlight policy implications for decision-makers in the Eastern Cascades and other complex hazard-prone landscapes. We also discuss how our conceptual and methodological approach for social-ecological network analysis reveals opportunities for advancing theories about environmental governance in social-ecological systems.

**Bridging Social Capital and Sustainable Behavior**Kyra Selina Hagge<sup>1</sup><sup>1</sup>Department of Economics and Business Studies, Justus-Liebig University Giessen

The anthropogenic caused increase of carbon dioxide concentration in the atmosphere has been researched since as early as the late 19<sup>th</sup> century. Although we know now what causes the climate to warm up and we also found ways to lower our carbon emissions, little to no progress in lowering carbon dioxide levels has been made so far. There are various reasons for this lack of taking action. Humans do not always act rationally, which has been acknowledged by the research community especially since psychologists successfully challenged this concept, and hence disbalances regarding sustainable behavior occur.

Attitudes shape behavior and are in turn influenced by the education and knowledge that is inherent in the individual. However, education can only partly explain sustainable behavior and is furthermore offset by the income effect. While education increases the knowledge about environmental processes, which is linked to sustainable behavior intentions, higher educated individuals demonstrate a larger carbon footprint. Therefore, this study adds to the literature in deciphering the effect of education on sustainable behavior and attitudes, by analyzing the moderating role of social capital as an attribute of cohesive groups within social networks. I ask specifically: 1) is education a determinant of sustainable behavior in Germany? 2) If so, is there an indirect link of education via the structural dimension of geographic distance within social networks to sustainable behavior? And 3) Does this effect change when including a measure for delayed discounting?

My research is based on data from the German Socio-Economic Panel (SOEP) using a panel estimation approach as well as several cross-sectional analyses. As a dimension of social context, social capital is a major determinant of sustainable behavior. Although characterized by individual assets, it can be summarized to collective actions, which have been related to the adaptation to dynamic processes, such as climate change. Social capital furthermore depends on the geographic location. Since the capability to uphold social ties over larger geographic distances increases with education, I argue that by being able to connect various social circles there are not only individual benefits through accessing more diverse information, but also societal benefits stemming from a faster dissemination of environmentally related knowledge. Another important aspect regarding pro-environmental behavior is the valuation of time, or the degree of delay discounting. Individuals who value the future more also tend to engage more in sustainable behavior. To account for this *present bias*, I employ two different strategies: 1) I am building upon empirical results of different authors who find that the discounting of environmental quality is positively correlated with the discounting of monetary outcomes. In varying intervals, the SOEP questionnaire included an experimental question on the time preference regarding a monetary prize, which I utilize to approximate the present bias of the respondents. 2) I employ the questions on ecological behavior that have been posed within the SOEP Innovation Sample (SOEP-IS) in 2014. Together with the previous analyses, this paper is drawing a recent picture of the impact of social capital on sustainable behavior in Germany.

**Bringing the balance theory back to the individual in the network: Proposed measures of an individual's embeddedness in unbalanced structures**Srebrenka Letina<sup>1,2</sup>, Flora Samu<sup>1</sup><sup>1</sup>Computational Social Science - Research Center for Educational and Network Studies (CSS-RECENS), <sup>2</sup>Department of Network and Data Science, Central European University

Structurally balanced and imbalanced configurations in social networks made of positive and negative ties have been a fruitful area of studies for decades. The identification of (im)balance is

usually based on triadic motifs. The idea itself comes from Heider's psychological theory, later extended by Harary and Cartwright to social networks who proposed that certain kind of combinations of positive and negative ties within a triad are producing a tension, a cognitive dissonance, in the individuals involved and therefore motivating and inducing its resolution – which is likely to result in a change in the direction of one or more ties among actors within the triad.

While the basic assumptions of the theory have been mostly supported by the research findings and encouraged many extensions of the theory and the measurement of the phenomena, this was almost exclusively done from the network perspective, leaving the individuals embedded in such relationships out of the focus.

Given that an actor's perspective, her internal psychological state of dissonance is the driving force of changes that structural balance theory predicts, we aim to measure it on actor's level and use it as to predict certain/specific actor level outcomes. Our proposed measure includes set of frequencies and ratios of six closed and five open triadic motifs representing the placement of positive and negative ties from an ego's/actor's perspective of her/his local environment. Furthermore, we extend this motif analysis by taking into account the centrality (in the network of positive ties) of each alter in the actor's triads.

Measures are demonstrated on a dataset for nine small firms (from 16 to 43 employees) in Hungary. The dataset contains information about positive ties – describing the following relationships between actors: “cooperate well”, “good friend”, and “like”; and negative ties – describing relationships: “would not cooperate with”, “do not like”, “would not befriend”, and “shares negative info about me”, resulting in directional, dense, and signed networks.

We use the measures to predict the behavior and subjective satisfaction of employees in the firms, proposing the following general hypotheses: H1: The embeddedness of an actor in unbalanced structures will be positively related with his/her tendency to gossip about others and to be the target of gossips; and H2: The embeddedness of an actor in unbalanced structures will be negatively related with his/her overall job satisfaction. However, we also look more closely at the nature of the association, gender and tenure differences, and the relation of new proposed measures to the negative, as well as the nonexistent, and “ambiguous” ties, on both dyadic and triadic level.

### **Brokering Diversity: How Mentorship Shapes the Networks of Racial and Ethnic Job Seekers**

Dr. Christopher Munn<sup>1</sup>, Dr. Dimitris Christopoulos<sup>2</sup>, Dr. Heather McGregor<sup>2</sup>, Mr. Kane Needham<sup>2</sup>

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Mentors are important to the occupational success of most people. They provide advice, support, and guidance, but more importantly, serve as broker between their mentees and broader professional networks. We know from previous literature that brokers tend to increase the job leads and social capital of people new to a professional field. However, evidence suggests that racial and ethnic minorities report fewer connections to the people that might help advance their careers. Our study examines data from a social network intervention that intends to build the social capital of racial and ethnic minorities pursuing careers in the communications field. We present qualitative themes regarding the participants' perceptions of their mentoring relationships and analyze changes to their professional networks on the networking website *LinkedIn*. Preliminary analysis included in this working paper suggests that mentorship provides positive emotional benefits and our ongoing analyses will further test the positive impact of the social capital intervention to influence online professional networks. As an analysis of the

intersection of racial and ethnic relations and brokerage, our paper contributes to understanding the role that social status plays in processes of social capital development.

### **Building and Mobilising Social Capital in Infrastructure Projects**

Kon shing Kenneth Chung<sup>1</sup>, Suresh Cuganesan<sup>1</sup>, Xinyao Du<sup>1</sup>

<sup>1</sup>The University of Sydney

While there are numerous definitions of social capital, in our study, we define it as “the goodwill available to individuals or groups”. It represents a valuable resource for entities that derives from the structure and nature of their relationships with others. Extensive research in management and sociology demonstrates that social capital provides entities with valuable benefits in terms of influence, information and support. Yet, there is still lack of research that understands the process of how social capital is created and mobilised.

In our study, we apply social capital theory to the study of infrastructure project teams and how they engage with their community stakeholders throughout various phases of the project. To date, social capital in project management has been predominantly examined for its benefits towards knowledge sharing within project teams. There is little guidance for project teams on how to: (i) build social capital with the community for their infrastructure projects and (ii) mobilise this social capital to contribute to project performance.

Hence, our two research questions are: (i) How can infrastructure project teams build social capital with community stakeholders? (ii) How can infrastructure project teams mobilise social capital with community stakeholders to positively impact project performance?

The context for our study is the WestConnex Project in New South Wales, Australia. WestConnex is one of the largest funded mega-project by the Australian government that seeks to improve road access and connect major regions around Sydney through better road infrastructure.

We utilise publicly available Twitter data to perform social network analysis (SNA) and sentiment analysis (SA) to measure the structure and nature respectively of a project team’s relationships with community stakeholders at multiple points in time for each project. In particular, tweets relating to this project will be used to understand network structure of interactions (i.e. who retweets or replies to whom) followed by a sentiment analysis of the tweets of each of the stakeholders within the community group. The sentiment analysis evaluates content of interactions and allows us to understand the nature and level of goodwill towards the project. Taken together, the results yield powerful social capital insights in terms of the goodwill of community stakeholder to the infrastructure project and to what extent influence is and potentially exerted within the network.

In this way, we are able to provide a dynamic perspective over time of how social capital with community stakeholders changes over time, what actions project teams took to influence this and what the effects were for the infrastructure project. In this paper, we report the theoretical foundations for this research and the preliminary results from the pilot stage (quantitative component) of our study.

### **Building Multi-Sector Relationships for Healthcare Innovation: Network Analyses of Regional Collaborations**

Tessa Heeren<sup>1</sup>

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The purpose of the State Innovation Model (SIM) grant in Iowa is to support the development and execution of innovative plans to achieve better quality of care, lower costs, and improve health for a state’s population. One component of the Iowa SIM is the Community and Clinical Care (C3) Initiative, which awarded seven regions funding to develop community-based coalitions across

medical, public health, and social service delivery systems to provide enhanced care coordination for patients and address Social Determinants of Health needs. Network analyses were conducted to evaluate the development and nature of multi-sector collaborative relationships within each of the seven regions of the C3 initiative.

**Methods**

The survey sample (n=223) consisted of representatives from organizations which are formally involved in one of the seven C3 sites (11-36 participating organizations at each site).

An online survey was administered to representatives from organizations involved in the C3s to gather perspectives about relationship development and collaborative endeavors. Respondents were asked to report about involvement in three types of collaborative activities 1) Care Coordination, 2) Data Sharing, and 3) Resource Sharing. And, to learn more about the C3 role in stimulating and maintaining collaboration, respondents were asked about the strength and perceived sustainability of relationships. UCINET software was used to analyze networks and identify key organizations within networks.

**Results**

The networks captured were diverse, and engaged multi-sector stakeholders in meaningful and promising collaborative relationships. In addition, relationships across sites were rated highly, with nearly half of all reported relationships across C3 sites receiving the strongest possible trust rating.

The C3 grant had a role in stimulating collaboration, with an average of 21% of respondents across sites attributing current collaborative relationships to the C3. In addition, respondents expected 39% of the current relationships (on average) to be sustained past the funding period. All seven networks achieved the highest density during the grant-funded period (compared to networks pre-existing the grant, and those predicted to sustain without funding).

Network development varied by activity type, as indicated by the average densities of networks. Across all C3 sites, the most developed networks were those involved in Resource Sharing, followed by Care Coordination, and Data Sharing networks were substantially less developed.

Qualitative responses highlighted the benefits of cross-sector networking, including decreased fragmentation and gaining awareness and understanding of local programs, resources, and agencies.

**Conclusion**

Two of the seven C3 networks excluded social service providers. Networks can be strengthened and better equipped for coordination social determinant of health needs by requiring representation from the social service sector in planning and administration of activities.

Baseline and intermittent collection of network relationships should be considered for future grants involving strengthening local care coordination networks to monitor this foundational aspect of cross-organization collaboration.

Four of the seven C3 site representatives reported delays in the development of infrastructure needed for Care Coordination and Data Sharing. Formally requiring Resource Sharing (e.g. subcontracts) is an opportunity to strengthen relationships early in the grant period and beyond the grant period since substantial technical assistance is not needed.

**Building temporality and textuality: scaffolding history reading comprehension with Net.Create, an interactive open-source network analysis tool**

Kalani Craig<sup>1</sup>, Haesol Bae<sup>1</sup>, Joshua Danish<sup>1</sup>, Ann McCranie<sup>1</sup>, Suraj Uttamchandani<sup>1</sup>, Maksymillian Szostalo<sup>1</sup>, Cindy Hmelo-Silver<sup>1</sup>

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The classroom balance between history as memorization and history as argumentation is a difficult one. Disciplinary practices in history privilege the identification and interpretation of historical data in order to support the most salient argument about the past based on available evidence. At the same time, novice history learners struggle to consume great volumes of historical texts because they tend to see historical texts as an established list of facts to memorize rather than as interpretive argument. When history is seen not as list of facts to memorize but as an interpretive account of historical interactions that is built collaboratively through scholarship, students begin to engage with both the details of the text and the scholarly interactions that build a historical argument.

Net.Create is an open-source network-analysis software tool that uses network-analysis data-entry and visualization to help students simultaneously create the framework for a historical event and fill in its details. In a Net.Create activity, small groups of students completed small-group network-data entry on one portion of a text in a browser window that simultaneously integrates their data into a combined visualization of the whole network being generated by other small groups in the class. This combination emphasizes both the localized details that make interactions manifest as well as the larger network that makes historical context visible and supports historical argumentation. This talk will discuss several student-created networks done in Net.Create pilot studies and demonstrate how students have made sense of different kinds of networks that can be drawn from historical texts of varying nature. Finally, we will end with a discussion of Net.Create's simultaneous visualization and data-scheme features, which make large-scale collaboration possible both in the lecture format that is common to many undergraduate history classes and in other settings that would benefit from collaborative network-data entry.

**Bullying and Victimization among Majority and Minority Students: The Role of Peers' Ethnic Perceptions**

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Bullying is an extreme form of negative ties and bullying among students of different ethnic background is an extreme form of negative interethnic relations. If bullying crosses ethnic boundaries, it may have long-lasting negative consequences for both individuals and communities. We investigate whether bullying occurs more often within or between ethnic groups among Roma and non-Roma Hungarian adolescents. The main novelty of our study is that, besides ethnic self-identification, we also include students' ethnic perceptions in the analysis of interethnic bullying. Individuals' ethnic self-identification and how their ethnicity is perceived by other people often differ. We argue that in students' decisions about whom to bully, bullies' perceptions of their classmates' ethnicity should be crucial.

We thus examine the associations between self-reported and victim-reported bullying and two dimensions of ethnicity (self-identification and ethnic perceptions) among non-Roma majority and Roma minority Hungarian secondary school students. Results of the meta-analysis of

exponential random graph models for 12 classes (347 students, 4 schools) show that both self-declared Roma and non-Roma students are more likely to report that they bully peers they perceive as Roma compared to peers they perceive as non-Roma. This is after controlling for gender, socio-economic status, and structural characteristics of the bullying networks. Similar associations have not been found, however, analysing victims' reports.

#### **BUYER-SUPPLIER NETWORK COEVOLUTION: THE ROLE OF BOARD INTERLOCKS AS FOUNDATION FOR INNOVATION**

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Drawing on resource dependency theory and network theory we examine the relation between a firm's propensity to maintain and create ties across two types of inter-firm networks. In this study we focus on the coevolution of board interlock and buyer-supplier relationships in particular, as two networks with direct implications for a firm's propensity to unlock new knowledge. The former is oriented to the strategic nature of these interactions, and the latter is oriented to the operational activities that steer the direct operational outflow of the companies involved. We further examine the role of both networks in relation to a firm's commitment to create knowledge in the same technology area. Based on stochastic actor-based modeling (RSIENA) we test a series of network derived tendencies as driver for innovative output. The actor-oriented nature of our hypothesis and modeling allows us to model network change based on strategic choices at the firm level over a period of 5 years. Findings from a longitudinal study of 86 firms active in the Chinese automotive illustrate the effectiveness of the underlying buyer-supplier relations, relative to the tendency between these firms to exchange knowledge at the highest managerial level via the industry's board interlock networks.

#### **Can Persistent Minorities Leverage the Majority Illusion?**

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<sup>1</sup>University of S Florida, <sup>2</sup>University of S Florida, <sup>3</sup>University of S Florida

Our work unites two lines of research into how minority views or conventions can come to dominate a population in which initially a majority view or convention is solidly established. The first line of research focuses on the "majority illusion," a phenomenon in which, based on the composition of their one-hop neighborhoods, a majority of a population conclude that an opinion or a behavior is held by most of the population when in fact that behavior or opinion is held only by a minority of individuals, and possibly a slim minority at that (Lerman, Yan & Wu 2016). The second line of research focuses on persistent minorities, small groups that push a particular convention and are immune to costs incurred for failure to coordinate with the majority. The majority, however, is sensitive to lack of coordination and so potentially can change practice. The important question is how large the minority must be to upset the established convention, a question researched experimentally by Centola, Becker, Brackbill & Baronchelli (2018). Our work first explores the susceptibility to majority illusion of theoretically defined types of networks not previously examined (specifically, small world and forest fire networks). Second, we embed the persistent minority problem in these theoretical classes of networks, extending the experimental work which was limited to, effectively, small complete graph networks. Finally, we explore these phenomena on real world graphs extracted from Twitter activity surrounding political issues in the Syrian conflict.

**Cardiovascular Health Awareness Program: portrait and mobilization of residents' social networks to support a program implementation in subsidized housings**Nadia Deville-Stoetzel<sup>1</sup><sup>1</sup>CRCHUM/ Université de Montréal

The proposed study applies a social network analysis (SNA) approach to document how interpersonal relationships between neighbors influence the participation in a community-based cardiovascular disease prevention and management program currently implemented in seniors subsidized social housing units. The Cardiovascular Health Awareness Program's (CHAP) main objective is to reduce the impact of cardiovascular disease on the health of seniors. CHAP has been shown to reduce CVD related hospitalizations without additional costs to the health care system.

CHAP is currently being offered weekly in the community rooms of seniors' subsidized social housing buildings in Québec, and so far participation rates between the buildings range from 18,3% to 43,6%. One hypothesis shared by researchers and housing authority for explaining such variation is that maybe relationships between tenants is associated with a low or high participation in the program.

Social network analysis has proven its worth in exploring, sustaining, and improving health programs implementations, especially by informing and improving network-based interventions. However, because of its setup difficulties (time constraints and number of people to interview), the analysis of program participants' network is often overlooked.

The objective of the proposed study is to make a portrait of two buildings' relational dynamics, which represents the extreme cases in terms of participation, in order to see if they can explain these differences. The presentation will describe the SNA methodology using sociometric questionnaires and complete network analysis, supplemented by a qualitative questionnaire to understand the building's relational dynamics and its influence on program participation. The results will be presented in two steps: 1) quantitative results, such as the number and strength of relationships (density, centrality, betweenness) and types of support, and 2) qualitative results, that will illustrate how conflicting relationships but also proximity and distance strategies between neighbors, can explain the participation differences. Discussion: SNA applied to interpersonal relationships could help understanding the interactions' influence on human behaviors' change or, in this case, on people's participation. Identifying the optimal conditions for CHAP to become an ongoing initiative, adapted in several contexts, suggest taking into account these neighbor's relational dynamics. Thus, networks can interfere with the expected effects of an intervention, i.e. the composition of the people's network mediates the benefits of the program.

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### **Changes in the relational autonomy of women victims of domestic violence**

Anne-Marie Nolet<sup>1</sup>, Carlo Morselli<sup>1</sup>, Marie-Marthe Cousineau<sup>1</sup>

<sup>1</sup>Université de Montréal

The social network of victims of domestic violence is a key concern for those preoccupied with victims' struggles and the need for appropriate responses. Victims need their network in order to cope with violence, get help, find alternative definitions of their situation, and ultimately rebuild an autonomous life. But domestic violence has a profound impact on the very network in which women access (or fail to access) necessary resources. Past research demonstrates that violent partners often use isolation as a mean of controlling their victim. Researchers have also described an array of network members' reactions. The potential result of these dynamics is a situation in which women lack an objective access to network members while also lacking the trust that is necessary in order to ask for and accept the support. While the interventions via shelters may prove effective for rebuilding a network, some argue that shelters may have the opposite effect—that is to increase a disconnect between women and their network members. This paper proposes an analysis of the creation of relational autonomy of women who were victims of domestic violence and who were seized by structural constraint. Four stages of social network transformations emerged from the 30 interviews realized with sheltered women across Quebec: the violent relationship stage, the break-up stage, shelter interventions, and post-shelter life. Results highlight that the structural constraint of these women diminished with the break-up and as they entered the shelter, and then increased after exiting the shelter. Examples of individual actions explaining these changes are offered across the paper. The implications of these patterns

for the relational autonomy of women and for the network-based interventions in domestic violence are also discussed.

### **Charting new territory or following old paths: dynamics of repeated collaboration and performance in research-oriented teams**

Paola Zappa<sup>1</sup>

<sup>1</sup>Maynooth University

This paper examines the dynamics of collaboration in emergent cross-functional R&D teams to assess the motivational effect of performance on team composition and stability.

A long tradition of studies point to R&D teams – where members with heterogeneous expertise interact to perform complex tasks and work on innovative projects – as the organizational entities that bridge disconnected knowledge spaces and promote organization innovativeness and creativity. Research on teams has repeatedly addressed the relation between team composition and stability as well as the extent to which they jointly affect team performance. Relatively less is known about the opposite relation. Because individuals typically monitor their progress toward achieving goals and change their behaviors as a consequence of their performance, team members are likely to adjust their collaboration relationships to the team outcomes, forming new beneficial ties and dissolving unprofitable ones or, more broadly, reevaluating their collaboration portfolio.

Studies on performance and performance feedback refer to self-efficacy as the main factor explaining an individual's willingness to mobilize their network of collaborators. Drawing on extant literature that examines the effects of performance feedback on evolution of social relationships, we argue that positive team performance contributes to an individual's sense of self-efficacy, making them more willing to take the risks involved in entering new teams and working with new partners. By contrast, negative performance leads individuals to evaluate their existing collaboration ties and to focus on close relationships which promote learning and are easier to maintain, while dissolving ties to more "distant" partners in order to minimize risks and costs of coordination.

We test our hypotheses using longitudinal data that we have collected in a large research-oriented hospital specialized in advanced cancer treatments. Doctors carry out their individual research activity. Yet, most advanced research occurs in cross-functional R&D teams, whose membership is based on voluntary participation and activity organized around projects. By observing the dynamics of team-based collaboration on research projects among 250 physicians over a period of around 15 years, we illuminate the effects of team performance on partner selection and participation in teamwork, which ultimately affect the diversity and innovativeness of the research activities carried out at both team and organizational level.

### **Chemistry Networks: from Invisible Colleges to regional development in south-east Asia**

John Webb<sup>1</sup>, Thomas H Spurling<sup>1</sup>, Barry Noller<sup>2</sup>, Adam Finch<sup>3</sup>

<sup>1</sup>Swinburne University of Technology, <sup>2</sup>University of Queensland, <sup>3</sup>CSIRO

Networks within the scientific community are widespread, accepted as a means of collaboration and achieving scientific progress, emerging from the 'invisible college' of 17<sup>th</sup> century Europe (Price, Little Science, Big Science, 1963; Crane 1972) to the global networks of today (Wagner: The New Invisible College 2008). Various approaches have been taken to map the structure of science using network analysis (Bellotti, Oxford Bibliog. 2016).

For the community of chemists, including both academic and industrial chemists, the twentieth century saw the emergence of the International Union for Pure and Applied Chemistry (IUPAC) that focused on issues of the naming of elements and compounds (nomenclature) and the

establishment of standards of measurement. The IUPAC was a global network whose members were national institutes in individual countries but whose decisions were accepted by the entire community of individual chemists.

On a geographical level, regional Federations of national chemical societies emerged to facilitate interchange of personnel and information within a particular geographical region. Thus, for example, the Federation of European Chemical Societies was formed in Prague in 1970, during the Cold War of competing political ideologies and the Federation of Asian Chemical Societies was formed in 1979 as economic development accelerated ( the new Asian Tigers). These Federations did not have the authority of IUPAC over nomenclature and standardisation, but became affiliates of that global Union. Their primary ambition was to support the development of the chemical sciences within their region.

Within the south-east Asia region, the organic chemistry of what is known as natural products (the chemistry of extracts from plants, herbs and spices) became the basis for the first UNESCO chemistry network, established in 1975. The success of this Network in turn spawned a variety of related networks, funded from various national or international sources. A strategic focus of this network was capacity building, with the network including countries at various stages of development. One outcome of the cooperation was a series of scientific papers in the international literature. In addition to active scientists, there were key personnel who did not co-publish papers but who provided the administrative and financial resources for the network to flourish.

This paper seeks to quantify these network outcomes through bibliometric data to reveal the structure of the network.

### **Classification and Typology of Social Networks: A Finite Mixture Perspective**

Tessa L. Johnson<sup>1</sup>, Tracy M. Sweet<sup>2</sup>

<sup>1</sup>University of Maryland, College Park, <sup>2</sup>University of Maryland, College Park

As the number of studies that sample multiple, independent networks has grown (e.g., peer networks within classrooms, see Rodkin et al., 2010), the need for new methods of network analysis that allow researchers to treat networks as stochastic units has similarly increased. Advances in mixed membership stochastic blockmodels (MMSBM; Airoldi et al., 2008) provide researchers greater flexibility in this regard by introducing useful parameters, such as the network insularity parameter ( $\gamma$ ; Sweet & Zheng, 2017; Sweet & Zheng, 2018), that have the potential to represent structural changes within networks due to researcher intervention. However, posterior distributions for the  $\gamma$  parameter were found in simulation to be too wide to have utility in pairwise hypothesis testing, that is, in determining whether two networks have the same degree of insularity. One alternative approach to interpreting the  $\gamma$  parameter is to consider that degree of insularity may be an indicator of an underlying network typology. Utilizing a finite mixture modeling framework, we classify network typologies based on their degree of insularity, allowing us to compare whether or not these classifications differ across groups as the result of intervention. We formalize the model, assess its performance using simulation studies, and demonstrate its implementation using real data.

### **Classifying and Understanding the Semantic Structures of Vaccine Misinformation on Twitter**

Jade (Jieyu) Featherstone<sup>1</sup>, Qiusi Sun<sup>1</sup>, Jingwen Zhang<sup>1</sup>

<sup>1</sup>University of California, Davis

Social media have enabled and accelerated the creation and spread of misinformation on a global level. Misinformation is defined as false information judged by expert consensus contemporaneous with the time period. Among different types of misinformation, exposure to

health misinformation, specifically vaccine misinformation, has been linked to the formation of false beliefs, possibly contributing to the recent upsurge of local vaccine-preventable disease outbreaks. This study developed an automatic machine learning algorithm to classify vaccine misinformation and analyzed semantic structures of classified tweets.

In this study, we focused on examining messages about flu vaccines posted on Twitter during the peak of 2018 flu season, we collected a sample of 120,379 original tweets (excluding retweets and quotes) from January 1<sup>st</sup> to February 11<sup>th</sup> 2018, using keywords specifying “flu” or “influenza” and “shot” or “vaccine,” “vaccination,” “vax,” “immunization,” “immunization,” with Twitter’s Premium API. Then we built a fact-checking classifier to automatically distinguish misinformation from non-misinformation. Lastly, we conducted semantic network analyses to pinpoint the different semantic structures of misinformation tweets and non-misinformation tweets.

To build the machine-learning classifier, we first conducted human annotations on a subset of randomly selected 1,235 tweets. Four annotators received an initial training on the procedures and each pair of two coders annotated half of the tweets. All pairwise inter-coder reliabilities reached the criterion of Cronbach’s alpha of 0.7. The discrepancies were resolved among the pair of coders through discussion and a final labeled training dataset was created. Based on coded labels we built a machine-learning model to predict whether a tweet contained misinformation or not. The multi-layer perceptron (MLP) classifier achieved a F1-score of 91.1% on the sample tweets. We then applied the finalized predictor to the rest of the tweets and classified 7,814 misinformation tweets (8.6%) and 82,576 non-misinformation tweets (91.4%).

To understand the differences in semantic structures of the misinformation and non-misinformation tweets, we performed semantic network analyses based on the analysis of word co-occurrence, separately on the misinformation tweets and the non-misinformation tweets. Preprocessing, summarizing, and network construction were performed using ConText software.

Lastly, semantic networks were explored through Gephi. Modularity analysis was conducted to determine sub-clusters within the networks. We found in the network of misinformation tweets, the most central words were *flu*, *vaccine*, *not*, *get*, and *death*. Whereas in the accurate tweets, the most central words were *flu*, *vaccine*, *not*, *get*, and *health*. Four clusters were identified in both the misinformation and non-misinformation networks. In brief, the misinformation networks centered on conspiracies about government, media scam, and citing Trump.

Developing automatic approaches to identify misinformation will make a significant contribution to improve the social media environment and if employed, may benefit individual decisions. Importantly, we show misinformation and non-misinformation tweets presented significant differences in their semantic structures, the insights of which can inform tailored misinformation correction and vaccine promotion strategies on social media to improve vaccine discussions and vaccine coverage.

### **Closed, Balancing and Embedded. Three network types describing Roma university students’ college transition process**

Beata David<sup>1,2</sup>, Agnes J Lukacs<sup>1</sup>

<sup>1</sup>Semmelweis University, <sup>2</sup>Hungarian Academy of Sciences

Students’ networks become significantly restructured during college transition. In the majority of cases, they need to move away from home and they often experience weakening ties with their families and – in our case – the Roma communities. On the other hand, these students establish new, non-Roma relationships at the university, although from time to time they have to face the discriminative attitudes of their peers and teachers. They also have to conform to new norms that many of them have no role models for in their immediate environments, and they have to fit into a not always particularly welcoming milieu. The dilemma of “being trapped between two groups”

is not new and not only ethnic in nature, as it appears to be inherent in the process of structural mobility.

In 2011 to endorse the social integration of Roma the Hungarian government with 4 churches established the Christian Roma Collegium Network to support Roma undergraduates getting their degree and successful college transition.

In the 5-year follow-up research we examined altogether 124 students from the Christian Roma Collegium Network (CRCN) of Hungary. We applied contact diary (one-week long) to map the students' egocentric network's size and composition. We implemented Brandes and his colleagues' social network model originally with migrants' integration processes in focus.

Thus in our Roma college students' structural mobility model the four main groups which were operationalized along the dimensions of ethnicity and educational attainment are: origin, fellow, host and other. Based on the proportion of origin, fellow, and host alters' groups by cluster analysis we identified the most relevant network types among Roma undergraduates. These are the closed cluster where the fellow group, the balancing cluster where the origin, and the embedded cluster where the host alters are overrepresented.

In our presentation we further elaborate and describe the different characteristics of the 3 clusters, and discuss the possible factors behind the successful college transition.

### **Clustering Ensembles of Social Networks**

Tracy Sweet<sup>1</sup>, Abby Flynt<sup>2</sup>, David Choi<sup>3</sup>

<sup>1</sup>University of Maryland, <sup>2</sup>Bucknell University, <sup>3</sup>Carnegie Mellon University

Recently there has been significant work in the social sciences involving ensembles of social networks; that is, multiple, independent, social networks such as students within schools or employees within organizations. There remains however very little methodological work on exploring these types of data structures. We present methods for clustering social networks with observed nodal class labels, based on statistics of walk counts between the nodal classes. We extend this method to consider only non-backtracking walks, and introduce a method for normalizing the counts of long walk sequences using those of shorter ones. We then present a method for clustering networks based on these statistics to explore similarities among networks. We demonstrate the utility of this method on simulated network data, as well as on advice-seeking networks in education.

### **Clustering motif profiles in environmental management networks**

Lorien Jasny<sup>1</sup>, Erika Svendsen<sup>2</sup>, Michelle Johnson<sup>2</sup>, Lindsay Campbell<sup>2</sup>

<sup>1</sup>University of Exeter, <sup>2</sup>US Forest Service

Civic environmental stewardship is on the rise in many cities and regions throughout the world. Civic stewardship groups range from informal groups of friends or neighbors to professionalized non-governmental organizations (NGOs) who engage in conserving, managing, monitoring educating about, or advocating for the local environment. Increasingly, environmental actors in these areas work within collaborative, networked structures to accomplish their goals and objectives. Organizational networks are important mechanisms for groups to share information and resources that can strengthen capacity and outcomes and address environmental problems frequently too complex or at too large a scale for any one organization to tackle alone. These collaborative networks often lead to new and innovative forms of governance over shared environmental resources and ecosystem services. At the same time, not all environmental groups engage equally in collaborative networks and, as a result, may have less access to ideas, materials and resources over time. Using a new technique, the Ego-ERGM (Exponential Random Graph Model) approach, we cluster organizations into similar stewardship 'profiles.' These profiles

describe which organizations broker, which form clusters of like-minded organizations, and which engage in niche relationships. We then compare these profiles to geographic and other attribute data to look at how these roles operate within the network. We conclude with implications for overall stewardship capacity in the network.

### **Co-evolution of a multilevel network in a national scientific discipline: A Stochastic Actor-Oriented Models for the study of scientific networks**

Alejandro Espinosa-Rada<sup>1</sup>

<sup>1</sup>The Mitchell Centre for Social Network Analysis, The University of Manchester

The aim of the presentation will be to explore the longitudinal multilevel dimension of a scientific network in a national discipline. The contribution of this research is expanding existing research on micro-mechanisms in dynamic scientific networks. Also, contribute developing a multilevel approach to understanding the simultaneous effect of different (cross)mechanisms that drive the evolution of the networks and the representation of macro processes when the multilevel is considered. Modelling the multilevel dimension of a scientific network offers one of the first empirical examples from a stochastic actor-oriented model in the study of scientific networks.

### **Coalition building and distortion: new evidence about legislative networks in Ukraine, 1993-2018**

Tymofii Brik<sup>1</sup>, Tymofiy Mylovanov<sup>2</sup>, Dmytro Ostapchuk<sup>3</sup>, Oleksandr Nadelnyuk<sup>4</sup>

<sup>1</sup>Kyiv School of Economics, <sup>2</sup>University of Pittsburg, <sup>3</sup>DataRobot, <sup>4</sup>VoxUkraine

In this paper, we address individuals that are affiliated to committees and political parties. Their organizational networks (e.g. parties) overlap with other types of networks (e.g. new and old party members). We study co-evolution of these networks and how they affect voting outcomes of individuals. Most of the existing studies of legislative networks are focused on Western democracies. However, little is known about legislative networks in other parts of the world. We analyze a novel dataset covering co-authorship and voting of Ukrainian legislators from 1993 till present. First, our data suggest that in Ukraine, in contrast to Western democracies, co-authorship and voting are not aligned. Second, we show that homophily effects and centrality measures are more important for voting but not for co-authorship. Third, we analyze specific cases of distortions when legislators flip and do not vote for those bills which they co-authored. We argue that these cases are indicative of coalition distortions. Our contribution to the literature is twofold. While previous literature tends to analyze voting or co-sponsorship in isolation, we analyze them together. Second, we shift empirical analysis from the success of a given bill to the success of a coalition. Our analysis shows how social ties overlap with organizational ties of legislators.

### **Cognitive Diversity and the Production of High-Impact Science**

Alexander V. Graham<sup>1</sup>, John McLevey<sup>1</sup>, Tyler Crick<sup>1</sup>, Pierson Browne<sup>1</sup>

<sup>1</sup>University of Waterloo

Sociologists of science, scientometricians, and network analysts have long been interested in the relationship between knowledge and the structure of social networks, including the consequences of thinking differently than those around you. Despite this interest, the concept of intellectual diversity remains vague and difficult to examine outside of individual case studies. In this paper we operationalize intellectual diversity and introduce two novel measures (coauthor diversity and group intellectual diversity) that can be computed using publication meta-data. The first measure -- collaborator diversity -- captures how different an author is from their coauthors. The second -- group intellectual diversity -- captures how intellectually diverse the members of a group of coauthors are from each other. We demonstrate the utility of these measures by

estimating the effects of intellectual diversity on scientific impact and productivity in the fields of biomechanical modeling and nanotechnology. We find that increasing both measures of diversity is associated with more citations to a point, after which citations exhibit negative returns as diversity increases. This behavior is consistent in both case studies. We also find that individual and group diversities have a significant effect on publication rates in biomechanical modeling, but not in nanotechnology. We conclude by considering the implications for theory and research on diversity bonuses, and other potential applications of these new measures for quantitative research on science.

### **Collaboration ego-networks and their influence on scientific productivity and impact in academia**

Till Krenz<sup>1</sup>, Raffaele Vacca<sup>1</sup>, Christopher McCarty<sup>1</sup>

<sup>1</sup>University of Florida

This paper describes and analyzes the professional egocentric networks of thousands of scientists at a large, public research university, and identifies characteristics of ego-network composition and structure that are associated with individual scientific productivity and impact. Unlike previous studies, this project (1) analyzes longitudinal ego-networks developing over five years; (2) examines multi-layer ego-networks spanning different types of professional collaboration, including collaboration on publications, research grants, and graduate committees; and (3) considers researchers (egos) in all disciplinary areas, including the natural, health, and social sciences.

We extract ego-networks of publication co-authorship from Clarivate Analytics Web of Science data with disambiguated author IDs. Ego-networks of grant co-participation are obtained from a university administrative database including all grant proposals for all departments and colleges, with information on all grant key personnel, project topics (titles, keywords, abstracts), and application outcome (funded or not). Ego-networks of co-membership in graduate committees are constructed from the university's graduate school database.

The result is a longitudinal database of multi-layer collaboration ego-networks, which allows us to examine (1) The different patterns of specialized professional relationships (occurring only in one collaboration layer, e.g. publications) and multiplex professional relationships (involving multiple layers, e.g. both publications and grants); (2) The evolution on professional ego-networks over time and the different collaborative styles they reveal across different disciplines; (3) The association between professional ego-networks and scientific productivity and impact of individual researchers over time. The outcome measures for scientific productivity and impact include publication counts, citation counts (potentially weighted by journal impact factor), H-Index, grant proposal count, proposal success (award) rate, and metrics of grant funding in US dollars. The longitudinal nature of the data allows us to establish causality by analyzing the association between networks and subsequent outcomes at later points in time.

### **Collective Impact Networks: A Case Study from Nigerian Civil Society Advocacy Clusters**

Rachel Dickinson<sup>1</sup>, Alexis Smart<sup>1</sup>

<sup>1</sup>Root Change

Strategic collective impact initiatives led by diverse organizations working across sectors and levels of government and united by a common advocacy agenda are increasingly being recognized as an effective mechanism for achieving greater social accountability and policy change. Civil society organizations (CSOs) that effectively connect with a community of peers and allies benefit

from a flow of trust, reciprocity, information exchange and the norms of cooperation that follow. Smart networking is particularly important for improving the ability for groups of actors to effectively work together to achieve their advocacy and social change goals.

The USAID-sponsored Strengthening Advocacy and Civic Engagement (SACE) program in Nigeria (2013-2018), led by Chemonics in partnership with Root Change, tested alternative approaches to fostering smart and strategic networking within civil society. Rather than supporting individual organizations, they adopted a collective impact approach. The program galvanized the efforts of 17 different clusters of advocacy and public engagement organizations, each working to influence social accountability issues ranging from open budgeting in education to accessibility of infant and newborn health services at state and national levels.

Advocacy clusters in SACE were made up of diverse actors including CSOs, community groups, businesses and government agencies. Together, these actors had a unique combination of skills, services, interests, knowledge, and influence needed to understand and strategize around the pieces of a problem. Clusters were facilitated by an anchor organization that utilized their connections and sector expertise to mobilize the cluster, build trust, facilitate continuous communication, and coordinate individual roles and responsibilities.

SACE and Root Change identified early on the need to support the advocacy clusters with a new set of system-based tools that could help them to visualize and understand the current social networks that support their work and discover new potential allies and influencers. During the design phase of SACE, Root Change introduced the use of SNA. SACE collected multi-year SNA data on 17 advocacy clusters to learn about the networking behavior of collective impact initiatives and how their networking influenced policy outcomes.

Over the five-year engagement, advocacy clusters formed through SACE morphed into very diverse network structures. The preexisting relationships, advocacy issue of focus, socio-political contexts, and leadership styles contributed to the diverse journey of each cluster.

For this case study we will present the journey of four Nigerian clusters advocating for greater accountability in the oil and gas industry, Niger Delta institutions, improved quality of services for maternal and newborn child health, and increased public budgeting and opportunities for youth. This study draws on three years of SNA and qualitative data collected and analyzed by SACE and Root Change. Our presentation will dive into the culture and contexts faced by these four clusters, as well how the cluster's networking influenced the larger civil society sector in Nigeria. The SACE case study is a unique opportunity for evaluators, practitioners, and data scientists alike to explore what networking looks like within collective impact initiatives and social movements.

### **Community Mobilization in Oil and Gas: Conventional tactics for unconventional development**

Madeline Gottlieb<sup>1</sup>

<sup>1</sup>UC Davis

High-volume hydraulic fracturing, or “fracking,” is an oil and gas extraction technique that has revolutionized the energy industry and created significant economic opportunities in marginalized communities. However, potential environmental and human health impacts have caused widespread concern about the process. Moreover, fracked wells are disproportionately located in low-income, minority communities. Few studies have explored the means by which low-socioeconomic communities, who often lack political access and power, are mobilized to influence political disputes around fracking. I address this gap by investigating how advocacy organizations promote political participation around fracking, particularly in historically underrepresented communities.

Foundational research asserts that nonprofits are the most effective means of providing a voice for marginalized members of society. Traditionally, nonprofits rely on a broad range of tactics to reach their target audience, such as email, mail and phone, but those working in marginalized communities have to rely more on in-person tactics. Smaller organizations, however, lack the resources to organize these activities independently, so they collaborate (network) with one another to build capacity. Network scholarship has demonstrated that greater centrality of a focal organization is negatively associated with collaboration outcomes, while greater network heterogeneity is positively associated with collaboration outcomes.

Thus, my central hypothesis is that advocacy organizations will employ different sets of tactics when working in low-SES communities than when working in high-SES communities, and that they will be more successful at passing preferred policies when they have a heterogeneous network of collaborators in which they are not central.

I focus on two states with distinct approaches to oil and gas regulation - California and Colorado. California's regulations are among the weakest in the nation in terms of breadth and depth, while Colorado's are some of the most stringent, providing a variety of contexts for analysis. Using a web-based survey, I explore the ways in which institutions work together to effectively leverage their resources to influence decision-making at the grassroots level. Survey questions address the types of communities the organization sought to engage; the methods they employed to engage those communities; the perceived efficacy of those methods; what types of organizations they collaborated with, if any, and how frequently; and key demographic data such as the size of the available resource base (e.g., finances, employees). I located survey recipients via web searching and snowball sampling. The survey was distributed first in California (n=334), in October 2018, and then in Colorado (n=313) in November, 2018. Response collection is ongoing; at present, I have a list of 352 organizations in California and 314 organizations in Colorado with response rates of 14% and 15%, respectively.

Preliminary results from the survey responses suggest that despite reporting distinct barriers to participation in marginalized communities, advocacy organizations do not alter their tactics in these communities. But, I find that advocacy organizations that collaborate with a broad range of organizations (e.g., unions, faith groups) are more successful than those that collaborate with a homogeneous group of organizations, regardless of whether they specifically mobilize marginalized communities or not.

### **Comparing network approaches to identifying online echo chambers**

Ella Guest<sup>1</sup>

<sup>1</sup>University of Manchester

What makes an 'echo chamber'? It can be most neutrally theorised to be a space in which like-minded people communicate with each other about a topic on which they agree. Importantly, an echo chamber, must also exclude people with dissenting opinions. From a network perspective this might present as a dense clique, loosely connected to the rest of the networks, or as a completely disconnected component. There has been much theorising within the social sciences and communications studies about the potential issues such online echo chambers have for public discourse. However, to date there has been little empirical evidence of the extent to which echo chamber exist on social media platforms, which would be vital to understand before we can address any societal problems. As such, this research seeks to understand the extent to which echo chamber behaviours exist on a single, discussion-based online platform - Reddit.

Reddit is organised into topic-based communities, called subreddits. Within subreddits users post content about the given topic, either links to other sources or first hand text, and users comment of the posts. Reddit has the most open data sharing policy of any leading social media

platform. Thus Reddit provides a unique opportunity to study the complete network of a social media platform. Using the comments made on all publicly subreddits we can map the ties between all subreddits. By using comments we can infer two typed of ties between subreddits. Firstly, co-authorship - the number of users who comment in both subreddits. Secondly, semantic - the amount on text-based content overlap between two subreddits. By distinguishing between author overlap and content overlap I can account for users filling different roles and different personae in different subreddit cultures. Framing subreddits separately as constituting of a) a group of authors and b) a body of text allows us to determine whether there are significant divergences in patterns of users and pattern of content, particularly as they relate to the phenomenon of echo chambers.

But why focus on between subreddit ties, vs within subreddit ties? Previous research has found that subreddits may substantively appear to fit definitions of echo chambers may in fact not fit empirical standards for 'echo chamber-ness'. In particular, 'The\_Donald', a subreddit for supporters of President Donald Trump, actively remove users who post content critical of Trump. However, within the subreddit this has not been shown to greatly change the attribute of users who choose to comment there. As such, the research presented here extends the working definition of an 'echo chamber' from focusing on the individual-subreddit level to identify cliques or clusters of highly overlapping subreddits that may exist as 'meta echo chambers'.

### **Comparison of country-level network exposures on the adoption of multiple WHO treaties**

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*Background.* To address the public health epidemic of tobacco smoking, the World Health Organization (WHO) Member States negotiated and unanimously adopted the WHO Framework Convention on Tobacco Control (FCTC), an international treaty aimed at reducing tobacco use. Throughout the negotiation and ratification process, an online forum for communication and information exchange about tobacco control, called the GLOBALink (GL) network, was available to anti-tobacco control advocates representing the 193 participating countries. The purpose of this online network was to assist in facilitating the adoption of the FCTC treaty. Previous research has shown that a country's likelihood of either signing or adopting an international treaty can be directly associated at various levels with peer effects and political signaling in both political and economic networks. Moreover, in the case of the FCTC treaty, earlier analyses provide evidence indicating that higher levels of exposure to countries adopting the framework had a positive and significant effect in the likelihood of a country adopting the FCTC. In this presentation, we will show new research analyzing country-level network influences on another WHO treaty, a non-tobacco-related "comparison treaty", that addresses the lowering of worldwide pollution levels (POLLUTE). These two treaties have spread internationally over similar time periods and at approximately the same rate. We hypothesize that social networks arising from GL influenced FCTC adoption, whereas other non-GL networks (e.g., international communication and trade networks) did not. Additionally, we hypothesize that these other non-GL networks will be associated with adoption of the other treaty, but will not be associated with FCTC adoption.

*Methods.* Using GL networks, and in particular: (1) GL interest group co-subscriptions, (2) GL membership referrals, and (3) GL communication networks, and non-GL networks, including: (1) international trade, (2) international of trade of tobacco-related products, (3) international communication, (4) geographical proximity between countries, and (5) bilateral aid-flow networks, we calculated exposure levels with respect to the adoption of the two aforementioned treaties (FCTC and POLLUTE), which we then used to estimate lagged logistic regressions models

in order to measure the effect size (if any) of exposure over adoption rates, i.e., a network diffusion model.

*Results.* Network lagged exposure effects were significant for the geographic proximity network (AOR=0.0004,  $p<0.01$ ) in terms of estimating likelihood of FCTC adoption. For the adoption of the POLLUTE treaty, the geographic proximity network (AOR=0.003,  $p<0.01$ ) and GL interest group co-membership network (AOR=0.2,  $p<0.05$ ) showed significant exposure effects.

*Conclusion.* These findings do not support our primary hypothesis that the GL networks were associated with FCTC adoption. Higher exposure via the geographic proximity network (i.e., countries closer in distance), however, did have a significant negative effect on the adoption of the FCTC and POLLUTE treaties. Despite null findings, this study utilizes a unique longitudinal dataset containing passive measures of multiple “behaviors” (treaties) and multiple networks, and provides a comparison and contrast of treaty exposures not typically available in international relations studies.

### **Complicating Racial Identification: External Racial Classification in Adolescent Friendship Networks**

Paulina Inara Rodis<sup>1</sup>, Diane Felmlee<sup>1</sup>

<sup>1</sup>Pennsylvania State University

Previous research suggests that we are likely to have friends who are similar to us (homophily) on any number of characteristics, including race and ethnicity. However, research in selective preferences often focuses on only one measure of race (usually self-identified race) and recent scholarship in racial classification suggests that there is no one perfect way to measure race; instead there are many different ways to measure race. Same-race friendships do not necessarily mean that the race we believe someone else to be (external classification of race) is the same as our friends’ own identification (self-identification of race). Is racial homophily in friendships significant when accounting for both internal and external racial identification processes? In this study, I illustrate how patterns of both self-identified and externally classified race help explain friendship networks.

To examine the process of racial identification on adolescent friendship selection, this study utilizes social network data from the National Longitudinal Study of Adolescent Health (Add Health). I explore patterns of racial identification and selective mixing within adolescent friendship networks in a diverse school sample located in a metropolitan area. In addition to a large school sample, I also test three other schools with varying levels of diversity to understand how two measures of race may manifest differently depending on the racial and ethnic composition of the school network.

Using exponential random graph modeling (ERGMs), findings show that even when utilizing two notions of race, the tendency to choose same-race friendship (racial homophily) is still common. The majority of reported friendships in the network are intraracial, thus, there is a strong observed tendency to nominate individuals of the same race as friends. This pattern remains true when considering both self-identified and externally classified racial measures. Friends choose same-race friends when considering both how friends’ self-identify and how they themselves might classify their friends.

The strong influence of external classification of race even when controlling for self-identified race suggests that these two components separately influence the presence of intraracial and interracial friendships.

In exponential random graph models analyzed here, significant and positive coefficients for Homophily based on Externally Classified Race suggests that students are likely to select friendships based on the external classification of another’s racial identity even when accounting

for other controls. Further, individuals who are externally classified the same race are likely to select one another as friends. Therefore, friendship preferences based on externally classified racial identities is a significant process among adolescents, supporting the main hypothesis.

It is hard to over-estimate the importance of race in American society. Cultural impulses to classify one another's racial identities are instantaneous and often go unquestioned. As one of the few studies using a separate measure of external race in understanding intraracial and interracial friendships, results here show that future studies should take into account the independent processes of internal and external racial identifications.

### **Computational Social Science in "Science" and "Nature": 2017-2019**

Joseph A.E. Shaheen<sup>1</sup>

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The growth of Computational Social Science as a subject that encompasses a variety of disciplines, topics, and methods has seen a dramatic increase over the last period. New entrants into this trans-disciplinary field come from a variety of view-points and interests, and in the process cause (welcome) disruption, a re-questioning of accepted principles, and sometimes down-right theater. In this session, I hope to summarily cover some of the more salient themes of Computational Social Science development concerning the study of networks with a focus on the last 2 years of issues from "Science" and "Nature" journals, parsed manually.

Given time and space, I'll share a rudimentary meta-analysis of the articles and authors published in those two top ranked journals in this arena. The session should be of interest to scholars who need to be informed about developments in the field especially in top general interest journals, but cannot dedicate the necessary time to search, find, and digest all relevant publications, or those who are curious about the direction of this ever-expanding field.

### **Conceptualizing Relationships: An Argument for Disjointed Fluidity**

Jacqueline Joslyn<sup>1</sup>

<sup>1</sup>University of Arizona

In an effort to help reconcile the relational sociological a critique of social network theory and analysis, this paper advances the concept of disjointed fluidity to explain relationships in terms of remembered and imagined events. Disjointed fluidity is an extension of the symbolic interactionist tradition, particularly the work of Mead and Cooley. Its contribution and assumptions are firmly situated within the relational sociology literature and is softly associated with actor-network theory. I use this paradigm to introduce the notion of the "lingering effect," or the effect of remembering relationships during a loss or absence. I also examine the significance of the imagination in constituting directed, one-way ties. I discuss the potential value of disjointed fluidity in theoretical and methodological integration of the actor-network and relational sociological streams as well as its promise for breaking down the walls between other subfields in sociology. As a paradigm, disjointed fluidity provides a more unifying answer to the question: What is a relationship?

**Confidant Ego-network and remuneration: what effect of social comparison on pay perception?** / Réseaux de confidents et rémunérations : quels effets de la comparaison sociale sur la perception des rémunérations ?

Elise Penalva-Icher<sup>1</sup>

<sup>1</sup>Université Paris-Dauphine, PSL research

This communication addresses the question of ego-network to remuneration packages. Remuneration has undergone complexification and rationalization for several decades. Indeed,

wages and bonuses have for a long time been subject to calculations that are supposed to predict the behaviour of employees, and more particularly to motivate them. However the dense literature in agency theory has shown that these predictions do not always turn out to be true. In addition, remuneration packages have also recently become more complex and individualized, making it harder to read and understand for employees. As a consequence, they have less and less benchmarks in terms of reference groups to evaluate their own salaries. Unpredictable phenomenon makes inequality and injustice even harder to accept. What about wages? What are the consequences when an individual cannot properly understand what he or she earns and why? What if his or her pay slip does not fit in with his or her perceptions?

This paper focuses on remunerations by shedding light on the way they are collected by employees, especially when they compare to peers. This comparison raises questions such as: is my pay comparable or even sizeable to what my colleague, my neighbour or my former classmate earns?

While peer effects and relative frustration are well-known in social sciences, there is more to say about their relational settlement. Investigate this relational part necessary calls for a definition of fellowship, that is expressed in and by work and through relational wages comparison. Do I earn the same as those doing the same job? for a same effort? diploma? seniority? with a comparable social destiny? All these questions are constantly submitted to and by the employee during the process of evaluating his or her compensation.

We rely on a mixed methodology based on qualitative and quantitative tools and social network analysis (110 semi-directed interviews and a survey of managers, n=1195). We rely on the network of confidants as used in Alexis Ferrand works. During the survey, we have collected information on ego-networks (direct and undirect contacts) to be able to understand how remuneration satisfaction depends on the discussion about money individuals maintain with their contacts.

In terms of results, a general rule of relational comparison is released. The more I compare myself, the more I am dissatisfied. But, the more cases of possible comparisons, the less dissatisfaction is. This rule highlights a non-linear link between pay satisfaction and size of the personal network. The traditional relational patterns of monad, dyad and triad also have their own effects. For example, dyads are places of trust. Other structures such as family networks, structural holes or networks of co-workers are also analysed. At last, we compare ourselves with equal or superior co-workers, never with subordinates and there are cumulative inequalities related to relational comparisons, especially for women.

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Cette communication aborde la question de ce que font les réseaux personnels à la perception des rémunérations. Depuis plusieurs décennies, les rémunérations se sont complexifiées et rationalisées. En effet, les salaires et les primes font depuis longtemps l'objet de calculs censés prédire le comportement des salariés, et plus particulièrement les motiver. Cependant, la littérature en théorie de l'agence a montré que ces prédictions ne se révèlent pas toujours être vraies. De plus, les systèmes de rémunération sont récemment devenus plus complexes et individualisés, ce qui rend leur lecture et compréhension plus difficiles pour les salariés. En conséquence, ces derniers ont de moins en moins de points de repère en termes de groupes de référence pour évaluer leurs propres salaires.

Cette présentation met en lumière la manière dont les rémunérations sont perçues par les salariés, notamment en comparaison d'avec leurs pairs. Cette comparaison soulève des questions telles que : mon salaire est-il comparable à celui de mon collègue, de mon voisin ou de mon ancien camarade de classe ? Bien que les effets des pairs et la frustration relative soient bien connus en sciences sociales, il y a encore beaucoup à dire sur leur fondement relationnel. Enquêter sur cette nature relationnelle nécessite de se donner une définition des pairs, qui est exprimée dans et par

le travail, notamment par la comparaison relationnelle des salaires. Est-ce que je gagne le même salaire que ceux qui font le même travail ? pour un même effort ? diplôme ? ancienneté ? avec un destin social comparable ? Toutes ces questions sont constamment adressées à et par le salarié au cours du processus d'évaluation de sa rémunération.

Nous nous appuyons sur une méthodologie mixte reposant sur des outils qualitatifs et quantitatifs et sur l'analyse de réseaux sociaux (110 entretiens et une enquête par questionnaire auprès des cadres, n=1 195). Nous nous utilisons la notion de réseau de confidents notamment développée dans les travaux d'Alexis Ferrand. Au cours de l'enquête, nous avons collecté des informations sur les réseaux ego-centré de cadres (contacts directs et indirects) afin de pouvoir comprendre comment la satisfaction de la rémunération dépend des discussions sur l'argent que les individus entretiennent avec leurs contacts.

En termes de résultats, une règle générale de comparaison relationnelle est mise au jour. Plus je me compare, plus je suis insatisfait. Mais, plus il y a de cas de comparaisons possibles, moins il y a d'insatisfaction. Cette règle met en évidence un lien non linéaire entre la satisfaction à l'égard de la rémunération et la taille du réseau personnel. Les structures relationnelles traditionnelles de la monade, de la dyade et de la triade ont également leurs propres effets. Par exemple, les dyades sont des lieux de confiance. D'autres formes structurales telles que les réseaux familiaux, les trous structuraux ou les réseaux de collègues sont également analysées. Enfin, nous nous comparons avec des collègues égaux ou supérieurs, jamais avec des subordonnés et il existe des inégalités cumulatives liées aux comparaisons relationnelles, en particulier pour les femmes.

### **Connections Result in a New Protest Cycle: Social Movement Organizations' Networks After the Fukushima Nuclear Accident**

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Since the Fukushima nuclear accident in 2011 (3/11), Japan witnessed a nationwide upsurge of antinuclear demonstrations and protests against diverse concerns. The spread of large-scale demonstrations across multiple social and political issues is regarded as a 'new protest cycle' by contrast with the former 35-year 'ice age' of social movements. However, the exact mechanism that caused this change in civil society has not been well explored. Given the limited number of first-time participants, this phenomenon can be fully explained only through an analysis of network-building processes among social movement organizations (SMOs).

Based on the first nationwide survey on SMOs conducted in Japan by our team in February 2018, which covers 308 groups, we analyzed the constellation of the SMOs' networks after 3/11, their logic of coalition building, and their network effects on mobilization.

We observed that the new characteristics of the constellation of the SMOs' networks are twofold. The first feature is that networks of various SMOs were bridged by nuclear groups. Antinuclear organizations served as the hub of SMOs' networks, which enabled the mobilization to cross different concerns. The second feature is the connections between the groups established after 3/11 and the labor unions. Labor unions increase participation in the events by mobilizing their partner unions. Both new connections contributed to the upsurge in large-scale demonstrations for various concerns after 3/11. Our paper adds value to the general discussion of the relationship between the coalition of SMOs and mobilization.

**Considering transitivity and leveraging text content to assess balance in directed networks**Ly Dinh<sup>1</sup>, Rezvaneh Rezapour<sup>1</sup>, Lan Jiang<sup>1</sup>, Jana Diesner<sup>1</sup><sup>1</sup>University of Illinois Urbana Champaign

A wide range of networks research has incorporated structural balance as both a theoretical and an empirical foundation to explain various social processes, including attitudes, beliefs, sentiment, and trust. Structural balance originates from Heider's cognitive consistency theory (1946), which postulates the drive for any social relationship to lessen tension and maintain a balanced state. The theory has been expanded in various ways, including Cartwright and Harary (1956)'s introduction of signs for undirected networks, in which (+) sign denotes positive links and (-) denotes negative links. Since then, structural balance has often been empirically tested for undirected networks. However, many real-world networks are directed. To address this missing piece, we aim to incorporate directionality into the testing of structural balance by establishing transitivity as an additional condition for balance. Using the triad census, we develop eight triad types, of which four are balanced and transitive conditions, and four are unbalanced and intransitive conditions. We report on our findings from labeling edges in three empirical networks based on sentiment, morality, and perceived trust to uncover the balance and transitive dynamics of these real-world, directed networks. For our experiments, we use two email datasets and one social network dataset constructed from surveys of 31 decision-making teams.

To label edges in email networks with a sign that represents sentiment (+ or -), we domain-adjusted and applied the MPQA subjectivity lexicon developed by Wilson and colleagues (2005) to syntactically disambiguated email content. We labeled each email with the dominant sentiment class. Similarly, to label edges in email networks with a sign that represents morality (virtue or vice), we leveraged the Morality Foundations Dictionary created by Graham and colleagues (2009). This dictionary consists of words that represent five basic moral principles and one miscellaneous category that characterize opposing values (virtues and vices) based on the Moral Foundations Theory. Since the original lexicon is limited in size (N= 324 entries) and not syntactically disambiguated, we expanded and syntactically disambiguated the entries. We labeled each email with the dominant tendency. For email data, analysis is under way. We hypothesize to see a diverse profile of triad types with higher instances of transitive and balanced triads, given the professional nature of corporate-level email communication.

To compute balance for the trust networks, we identified all triads associated with each team. We use a positive edge sign to denote directed trust, and a negative sign to represent distrust. There are eighteen four-person groups, with eight triads contained in each group. For the 13 eight-person groups, there are 112 triads in each group. Balance analysis revealed that most triads fall under two main types of balanced and transitive states: (A2) A friend of an enemy is an enemy, and (A3), an enemy of a friend is an enemy.

We will compare results across the three empirical networks and examine how networks differ with respect to balance when also considering directionality. This work also expands and tests the theoretical foundations of balance theory.

**Contact-formation Mechanisms for ERGM Reference Measures with Local Dependence**Carter T. Butts<sup>1</sup><sup>1</sup>University of California, Irvine

Prior work by Krivitsky, Kolaczyk, and others has shown conditions under which ERGMs will produce "stable" behavior of certain local statistics (e.g., mean degree and edgewise reciprocity) as the number of vertices becomes large. Model families satisfying these conditions are often robust and realistic choices for modeling pooled networks of varying size, when performing extrapolative simulation, or when modeling networks with endogenous vertex dynamics. More

recently, it has become clear that these conditions are equivalent to the use of specific classes of reference measures in the ERGM specification, with the reference measure determining the "baseline" behavior of the network model in the hypothetical limit as all model coefficients approach zero. Work by Butts (2018) has shown that these reference measures can themselves be interpreted as specifying the entropy associated with a single graph "microstate" arising from the action of unmodeled degrees of freedom: i.e., they can be understood as corrections for the action of unobserved dynamic processes that provide more ways to obtain certain networks than others. In particular, a simple baseline model in which vertices migrate within a set of foci and ties can only be formed between vertices occupying the same focus can reproduce the Krivitsky reference measure that guarantees asymptotically constant mean degree scaling. Here, we further extend these results to consider the case of local dependence. We provide a contact-formation mechanism that rationalizes the reciprocity scaling offset proposed by Krivitsky and Kolaczyk (2015), and show how this leads to additional insights regarding expected scaling in different asymptotic settings. We also examine triadic generalizations of the same mechanism, following proposals made for two-path connectedness as a context for tie formation; our results suggest, however, that these generalizations have more subtle behavior than might be anticipated, and that other mechanisms may govern the scaling of higher-order network properties.

### **Contagion vs Interpersonal Influence: Distinguishing Mechanisms of Behavior Change Using Social Network Theory**

Thomas Valente<sup>1</sup>

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This paper articulates the many ways social networks can influence people's behaviors. Four categories of network influences are described: (1) personal network, (2) positional, (3) network level, and (4) individual network-level interactions. Personal network effects are based on data from the individual's immediate contacts (and indirect ones). Positional effects are derived from the individual's position in the network such as being central. Network-level effects are measured using network-level indicators such as centralization or clustering. Interaction effects occur when there is consideration of both the individual and network level measures such as understanding the influence of being in a central position in a centralized or decentralized network. These various network effects are contrasted with contagion explanations which tend to elicit rather simple explanations for behavior change. One conclusion drawn from this review is that when we invoke contagion explanations we give agency to the product whereas when we invoke interpersonal influence explanations we give agency to people and social systems.

### **Contexts and Determinants of Cross-University Collaboration: Extracting and Analyzing Networks from Grant Acknowledgement Texts**

Jared Adams<sup>1,2</sup>, Till Krenz<sup>2,3</sup>, Raffaele Vacca<sup>1,2,3</sup>

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This study examines cross-organizational collaboration among US academic research institutes supported by NIH Clinical and Translational Science Awards (CTSAs). Between 2014 and 2018, over 60 medical research institutions ("Hubs") across US universities have received CTSA funding to promote research that expedites the translation of basic science into improved patient care and community health. In addition to facilitating translational science within each Hub, a major goal of CTSA funding is to encourage inter-university scientific collaboration between different hubs.

We propose to measure and evaluate progress toward this goal by extracting cross-CTSA collaboration networks from grant acknowledgement texts in PubMed publications. Nodes within the network represent CTSA Hubs at different universities, which are cited in grant acknowledgements. Similar to co-citation networks, a link between two nodes indicates that the two Hubs are co-cited by the grant acknowledgment text of the same publications, revealing collaboration between two CTSA Hubs at different universities. These are social and spatial networks between organizations with specific spatial location (the location of the university housing the CTSA hub). We employ (Temporal) Exponential Random Graph Modeling (TERGM) to (1) examine the prevalence of cross-CTSA Hub collaboration and (2) identify determinants of collaboration across the 64 CTSA Hubs between 2014 and 2018. Potential determinants of interest include CTSA Hub location, centrality within the cross-CTSA network, the amount of NIH funding awarded to a given Hub, and the number of years a Hub has been in operation. We also consider a number of organizational characteristics for universities and academic medical programs which house or are otherwise affiliated with a given CTSA Hub. These include USNews and World Report university prestige rankings, global university rankings for international collaborative publications, medical program research and primary care rankings, public versus private university distinction, geographic location and distance between CTSA Hubs, and university and medical program size in terms of student enrollment or number of full-time faculty employed. In addition to assessing the extent to which NIH support has translated into cross-CTSA collaboration, results from our analysis provide more generalizable insights into ways government research funding may be directed to maximize collaboration between different universities and to facilitate the assembly of cross-disciplinary scientific teams that are relevant to the mission of specific government funding agencies.

#### **Contexts from socio-semantic-networks – Analyzing Microblogging Platforms**

Marco Schmitt<sup>1</sup>, Oliver Hohlfeldt<sup>2</sup>, Stella Neumann<sup>3</sup>, Helge Reelfs<sup>2</sup>, Jennifer Fest<sup>3</sup>, Alina Vogelgesang<sup>1</sup>

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Microblogging platforms (like Twitter or JodelApp) play a major role in the public communication space today. They offer a specific socio-technical context to analyze how relation-based and language-based features of communication create contexts for public communication together and how these contexts shape relational structures and language behavior as well. We analyze the communication patterns around the highly politicized and polarized event of a stabbing supposedly related to migrants in the German city of Chemnitz in September of 2018 to show how semantic framings and story-lines match with relational structures and how both co-evolve in time. We are especially interested in what these structures and their temporal unfolding can tell us about contexts for language behavior in such spaces and how these methods of context identification can be used to find instances of problematic developments. We are especially interested in the way how specific context indicators like hashtags or mentions are used, how wider context is inferred and how context is shaping the co-evolution or interlock of semantic story-lines and the structure of distinguishable network subgraphs. Apart from the expected polarization happening, we are interested in identifying finer grained differences in contextualization to provide a more appropriate socio-semantic network map of an emerging public space. To achieve this, we employ theoretical devices from Register Analysis in Linguistics and Harrison Whites network theory of Identity & Control. The emerging publics will be observed as Netdoms and characterized by the discernible features of their contextual embedding, especially their relation to other publics in time and their styles of story production and identity

formation. Register Analysis will enable us to use field, tenor and mode to pinpoint the language behavior associated with these processes and the appropriate contexts. We analyze unfolding networks between users and story-lines over 4 days and try to follow the identity formation of stories and communities that will dominate the public space and to exemplify crucial features of context for these developments.

The strong alignment of Social Network Analysis and Register Analysis, or more broadly speaking of Linguistics and Sociology generally provides us with the chance to advance socio-semantic approaches to map the culture-structure interlock in multiple ways. First, we will be able to deduce context from noisy data through the combination of different lenses in a kind of forensic methodology. Second, we will achieve a much better understanding of the role of context in structuring practices and the resulting relational structures for a variety of social phenomena. A finally, concerning the case, especially interesting us here, we will get a more comprehensive and detailed picture of the unfolding of relationally structured socio-semantic public space that helps us to identify contexts of concern and heightened relevance for the public debate.

### **Copula-Based Models for Imputation of Sampled Networks**

Aaron Danielson<sup>1</sup>, Mark Handcock<sup>2</sup>, Barbara Lawrence<sup>2</sup>

<sup>1</sup>Simon Fraser University, <sup>2</sup>University of California, Los Angeles

Frequently, networks are sampled, revealing a fraction of the social structure of interest. But, social scientists have an interest in the analysis of the entire system. Often this analysis is foregone in the hope that the sample is representative of the population. Of course, this need not be the case. The nodes or dyads comprising the network may not be sampled randomly. Even when units are sampled randomly, their decisions to respond may depend on features of the underlying social structure. Simply put, sampled nodes may decide whether or not to respond to a network survey based on the decisions of other nodes to whom they are connected. In cases like these, the results derived from samples of networks need not be indicative of patterns in the population. One strategy to avoid these complexities is to model the network formation and survey responses processes jointly. This method removes bias in parameter estimates of the network formation process associated with the non-ignorable missing data mechanism. With parameters in hand, we can sample imputations for the missing dyads. Existing multiple imputation techniques suggest how one might average results derived from the imputations.

We develop a method to generate imputations for unmeasured dyads when the dyads are missing as a result of a non-ignorable missing data mechanism. A novel model for directed networks, called Copula Generated Random Graphs (CGRG), is introduced. Unlike exponential random graph models (ERGM), there is no intractable normalizing constant so that samples from the posterior distribution can be drawn without complicated sampling schemes. Unlike Additive Multiplicative models (AME), the model does not posit complicated latent structures. Since the response decisions of sampled nodes depend on the response decisions of their alters, we bind the marginal propensities to respond to the survey with a copula. Models for response decisions with weak and strong dependence are introduced, and their relative merits are compared. This contribution has applications that extend beyond the network sampling framework. Exponential random network models (ERNM) provide a framework to represent network formation and random variables on the nodes simultaneously. Copula Generated Random Networks (CGRN) can model network formation and random variables on the dyads or nodes without the use of Markov Chain Monte Carlo Maximum Likelihood methods. It can be used to model binary or continuous measures on nodes that depend on network structure. The utility of this method is demonstrated in some simple examples.

Our model is motivated by a network survey of a large organization in Southern California. Nodes were randomly sampled to participate in an extensive survey. Approximately 70% of sampled egos responded to the survey. However, the response decisions of sampled nodes were discovered to be correlated. We apply the method to the data and impute the values for missing dyads. We assess the quality of the imputations. Then we demonstrate how to combine social network analysis over the set of imputations.

### **Core discussion networks in Poland and America through the lens of Exponential-family Random Graph Models applied to egocentrically sampled data**

Michal Bojanowski<sup>1</sup>, Pavel Krivitsky<sup>2</sup>, Martina Morris<sup>3</sup>

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People discuss certain important topics only with selected group other people. Members of these "core discussion networks" are probably very close and trustworthy. World Value Survey statistics on interpersonal trust report that around 40% of Americans agree with the statement that "most people can be trusted". This percentage in Poland is around 20%, the lowest among the countries in European Union. Do the two countries differ in terms of with whom the people tend to discuss important matters? We pose the question about the structure of core discussion networks in Poland and America -- what are the important factors explaining why certain discussion ties are but some others are not. We address this question by analyzing data from (American) General Social Survey and Polish 'People in networks' survey. Using Exponential-family Random Graph Models fitted to egocentrically-sample data we (1) evaluate the importance of exogeneous factors such as age, gender, or educational level and endogenous degree-related effects on the structure of discussion networks, and (2) compare the role of these factors in America and Poland.

### **Core Group Detection on Relational Datasets**

Ian McCulloh<sup>1</sup>, Anthony Johnson<sup>1</sup>

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There are often three challenges in locating cohesive communities in social groups. First, there is a need to measure relational similarity among the various actors, second, a schema must be devised to reduce complexity, and finally, a fast algorithm to detect the disparate communities present. In this talk, we propose an integrated approach using Jaccard similarity, irreducible network backbone, and truss clustering to uncover core members of cohesive communities. The approach is demonstrated on a social forum of software developers, social media data, and software binaries. Computational limitations will be addressed.

### **Core-Periphery Decomposition of Online Social Protest Networks**

Ryan J. Gallagher<sup>1</sup>, Brooke Foucault Welles<sup>1,2</sup>

<sup>1</sup>Network Science Institute, Northeastern University, <sup>2</sup>Communication Studies Department, College of Arts, Media, and Design, Northeastern University

Women, people of color, and other disenfranchised individuals leverage the decentralized architecture of social media to weave communication networks that circumvent broadcast media outlets and, instead, collectively crowdsource marginalized narratives to the forefront of public conversations. This networked gatekeeping elevates the often-marginalized voices of activists, citizen journalists, on-the-ground protestors, and ordinary people to the cores of online social protest networks. The concentration of these voices within the network's core unifies narratives that challenge those of the mainstream public. However, the overall reach of their collective voice is determined by the periphery, the collection of individuals at the edge of the network who may only tangentially interact with the core's message. While those within the periphery may

sometimes be derided as “slacktivists,” their collective mass simultaneously amplifies the core’s narrative and reframes it to a wider audience. Understanding the broadcast functions of core-periphery network structures lies at the heart of disentangling the dynamics of how online social protests arise and how they gain momentum through hashtag activism on social media platforms. The alignment of core-periphery network structure with social protest theory has already opened fruitful avenues for studying the digital trace data generated by online social movements. This alignment has been aided by a recent methodological shift in focus within network science from community detection to core-periphery extraction. Core-periphery algorithms are usually grounded in one of two characterizations of core-periphery structure. The first, specified by Borgatti and Everett, states that core nodes connect to one another, peripheral nodes connect to the core, but peripheral nodes do not connect to one another. The second characterization describes core-periphery structure as a nested hierarchy of increasingly dense layers, as in the popular k-cores decomposition method. Although these are mathematically distinct models, “core-periphery” and “k-cores” are still often used interchangeably in the social science literature to describe the same mesoscale pattern. By masking the different assumptions made by different algorithms, this colloquial conflation can result in unexpected results when the assumed structure of the algorithm conflicts with the existing structure within the network.

We assess the substantive consequences of mischaracterization of core-periphery structure in online social protest networks by first developing a taxonomy of core-periphery algorithms based on the structural assumptions they make. Across several types of online social protest networks regarding activism (like #BlackLivesMatter), allyship (like #CrimingWhileWhite), and social support (like #MeToo), we then evaluate how prominently Borgatti-Everett and nested hierarchical core-periphery structures are displayed in practice. Finally, having characterized both the algorithms and networks in terms of their core-periphery assumptions and structures respectively, we assess the severity and repercussions of mischaracterizing core-periphery structure when measuring the reach of online social protest messages. This methodological clarification provides guidelines to scholars of collective collective action, social movements, and hashtag activism for carefully measuring and extracting core-periphery structure, and allows them to more confidently and tightly tie together theories of social protests with their underlying network structures.

### **Corporate Bankruptcy, Reorganization and Director Networks**

Ahmed Eissa<sup>1</sup>, Harjeet Bhabra<sup>2</sup>

<sup>1</sup>Concordia University, <sup>2</sup>Saint Mary's University

When firm performance deteriorates to a point where it has difficulties fulfilling its fixed financial obligations, the firm is considered to be in a state of financial distress. Firms attempt to reorganize and turnaround firm performance through financial and asset restructuring. In order to avoid formal bankruptcy reorganization and its associated costs on both the firm, managers and stakeholders, corporate boards of firms play two major roles with respect to the top management team, first they advise the top management team regarding firm specific and general economic trends, secondly they monitor the top management team and make sure corporate finance decisions are taken to enhance shareholder value maximization. One important element that is gaining interest by scholars recently is the impact of independent director tenure on the effectiveness of board independence which further impacts the advising and monitoring role of independent directors.

We attempt to focus on how director and firm level social capital impacts the likelihood of bankruptcy filing, bankruptcy filing outcome and post-bankruptcy operating performance while taking into consideration individual and group level attributes that might hinder or help the influence of social capital on firm performance. Board Social Capital Theory suggests that directors

through with connections with members of the organization or connections with members from outside the organization can respectively develop internal and external social capital. Extensive links created by directors through board memberships could facilitate the quick collection, processing and diffusion of critical information on business activities or business trends, which is crucial for independent directors in conducting their advising role for the firm. More specifically, we examine weighted degree centrality and utilize the size or the number of links and the weight or duration of a link to examine the social capital of the board and of individual directors. Previous literature has mainly focused on board characteristics, ownership structure and committee membership. Group and individual level attributes could impact the influence board social capital can have on the firm through their influence on how individual directors react to and process new information. One group level factor is shared tenure among directors.

Our empirical findings can be summarized as follows, first, we find that Weighted Degree centrality at the board level increase the likelihood of firm bankruptcy filings. We find that this result is unique for firms with high group longevity using both variability of director tenure and difference in tenure between senior and junior directors. Second, focusing on the weighted centrality of junior and senior director groups, we find that higher weighted degree centrality for junior directors increases the likelihood of bankruptcy filing , while the results are not significant for senior directors. Third, when we take into consideration firm advisory versus monitoring needs we find that weighted degree centrality for junior (senior) directors increase the likelihood of bankruptcy filing for firms with high monitoring (advising) needs. Consistent with the results at the board level, we find that these results are concluded for firms with high group tenure longevity.

### **Creating an urban vocabulary from networked conversations**

Sharon Richardson<sup>1</sup>, Andy Hudson-Smith<sup>1</sup>

<sup>1</sup>University College London

Online social networks contain rich conversations about real-world places and interactions. This study introduces a model that combines natural language processing, machine learning and network analysis to automatically extract spatial topics representing localised people-place experiences. The model is capable of producing topics in near real-time and is robust with even small samples of text. It requires no manual intervention such as the use of word dictionaries, pre-defined topics or labelled data to train the model.

The traditional and most popular methods for topic modelling require pre-defining the number of topics expected to be discovered and/or require language-specific dictionaries. This study takes an alternative approach, converting social media content into a network and using a community detection algorithm to identify clusters of terms shared between messages. It utilises the popularity across social media networks for creating hashtags to identify and promote keywords within a media message. The shared terms, if any, form communities that are then converted into topics. An additional benefit of using network analysis is that it does not require randomisation within the algorithm. The same data will produce the same results each time without requiring a pseudo-random seed. It is also a fast algorithm making it well suited for real-time analytics.

The purpose of the model is to form an urban vocabulary at the neighbourhood scale including linguistic variations detected that correlate with seasonal changes and dynamic contexts. The ability to run the model continuously and in real-time enables it to detect elasticity in language used to express spatial and social interactions. Whilst some terms are stable in use, others are directly associated with contexts and decay over time.

This study presents the results from running the model for eighteen months, monitoring central London. The model has multiple potential applications. It can be used to aid tourism and

marketing, identify how people-place experiences differ across the city and identify shifting opinions about local neighbourhoods and attractions. The ability to run the model continuously can rapidly generate insights into people-place experiences to aid urban planning. Operating in real-time enables the model to include an alerting mechanism for abnormal and unexpected uses of language to assist real-time decisions and interventions.

### **Cross-university network intervention using a targeted topic model**

Christopher McCarty<sup>1</sup>, Giuseppe (Joe) Labianca<sup>2</sup>, Raffaele Vacca<sup>1</sup>, Tom Smith<sup>1</sup>

<sup>1</sup>University of Florida, <sup>2</sup>University of Kentucky

We will present the results from an ongoing collaboration intervention between two institutions with NIH Clinical and Translational Science Awards, the University of Florida (UF) and the University of Kentucky (UK). We will describe networks at both institutions based on publication and grant collaborations and the results of a community detection analysis. Analyses of existing cross-university ties based on actual behavior, such as existing co-authorship and co-investigation on grants, reveal a sparse network as would be expected between any two universities. Using natural language processing and topic modeling on publication and grant titles and abstracts, we are exploring cross-university community detection based on conceptual ties (i.e., topic similarity) rather than behavioral ties (i.e., collaboration) between authors to identify potential collaborators for interventions.

While we are optimistic about the potential for identifying cross-university communities that emerge organically, a different approach is to use topic models to identify enhanced network communities around a specific topic known to be a focus at the two institutions. As is reported in a separate presentation, the bag-of-words model generates very large networks very quickly, much larger than can be processed even with a super-computer. When all works of all researchers at two universities are considered, specific parameters, such as the number of years considered and the number of topics extracted per author, can be modified to make processing the data practical.

A different approach is to constrain the topic models to a pre-defined research area believed to exist at both universities, using the full bag-of-words model for a smaller subset of researchers. This presentation will examine the potential collaborative overlap between two research groups that focus on opioid use, one at UF and one at UK. By focusing on a specific topic we can use a seed word, such as “opioids”, to find a more complete set of keywords and process full abstracts on a smaller set of researchers. We will compare the results from the two approaches.

### **Defining the “Local Education Market”: a Network Cluster Analysis Approach**

Joseph Marr<sup>1</sup>, Tanner Delpier<sup>1</sup>

<sup>1</sup>Michigan State University

Early in the study of school choice, scholars looked to understand intra-market competition and differentiation. They also sought to understand the variability between markets, as widely variable policies intersect with even greater diversity of local contexts (Priestley, Higham, & Sharp, 2000; Taylor, 2001a). To do this, scholars quickly realized the need to define the scope of educational markets for both practical and theoretical reasons (Hesketh & Knight, 1998). Consequently, the local education market (LEM) was introduced to bound the study of educational markets both conceptually and geographically.

Theoretically, LEMs have been defined (though often implicitly) as the set of educational agencies that “compete for a common pool of potential students” (Lubienski, 2007). While this definition makes intuitive sense, its implementation as sampling strategy has been somewhat volatile.

LEMs have been defined differently. Some scholars have used district (e.g. Glomm, Harris, & Lo, 2005; Lubienski, Gulosino, & Weitzel, 2009) or municipal boundaries (e.g. Ahlin 2003; Lubienski, 2006) and others have used a geographic conglomeration of contiguous districts (e.g. Taylor, 2001b; Lubienski, Gulosino, & Weitzel, 2009). Still other researchers have used less definitive boundaries such as a neighborhood (e.g. Bonal, Verger, & Zancajo, 2017) or have used the concept without defining its borders (e.g. Priestley et. al. 2000).

Instead of defining educational markets as the pool of *potential* students, Sirer and colleagues shift the discussion to the *real* movement of students between schools (2015). They re-conceptualize education markets as the network of student flows between schools. We follow Sirer et al. (2015) in asserting that the real flow of students should be the defining feature of a LEM. This project aims to empirically define the boundaries of LEMs across an entire state: Michigan.

#### **Data and Methods**

We observe the full network of student transfers in Michigan from resident district to operating agency at the LEA level from 2010 to 2017.

We adopt social network cluster analysis established by Frank (1995), to generate LEMs and tests for statistical significance. Work from Sirer et al. (2015), who traced student enrollment networks in Chicago Public Schools, is directly applicable. Together, these strategies have the potential to identify relationships between LEAs not easily observed using geographic data.

#### **Significance**

School choice policies have been one of the most powerful features of the 21st century education reform efforts. The concept of the LEM helped scholars study the competition and differentiation within educational markets. Yet, the scale of these analyses--the LEM--has been difficult to operationalize.

When choice policies are geographically restricted, defining a LEM by that jurisdiction is justifiable (Lubienski 2006). If students are free to cross jurisdictional boundaries, however, (as is the case in Michigan) assumptions about the extent of a LEM may be misleading. If the LEM is defined too narrowly, scholars may under-emphasize the interconnectedness of ostensibly disparate education markets; if the LEM is defined too broadly, we may miss-identify the geographically proximal nature of educational markets. We use SNA to try and alleviate these problems.

#### **Defriending: Personal Networks in a Politically Polarized Age**

Mark Pachucki<sup>1</sup>, [Anthony Paik](#)<sup>1</sup>, Hsin Fei Tu<sup>1</sup>

<sup>1</sup>University of Massachusetts-Amherst

Anecdotal news accounts and social science research showing information bubbles and echo chambers suggest that homophily based on political identities is critical for increasing political polarization. Key mechanisms producing political homophily are selectivity in tie formation and differential tie dissolution. In the wake of the 2016 presidential election in the United States, were personal networks impacted by widespread “defriending” based on political identities? This paper examines tie dissolution in personal networks in the context of increased political polarization and racial tension. We employed the UCNets data (n=1,159 at Wave, 2015-2018), a representative data set of 20-30 and 50-70 year olds who were drawn from the six counties constituting the San Francisco Bay Area, to examine tie dissolution in personal networks immediately after the election of Trump. The UCNets study originally generated personal network data via multiple name generators, eliciting alters who were intimate, household, social, confiding, advice, social support, and difficult partners, in late 2015 and early 2016. We then examined tie dissolution immediately following the inauguration of Trump in early 2017. Results provide some support for the defriending hypothesis. Moreover, we found some evidence that

racially and politically homogenous personal networks were more likely to dissolve ties with alters. Despite finding some support for the defriending phenomena, a more consistent finding is widespread defriending of alters of a different race, and this effect was present for all political affiliations. The results suggest that defriending based on politics did occur at the beginning of the Trump's presidency, but also highlight the continuing significance of race in personal networks, a stylized fact almost completely omitted from contemporary narratives about polarization.

### **Detecting changes in social-ecological networked systems using multilevel exponential random graph models**

Michele L Barnes<sup>2</sup>, Peng Wang<sup>1</sup>

<sup>1</sup>Swinburne University of Technology, <sup>2</sup>James Cook University

There is a strong interdependency between (human) social networks and ecological system structures. For example, ecological systems provide critical resources that support human well-being, yet the exploitation of these resources can feedback to impact the social network as well as the overall functioning of the social-ecological system. Multilevel social-ecological network approaches offer a promising way to conceptualize these interdependencies. While we have seen a proliferation of research adopting this approach, how multilevel social-ecological networks change over time in response to internal or external drivers remains unclear. Conceptualizing a coral reef social-ecological system as a multilevel network, where human social networks comprise one level and the natural ecological system comprises the other, we use exponential random graph models to explore potential changes in interdependencies among social and ecological network ties. Social network data was collected among fishers from several clans comprising the population of a small Papua New Guinean island in the years 2016 and 2018, during which time the island experienced continued ecological declines. Ecological network data on fish species was also collected. Exponential random graph models were fitted both within, and across both years to discover the changes in this multilevel social-ecological system. We find no significant cross-level social-ecological effects, suggesting fishers are not organizing or adapting their networks in ways that align with the underlying ecological structure of fish communities. We also find interesting changes in the social system that may pose a risk to the community's ability to halt ongoing declines, such as older fishers whom have presumably accumulated potentially useful ecological knowledge becoming less active and more homophilous. We reflect on the implications of these results and conclude with a brief discussion of the utility and current limitations of dynamic, multilevel network modeling for understanding social-ecological dynamics.

### **Detection of Office and Residence Regions in Bike-Share Networks Using Time-Dependent Stochastic Blockmodels**

Jane Carlen<sup>1</sup>, Cassidy Mentus<sup>2</sup>, Jaume de Dios<sup>2</sup>, Shyr-Shea Chang<sup>2</sup>, Mason Porter<sup>2</sup>

<sup>1</sup>UC Davis Data Science Initiative; <sup>2</sup>UCLA Department of Mathematics

Urban spatial networks are complex systems that reflect the interdependent roles of neighborhoods and the methods of transportation people choose to move between them. Functional neighborhood divisions can be difficult to identify, especially as the number of individual work styles grows and cities evolve from monocentric to polycentric organizing structures. Bicycle-sharing systems represent a rapidly growing component of urban transportation networks. Since 2005, more than 1500 systems worldwide have been established, and many have open data portals that provide rich data on urban mobility.

In this talk, we present a method to classify docking stations in urban bike-share networks according to functional roles. We propose novel time-dependent stochastic blockmodels with degree correction to detect the roles that stations serve and describe the traffic within and between blocks over the course of a day. We consider both discrete and mixed-membership role assignments. Our models produce elegant descriptions of daily usage patterns, which we illustrate through examples in Los Angeles, San Francisco, and New York City. They also reveal how surrounding public transportation infrastructure and land-use designations encoded in zoning ordinances influence the functional roles of bike-share stations. Our work proposes a new community detection layer that can be incorporated in multilayer urban transportation networks. It has direct application to the design and maintenance of bike-share systems, but can also be applied to temporal networks more broadly.

### **Differential Access to Social Capital of Natives and Migrants – A Macro-Structural Explanation of Adolescents' Access to Social Capital in Four European Countries**

Sven Lenkewitz<sup>1</sup>

<sup>1</sup>University of Cologne

This study examines the differential access to social capital of majority and minority adolescents in four European countries (England, Germany, the Netherlands, and Sweden). Following Lin, I conceive social capital as resources embedded in social relations. By analyzing the CILS4EU data, I show that minority adolescents suffer a penalty in social capital – operationalized by the average socio-economic status of adolescents' ego network – in all countries except of England. However, this ethnic penalty largely emerges on the macro-level indicating that students are sorted based on their social origin into different schools, which then constitute the pool of potential peers. The personal networks then reflect the socio-economic opportunity structure to a large extent. This sorting due to ethnic and socio-economic neighbourhood segregation, educational tracking, and parental choice explains the access to social capital of migrants when minority status and SES are correlated as is the case in Germany, the Netherlands, and Sweden. Special attention has to be drawn to the effect of educational tracking: While the school system in Germany and the Netherlands is formally stratified, England and especially Sweden rely on a comprehensive approach. However, also in the latter two countries schools of different quality emerge due to selective sorting of students leading to an informally stratified school system. This informal stratification helps to explain the penalty in these two countries. But, even after explaining between-school variance a small penalty remains indicating that the reduced access of migrants also emerges as a consequence of friendship choices adolescents make within the school context.

### **Discerning group structure from consequential talk: conflict, class, and deference among decision-makers during the Cuban Missile Crisis**

Peter McMahan<sup>1</sup>

<sup>1</sup>McGill University

Communication reveals relations between people. The words we use and the way we use them are acutely sensitive to even the most subtle variations in meaning across relationships, interactions, and social situations. The research presented here exploits this sensitivity to uncover hidden interpersonal structure among the members of U.S. President Kennedy's ad-hoc Executive Committee (ExComm) during the Cuban Missile Crisis in 1962. The research makes two primary contributions. First, it describes a quantitative methodology that identifies relations of deference and dominance based on transcripts of informal conversation. It does so using a nonlinear, Bayesian statistical model of linguistic style that accounts for the adjustment of individuals'

patterns of speech as they interact with one another and with groups. The method comprises a computationally sophisticated tool that is shown to be adaptable to different contexts, including both online and face-to-face interactions.

The second major contribution is substantive. Using transcripts of sixteen recorded meetings of the ExComm, individual linguistic style for each of the sixteen core members is estimated simultaneously with the relations of deference between each pair of members. The result of this analysis is a network of deferential relationships among the committee members describing a near-perfect hierarchy represented in a directed, acyclic graph (DAG). A striking feature of this influence network is its apparent independence from the formal relations of organizational precedence and subordination that existed between the participants. Instead, the revealed hierarchy follows the contours of social class. Family background, employment history, and Ivy League membership define the vertical dimension of the hierarchy rather than formal power or administrative authority. Moreover, the estimates reveal multiple, parallel "lines" of informal hierarchy in the committee's structure. The micro-structure of the network depends primarily on distinct types of relationships—old friends, professional colleagues, or family members. Taken together, the results demonstrate the deep linkage between social and situational categories on one side and the informal, unobserved structure of groups on the other. ExComm provides an ideal case for this work. By studying an elite group of some of the most powerful people in the United States, this work shows that social class remains a salient feature of interaction even among the most narrow slices of the social strata. The decisions being considered by the committee were quite literally life-or-death, but the patterns of influence and the dynamics of decision-making were shaped by the types of relationships between the members and the meaning those relationships held for them. This work underscores how interactions are defined and redefined by multi-level contexts in which they take place. The structure of a group is determined not just by the presence or absence of relations, but by the meaning ascribed to those relations in the moment.

#### **Discovery of socio-semantic networks based on discourse analysis on large corpora of documents.**

Szymon Talaga, [Mikołaj Biesaga](#), Magda Roszczyńska-Kurasińska, Andrzej Nowak

While reading newspapers of different publishers and watching different news channels humans intuitively perceive how different actors are described by different discourse sources. Can we do it in an automated and systematic fashion? Recent advances in natural language processing (NLP) techniques together with the increase of easily accessible computational power make it possible to create new analytic methods for studying socio-semantic systems. Especially, entity recognition methods and advanced part of speech tagging turned out to be crucial for automatic text processing. They allow to not only discover and classify main actors but also to understand semantics which are ascribed to them by content producers.

We propose a novel approach to automated discourse analysis on Discovery of socio-semantic networks based on discourse analysis on large corpora of documents. large corpora of documents which is a combination of four methods: entity recognition methods, topic modelling, sentiment analysis and analysis of syntactic dependencies. This approach allows to identify main actors (entity recognition method) and analyze differences in regard to how they are described (sentiment analysis and syntactic analysis) by different content sources. The differences are described along two main dimensions: semantics and sentiment (emotional valence). This technique makes it possible to discover complex networks of relations between actors and their discursive representations as well as content generating sources.

We present results of an application of the proposed approach to a corpus of texts published in 2017 and 2018 by leading European online magazines such as POLITICO Europe and Euronews English. The scope of the articles was narrowed to issues related to European Union (EU), Europe itself and world affairs as viewed from the European perspective. The main aim herein was to determine crucial actors (i.e. politicians, institutions) present in the discourse and discover how discourse generating actors (i.e. POLITICO Europe, Euronews English) perceive/depict important public figures and institutions over the time period. The analysis is based on English content exclusively, but we will also discuss how this approach might be extended to other languages.

### **Discussant**

Mark Mizruchi<sup>1</sup>

<sup>1</sup>University of Michigan

I have been asked by the organizers to serve as the discussant for one of the panels of papers on corporate networks.

This abstract is related to "Corporate Networks."

### **Disentangling Selection from Influence Effects in Social Networks Using Relational Event Models**

Sebastian Martinez<sup>1</sup>, Philip Leifeld<sup>1</sup>, Laurence Brandenberger<sup>2</sup>

<sup>1</sup>University of Glasgow, <sup>2</sup>ETH Zurich

Social networks are often characterised by homophily, where similar nodes cluster together and interact at higher rates than dissimilar nodes. Homophily can lead to segregated networks and can have negative consequences. Two different social mechanisms can result in something that looks just like homophily: social selection and social influence.

Social selection occurs when nodes have similar preferences and thus engage in a similar manner; social influence occurs when nodes influence (or mimic) each other and become more similar. Statistically, these two mechanisms are hard to distinguish. Both of these mechanisms can present themselves similarly in static social networks. However, some networks include time-stamped data of the exact moment when different events occurred. With this, social influence and social selection can be distinguished when looking at the temporal order of ties forming in a network.

We present a new way of distinguishing selection from influence by examining the temporal order or sequence in tie formation. We argue that in the case of social influence, sender nodes engage with target nodes if other sender nodes with similar observable characteristics engaged with this target node before. This results in event sequences where sender nodes with similar attributes engage with target nodes in a particular temporal order. In the case of social selection, the temporal order of events matters less in comparison, as sender nodes engage with target nodes regardless of who did what before. Instead, connections are made based on their preference for engaging with this specific target node (which they share with other nodes, thus resulting in homophilous clustering in the network).

In our paper we use an agent-based model to simulate event sequences where sender nodes engage with target nodes over time exhibiting homophilous behaviour. The sequences are generated based on a selection mechanism, influence mechanism, or a mix of the two. We run relational event models on the simulated sequences and through temporal permutations are able to distinguish whether if the sequences were generated by a social influence mechanism or a social selection mechanism.

Our results show that the temporal order of events holds important information that can be used to distinguish selection from influence effects in social networks.

**Diversity and disconnectedness in personal networks: The promise and peril of embracing difference in a politically polarized age**Mark C. Pachucki<sup>1</sup>, [Anthony Paik](#)<sup>1</sup><sup>1</sup>University of Massachusetts, Amherst

America is becoming more of a multi-racial society, one home to an eclectic mix of political ideologies, and yet increasingly the political sphere is polarized. These patterns are reflected in individuals' social networks, which can be sources not only of comfort but also conflict. We seek to address a fundamental question that will likely engage scholars of social support and health: "Does segregation in personal networks promote or undermine social connectedness?" In particular, we examine how racial and political diversity within one's personal network are associated with decreased social connectedness, which is expressed in terms of relationship difficulties, feelings of isolation or loneliness, decreased social support from family and friends, and depressive symptoms. Drawing upon a recent survey of 1159 San Francisco-area adults (UCNets), we find a curious phenomenon: that respondents with more politically homogenous networks were more likely to report difficult alters, yet that named alters who had the same politics as the respondent were also less than half as likely to be reported as "difficult people". This suggests some support for our hypothesis that network diversity is associated with the likelihood of having difficult alters, but also surprising, contrary evidence for political network diversity. Moreover, we found that racial network diversity was associated with increased loneliness and depressive symptoms, whereas political network diversity was associated with increased levels of family and friend support. Thus, while we observed mixed support for our initial hypotheses, the findings showed a consistent pattern of findings by the *type* of network diversity. Racial network diversity appears to be linked to feeling disconnected, whereas political network diversity seems to impair the ability to mobilize social support. Of particular interest to us are the possible mechanisms of difficult relationships with alters within one's network, and a sense of control of one's destiny that might explain these associations. We find empirical support for the proposition that these mechanisms are more important than current scholarship has acknowledged. While homophily research tends to emphasize structural underpinnings of segregation, this study shows who benefits from maintaining social homogeneity.

**Do Brokers Gossip Strategically? Investigating Information Sharing and Control in Organizations Using Exponential Random Graph Models**[Tanja Sliskovic](#)<sup>1</sup>, [Károly Takács](#)<sup>2</sup>, [Marko Lucic](#)<sup>3</sup>, [Srebrenka Letina](#)<sup>4</sup>

<sup>1</sup>Hungarian Academy of Sciences, Computational Social Science - Research Center for Educational and Network Studies (CSS-RECENS), <sup>2</sup>Computational Social Science - Research Center for Educational and Network Studies (CSS-RECENS), <sup>3</sup>Croatian Employment Agency, <sup>4</sup>Computational Social Science - Research Center for Educational and Network Studies (CSS-RECENS)

We advance the scholarship on social network brokerage theory and information control. Brokers in social networks connect otherwise unconnected people. Brokerage is a central concept in social network theory and research, since it has been shown to bring an array of benefits to individuals who occupy the brokerage position. Hence, it has been suggested that brokers and not central actors are in a position of control, and ultimately power. Our study tests this assertion by observing how brokers behave and which social information they share in an organizational gossip network. Given their structural position, brokers as well as central actors are likely to receive more social information. If brokers really do control information, the hypothesis is they and not necessarily the central actors are those who share gossip strategically. In order to maintain their brokerage position, we test whether brokers share less gossip, in particular with other brokers

and spread more gossip about them. Using exponential random graph models, on employee network data from six organizational units in Hungary, of size 20-30, we find partial support of our hypotheses dependent on the company context.

### **Does Building Structural Holes Increase Innovative Performance? Evidence from a Field Experiment**

Gianluca Carnabuci<sup>1</sup>, [Eric Quintane](#)<sup>2</sup>

<sup>1</sup>ESMT Berlin, <sup>2</sup>University of Los Andes

Over the past decades, structural holes theory has established itself as one of the most influential theories in the social sciences, spurring fruitful lines of research among management scholars and sociologists. The theory's core argument is that networks that comprise bridging relationships across structural holes enhance employees' innovativeness by exposing them to more diverse information, opinions and behaviors. Consistent with this argument, a sizeable body of literature has found that individuals whose network spans many structural holes display, on average, higher levels of innovative performance than those whose network is more constrained. Recent research has pushed the theoretical development of structural holes theory in two parallel directions. First, researchers have examined the process of *brokering*, that is, the brokerage activities individuals engage in when they occupy a brokerage position (see Halevy, Halali and Zlatev, 2019). Second, researchers have worked on *networking*, the process through which individuals build relationship with others with whom they have no prior direct or indirect connections (Casciaro, Gino and Kouchaki, 2014; Ingram and Morris, 2007; Sosovova et al, 2010; Vissa, 2011). While networking is in many cases a necessary condition for brokering, i.e., individuals need to build structural holes in order to occupy a brokerage position, it is not clear whether the networking activity is beneficial in itself, beyond being a first step in creating a brokerage position. That is, does creating bridging relationships with new and unconnected alters increase one's innovative performance, irrespective of one's brokerage position? Relatedly, do the individual traits and characteristics that help individuals create new structural holes also help them leveraging these structural holes for value.

We carried out a longitudinal field experiment in the Italian subsidiary of a large US-based electronics company as part of a 2.5-year long research project. We measured the social networks of all employees, as well as their innovative performance ratings as assessed by their direct supervisors, both before and after a "treatment" – a day of executive education aimed at increasing participants' tendency to broker structural holes – to which a randomly selected subset of employees was assigned. We estimated, first, the effect of the randomly assigned treatment on employees' likelihood to generate new structural holes after the treatment and, second, the effect of the treatment-induced bridging ties on employees' subsequent innovation performance. We examined the resulting data using two modeling approaches – causal mediation analysis (Imai et al., 2010) and instrumental variables estimation (Angrist and Krueger, 2001) – and obtained consistent results. We demonstrated that forming bridging ties across structural holes causes employees' innovative performance to increase and that individual-level traits (Gender, personality and cognitive style) affect employees' ability to form versus leverage bridging relations in very different ways. Because the treatment was assigned randomly, our results can be safely interpreted as evidence that there is a causal relationship between forming bridging ties across structural holes and an increase in employees' innovative performance.

**Does prejudice contribute to ethnic segregation in social networks? Effects of outgroup attitudes on interethnic friendship among ethnic majority and ethnic minority youth in Germany**

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Ethnic and racial segregation is one of the biggest issues multiethnic societies are confronted with. However, whereas the overrepresentation of social ties among members of the same ethnic origin is well established in the research of social networks (cf., Wimmer and Lewis 2010), less empirical knowledge exists about the conditions of social ties across ethnic boundaries to be formed and maintained.

Building on Allport's (1954) contact hypothesis, several studies revealed interdependencies between interethnic attitudes and interethnic contact (Brown and Hewstone 2005; Pettigrew and Tropp 2006; Binder et al. 2009; ten Berge, Lancee, and Jaspers 2017). However, these studies rely on regression analyses and do not consider the complexity and the dynamics of social networks (Snijders, Van de Bunt, and Steglich 2010). The aim of our study was to take in a social network perspective and to examine whether interethnic attitudes of adolescents affect their decisions to nominate friends across ethnic boundaries. Besides testing the general relationship between interethnic attitudes and interethnic friendship, we also compared the effects of attitudes towards different outgroups on the likelihood to befriend members of these groups. We also tested whether effects of attitudes on friendship differed between ethnic majority and ethnic minority youth.

We used sociometric data from the longitudinal CILS4EU study (N = 1,381 students from 67 school classes) (Kalter et al. 2014) to re-construct the friendship networks of secondary school students in Germany. Outgroup attitudes were measured using a feeling thermometer. Respondents were asked to indicate their feeling about a specified group on a 100-point scale, ranging from negative (0) to positive (100), with intervals of ten points.

We applied Stochastic Actor-Oriented Models (SAOM, Snijders, Van de Bunt, and Steglich 2010) and made use of a random coefficient multilevel approach that was only recently developed to analyze stochastically independent groups (in our case, classrooms). This approach is implemented in RSienaTest using a Bayesian estimate procedure (SienaBayes).

Our models contained dyadic effects reflecting the ethnicity of pairs of students (e.g., "majority-majority", "majority-Turkish", "Turkish-majority" etc.). We focused on the three largest ethnic origin groups in Germany, namely ethnic majority students, students of Turkish origin and students of Polish origin. We tested possible effects of outgroup attitudes on interethnic friendship by examining interactions between intergroup dyad effects and outgroup attitude effects.

In line with existing studies, our preliminary results revealed that interethnic friendship was less likely than friendship among students of the same ethnic background. Among ethnic majority students and students of Polish origin, outgroup attitudes were unrelated to the likelihood of befriend outgroup members. Students from Turkish families, however, did befriend students of Polish origin more often when they had more positive attitudes towards this group. Furthermore, Turkish-background students with more negative attitudes towards "Germans" befriended ethnic majority students with a higher probability. The results are discussed in terms of the possible reverse causation between interethnic friendship and interethnic attitudes.

### **Dynamic Network Representation of Text as Narratives and Visualization of Character Interactions**

Juyong Park<sup>1</sup>

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Human communication is often executed in the form of a narrative, an account of connected events composed of characters, actions, and settings. A coherent narrative structure is therefore a requisite for a well-formulated narrative – be it fictional or nonfictional – for informative and effective communication, opening up the possibility of a deeper understanding of a narrative by studying its structural properties. In this paper we present a network-based framework for modeling and analyzing the structure of a narrative, which is further expanded by incorporating methods from computational linguistics to utilize the narrative text. Modeling the narrative as a dynamically unfolding network, we characterize its progression via the growth patterns of the character network, and use sentiment analysis and topic modeling to represent the actual content of the narrative to track the impact on the actions and the trajectories of characters as a result of interactions with other characters. The dynamics of the changes in the characters' states defined by the associated words can be visualized as an interaction map consisting of character trajectories that show the exchanging of sentiments and keywords. This network framework allows us to understand and visualize how progressing narratives affect the characters and guide their future actions, which is significantly more realistic and useful, unlike simple occurrence-based network analysis that allows only an aggregate understanding of static, average characteristics. Given the increasing ubiquity and importance of textual information on conversations and interaction, such network-based representation and analysis framework for narratives may lead to a more systematic modeling and understanding of social interactions, expression of human sentiments, and communication.

### **Dynamic Networks of Technological Collaborations: Impact of Globalization and China on Semiconductor Firms in Taiwan**

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The semiconductor industry in Taiwan has built a stable field of interorganizational networks and successfully upgraded since the 1990s, including complete supply chains, international and domestic technological collaborations. Although there are abundant studies showing the network pattern of Taiwan's integrated circuit companies, there have been lacking researches on how patterns of technological collaborations vary with the uncertainty of global and China markets. The 2008 financial crisis and the rapid development of China's semiconductor industry supported by the government have increased the uncertainty of the marketplace. This paper has two purposes. The first aim is to describe the changing status of semiconductor firms in technological collaboration networks, and the other aim is to investigate different patterns of global tactics in these collaboration networks, before and after the alterations of markets and institutions in 2008.

This research collected 3200 technological collaboration contracts from thirty-five listed semiconductor companies between 2000 and 2017. We coded relations between these listed firms and global firms distributed among 6 geographical regions annually from contracts. Using the measurement of social capital to indicate the status of firms in technological collaboration networks each year, we constructed five variables for a firm level of analysis: regional diversity, embeddedness, status in the collaboration networks, organizational characters, and age of firms. To measure firms' status, we created "status score" to capture entities' status signals in the global market. This research has two findings: (1) Stable collaborations have been broken given the fast development of the mobile device and the artificial intelligence technology. Countries owning

these new technologies, such as China and England, have become popular partners of the IC industry in Taiwan. (2) Under the highly uncertain environment, the market status has been an important signal to build a partnership.

### **Dynamic overlapping community detection with node attributes**

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Networks can be extracted from a wide range of real systems, such as online social networks, communication networks and biological systems. Detection of cohesive groups in these graphs, primarily based on link information, is the goal of community detection, which can give insights on decision and policy making. The identification of groups in networks have been applied in areas such as e-commerce, fraud detection and disease propagation. Community structures emerge when a group of nodes is more likely to be linked to each other than to rest of the network. The modules found can be disjoint or overlapping. In the disjoint case, each node can belong to only one community. In the overlapping case, a node can be a member of several communities. Another relevant feature of networks is the possibility to evolve over time. Furthermore, nodes can have valuable information to improve the community detection process. Hence, in this work we propose to design a soft overlapping community detection method for static and dynamic social networks with node attributes. Our approach is based on a Bayesian nonnegative matrix factorization generative model that uses automatic relevance determination to detect the number of communities in the network, which is always a challenging task in community detection, moreover in the case of temporal networks. A gradient descent method based on multiplicative update rules is used to optimize the model, resulting in the detection of the overlapping communities. Results on toy and synthetic networks are promising.

### **Dynamics and stability in ego-centered network data**

Marina Hennig<sup>1</sup>

<sup>1</sup>Johannes Gutenberg University of Mainz

I am conducting an inquiry into the evolution of ego-centered networks over time and how they are affected by panel members' socio-demographic characteristics.

Data basis are the 2011 and 2016 survey waves of the socio-economic panel in Germany. The dataset contains 13,350 respondents who were between 23 and 101 years old at the time of the 2016 survey.

In 2011 and 2016 five identical name generators were used, each with five possible mentions. These included talking about important things, help with career advancement, help with long-term care, with whom one occasionally has disputes and who is allowed to tell unpleasant truths to the respondent. To characterize the persons within the network, only the relationship type was available. Nevertheless some measures could be calculated from this, such as the IQV of the relationship context, the network size and the proportion of family members. In my presentation I will first discuss the stability in the individual relationship types, as well as changes in the supportiveness of the network. Subsequently the influence of respondents' sociodemographic characteristics on structural properties of networks between 2011 and 2016 will be analyzed.

**Dynamics of conflict resolution through emotions and ego-networks: '12 Angry Men'**

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<sup>1</sup>Carleton University, <sup>2</sup>Ahmedabad University

Conflict resolution is a multi-level process where a single emotion does not guide a network of interactions. The individuals who are engaged in conflict resolution cannot be segregated just on positive and negative interactions within the network. Each stage has multiple interactions where the domination of particular behavior leads to a change in positions or opinions. To map such interactions involves social network analysis through a qualitative approach. In the real world, information of such interactions is challenging to observe thus movie '12 Angry Men' is analyzed. According to the Library of Congress, USA, '12 Angry Men' culturally, historically and aesthetically represents one of the best courtroom drama situations. The movie includes more than 850 interactions among 12 jury members in 96 minutes over a murder trial. Through the qualitative analysis of script, interactions are mapped considering the nature of their positive and negative behavior and ego-network diagrams. Longitudinal study leads to understanding the changing behavioral patterns of the ego-network in 5 different phases. It also represents the importance of influence and use of various emotions for successful conflict resolution. Detailed analysis of dominant emotions, network dynamics and its impact on conflict resolution provides insight into the effective conflict resolution mechanism through social network analysis tool.

**Effects of Immediate Family Members' Deaths on Relationships Among Siblings in Adulthood: A Within-Family Mixed-Method Approach**

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Major negative life events that are shared by all members of networks, such as the deaths of central members, may change the relationships among remaining members. In this paper, we use mixed-methods data from the Within-Family Differences Study to explore how the quality of siblings' relationships with one another are affected by the deaths of their mothers, fathers, or brothers/sisters. We address these questions using data collected from 800 adult children nested within 350 families, approximately 25% of which had experienced the death of at least one parent or sibling in the previous five years. Preliminary findings showed that the deaths of brothers or sisters did not affect relationship quality among surviving siblings. In contrast, deaths of mothers and fathers were associated with more harmonious sibling relationships as reported by sisters, but not brothers. Consistent with the quantitative analysis, qualitative data revealed that sisters were substantially more likely than brothers to say that their parents' deaths had affected their relationships, and to describe the deaths as having increased the emphasis that they placed on their sibling relationships, particularly among daughters with living sisters.

**Effects of Potential and Active Network Combinations: Evidence from Colombian Labour Market**

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<sup>1</sup>Sciences Po Bordeaux, <sup>2</sup>University of Bordeaux

This article examines the effect of social network configurations on labour market outcomes. Drawing from the socioeconomic literature on social networks and employment, we note large discussions and contrasted results between potential and active network approaches on labour market, and we offer three contributions in this debate. First, we propose an original definition of relational embeddedness, combining potential network dimensions, coming from social capital literature (reachability, extensity and diversity of social positions), and active network dimensions

(structure, homophily and strength of ties). Second, using a representative sample of 1600 workers in Bogota (Colombia) coming from original ego-centred data recollected between 2016 and 2017, we observe different multidimensional and uncorrelated types of potential and active networks describing workers' relational embeddedness forms. Third, we use a quasi-experimental model (IPWRA estimators) to measure the impact of each potential and active network combination on labour market performances and specifically on job search and job matching. We find evidence that articulation between extended (potential) and cohesive (active) networks produce a better matching than others. Moreover, the combination between extended potential and opened active networks do not have significant effects. Our results show that network combinations matter, and mixing extended (potential) and cohesive (active) dimensions are crucial to improve labour market outcomes in developing countries. Finally, we discuss some implications for labour market institutions in the Colombian context.

### **Ego Network Structure of Hepatitis C Infected People who inject drugs (PWIDs) in Baltimore: Implications for Intervention Development**

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People who inject drugs (PWIDs) have a high prevalence of Hepatitis C Virus (HCV), a life threatening but curable infection of the liver which spreads easily through sharing of drug injection paraphernalia with drug network members. PWIDs face many barriers to testing and linkage to care for HCV, including difficulty navigating the healthcare system and competing priorities. Furthermore, PWIDs are at high risk for reinfection after curative HCV treatment due to continued sharing of drug use equipment with HCV infected network members and other contacts. Therefore, a network-based intervention, capitalizing on network contacts and peer influence to recruit this hard-to-reach population for testing and care, may prove effective for reducing HCV infection prevalence in populations of PWIDs. This study examines the feasibility of using a network-based intervention to recruit PWIDs for HCV testing and subsequent treatment. A respondent-driven sampling framework was used to recruit participants for a 90-minute interviewer administered network survey, rapid HIV and HCV testing, and linkage to care. Primary index PWIDs with HCV who reported injecting drugs with at least one other person in the last year were recruited at a clinic in Baltimore, Maryland, USA. Participants provided information on demographics, drug use, medical care, HCV knowledge, and attributes of the egocentric injection drug use network. All participants were tested for HCV, provided blood samples, and offered linkage to HCV care and treatment. Participants were asked to become a "Champion of Change" and recruit their injection drug use network members for HCV testing and linkage to care. Recruited network members were invited to participate in the study and were encouraged to recruit their own network members. Indexes received \$10 for each injection drug use network member recruited. The study is currently ongoing. The main goal of this analysis is to identify characteristics of PWIDs who successfully recruit injection drug use network members to HCV testing and to explore the feasibility of a network-based intervention for increasing HCV testing and care linkage.

Initial analysis of the first 96 participants found that 61 participants were recruited by another participant. Overall, only 35% of the participants had recruited a network member at the time of analysis. The number of network members recruited per participant ranged from one to five. The sample is 80% aged 40+, 76% male, 72% Black, and 49% homeless. On average, participants

reported 3.6 alters in their injection drug use network, about half of participants inject drugs daily, and a third of participants reported ever having been treated for HCV.

Preliminary analysis used a multivariate logistic regression to examine characteristics associated with successfully recruiting a PWID to the study. Being homeless and having ever received treatment for HCV were marginally associated with increased odds of recruiting a network member. Additional analyses will explore characteristics of participants' egocentric networks as predictors of peer recruitment success. Differences between clinic-recruited index participants and peer-recruited index participants will also be examined.

### **Ego-centric maps as qualitative data: an experiment of inductive analysis of support networks of caregivers to patients with mental illness**

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<sup>1</sup>Department of Public Health Sciences, University of Rochester, <sup>2</sup>Department of psychiatry, Tehran University of Medical Sciences

Rationale: exploratory network analysis displays features that are generally ascribed to qualitative research, making it a fitting example of fused approach. These features include inductive and iterative processes, subjective interpretation of graphs, and transformation of numbers into words/meanings. Here we describe an exercise of analyzing a series of egocentric network maps in a process that resembles qualitative analysis.

Methods: 13 Caregivers to hospitalized patients with schizophrenia and bipolar mood disorders participated in semi-structured interviews. The interviewer assisted the caregiver to complete an egocentric network chart of his/her support network, consisting of concentric circles indicating the importance of the alters in providing support, and were sliced into six social groups: family at home, family outside home, friends, colleagues and neighbors, health care providers, and others. The caregivers elaborated on the process and quality of support relations and alter-to-alter connections. In this exercise, we considered the network charts and basic demographic attributes of caregiver and patient as qualitative data. The analysis involved an iterative and inductive process of sense making and classification through constant comparison and memo-writing. In this circular process, we used several techniques including simplification/abstraction of the charts by drawing vectors aggregating the relation to each social group; focused analysis of the maps by contrasting special social groups such as health care providers vs others; and classifying network relations based on social group, importance to ego, and ego's attributes.

Results: we realized that a comparative analysis of social groups would provide a more meaningful picture of the network charts. Family: Relationship to family members usually preceded the relations to others, and egos that had only weak connections with family members usually were isolated and did not report any relations with other groups. The relations with family members varied in a diverse range of strong and weak connections with family members inside and outside home, whom also varied in terms of inter-connectivity. Two interesting themes were: 1) if the ego was the mother of patient, father was usually peripheral or missing in the support network. 2) If the ego was the spouse of the patient, usually multiple in-laws (patient's biological family) were influential actors in the support network. Health care providers: Stronger relationships usually happened with one or two alters (usually a doctor), while egos could have weaker relationships with several health care providers (including multiple doctors, nurses, and social workers). Health care providers with stronger relations to ego were also usually connected to family members. Health care providers did not connect to each other. Friends and colleagues: the extended network relations usually existed if ego already had strong connections to the family. Extended network members did not have connections to family or health care providers. Conclusions: We are in process of qualitative analysis of interview transcripts. The patterns we inferred by inductive

analysis of egocentric network charts can be used as “themes” in analyzing the interviews. This dialogue between various data sources and perspectives forms a fused analysis in which the boundaries between quantitative and qualitative is blurred

### **Embeddedness of social and transactional ties: multiplex networks of civic engagement in Cape Town, South Africa**

Lorien Jasny<sup>1</sup>, Mario Diani<sup>2</sup>, Henrik Ernstson<sup>3</sup>

<sup>1</sup>University of Exeter, <sup>2</sup>University of Trento, <sup>3</sup>Manchester University

This paper investigates the multiplex relationship between networks of social bonds and transactional ties among civic organizations in Cape Town, South Africa. Social identity is constructed through overlapping and intersecting fields (sharing common goals, core members, etc.), but transactional ties (the exchange of resources) is often a fundamentally different relationship. We first operationalize these concepts using 8 different types of relationships among civic organizations in broader Cape Town. We then model the interactions of these ties using multiplex ERG models. Until recently in the field of social networks we have been able to describe the similarities between networks and use the relations in one network to predict ties in another, but we could not test more sophisticated terms like whether ties in one network close triads in the other, etc. With new formulations of exponential random graph models, we can. We examine several differences in the mechanisms associated with these networks separately, and then the terms from modeling them together. From a comparison of these models, we see how organizations are embedded in these social networks.

### **Embedding LMX in Networks**

Kristin Cullen-Lester<sup>1</sup>, Cecile Emery<sup>2</sup>, Alexandra Gerbasi<sup>3</sup>

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Although embedded in complex informal intra-organizational networks, the Leader–Member Exchange (LMX) relationship tends to be studied in “a vacuum”, that is, independent from other social relationships. In this symposium, we will review the limited literature on LMX and social networks and would like to discuss new and innovative ways participants may use social network theories and statistical network models to extend the understanding the impact of LMX and LMX differentiation on other workplace social interactions and outcomes.

In this project we look at the interplay between LMX and networks of energizing ties within organizations. Relational energy is defined as the heightened level of psychological resourcefulness generated from interpersonal interactions that enhances one’s capacity to do work. We propose that relational energy mediates the relationship between LMX and employee job satisfaction. Furthermore, we examine whether low-LMX employees, who receive lower levels of relational energy from their supervisor compared to high-LMX employees, can be satisfied at work depending on their embeddedness in a larger network of energizing relationships with co-workers. In other words, we empirically test a second-stage moderated-mediation model examining relational energy as a mediator between LMX and job satisfaction and relational energy from co-workers as a boundary condition. Using social network data collected from 185 employees from the engineering department of a large multinational corporation, our findings suggest that relational energy mediates the relationship between LMX and employee job satisfaction. Furthermore, we found empirical support for relational energy from co-workers moderating the strength of the relationship between LMX and job satisfaction via relational energy from supervisor, meaning high levels of relational energy from co-workers (compared to low or average levels of relational energy) compensates for a low-LMX relationship in terms of job

satisfaction. We would also like to take the opportunity to discuss how social network techniques offer opportunity for answering innovative LMX research question. For example, should we study LMX at a triadic level, with one leader and two followers, to better understand how LMX impact the formation of other social relationships, such as friendship or perceived competition, within work-groups?

**Emergence des plateformes numériques et redéfinition des dynamiques de l'action collective dans le secteur agricole en France** / Émergence des plateformes numériques et redéfinition des dynamiques de l'action collective dans le secteur agricole en France

Julien Brailly<sup>1</sup>, François Purseigle<sup>1</sup>, Geneviève Nguyen<sup>1</sup>

<sup>1</sup>Université Fédérale de Toulouse / INPT-ENSAT

By combining sociology, economics and management science, the PADAC project aims to study over a period of four years how the emergence of digital platforms in agriculture reshapes the dynamics of collective action and farmers' labor organization. These platforms compete traditional professional organizations charging by the State of some missions of political and economic regulation of the agricultural sector. They disrupt the political organization of this sector and raise regulation issues by opposing their financial logic to the political logic of traditional organizations. This project aims to articulate the study of the actors' practices, the relational context (multilevel social networks), the local environment and the system of action at the national level in the study of the political and economic regulation of these platforms.

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En combinant des approches relevant de la sociologie, de l'économie et de la gestion, le projet PADAC propose d'étudier en temps réel durant une période de quatre années l'émergence des plateformes numériques dans le secteur agricole, les dynamiques de l'action collective et les évolutions dans l'organisation du travail qui en résultent.

Elles concurrencent les organisations professionnelles traditionnelles auxquelles l'Etat a confié des outils de régulation politique et économique et ainsi bouleversent l'organisation politique de ce secteur. Elles posent la question de la régulation de ce secteur au sein duquel la logique financière des plateformes s'oppose à la logique politique des organisations traditionnelles. En variant les niveaux d'analyse, nous ambitionnons d'articuler étude des usages des acteurs, contexte relationnel (analyse de réseaux complets multiniveaux), environnement territorial local et système d'action à l'échelle nationale dans l'étude de la régulation politique et marchande de ces plateformes.

**Emergence of Digital Platforms and Redefinition of the Dynamics of Collective Action in the Agricultural Sector in France** / Émergence des plateformes numériques et redéfinition des dynamiques de l'action collective dans le secteur agricole en France Julien Brailly, François

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### **Emotion and framing-based homophily: A network analysis of message characteristics in cancer talks on social media**

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Social media platforms are becoming increasingly popular for several forms of health communication, such as seeking cancer-related information and emotional support. Previous research efforts have been investigated to understand the nature of cancer talks on social media, the others have investigated the diffusion of cancer information. However, from content to social context, the network structure in cancer talks remain understudied. Studies in this vein have not looked at how message characteristics stimulate responses from the audience. Recognizing the growing literature that documents the important role of emotion and framing in cancer messages, this study anchors on the theory of homophily and investigates the role of emotion valence and framing factors on the formation of the cancer discussion network.

This study contributes to the existing literature in twofold. First, it bridges a gap in the homophily literature, which has so far essentially ignored the role of emotions and framing in cancer talks. Second, it introduces a novel methodology for examining message characteristics in health communication. This research integrates both manual content analysis and machine-learning based texting mining to identify message characteristics, and examine the effect of homophily using Exponential Random Graph Models (ERGMs).

To address the research objective, cancer-related tweets are downloaded from Twitter during a period of two months in 2018. The initial dataset contains 153,765 tweets. Data are cleaned before analysis. Three sub-datasets are established from the initial dataset, including the tweet attributes, the user attributes, and the post-reply network. The post-reply network is constructed in such a way that if message  $i$  quotes or replies to the message  $j$ , then  $i$  is sending a tie to  $j$ . Emotion valence of the tweets is generated through sentiment analysis. Additional measure is taken by human-coding a sample of all the tweets for two framing variables: uncertainty and themes. The human coding results will then be utilized as training data for machine learning to classify all the data.

Finally, the homophily of emotion and framing in the post-reply network of cancer tweets will be tested with associative mixing. Results demonstrated polarity-based homophily (associativity coefficient = 0.218), while the homophily effect of volume of emotion in the post-reply network was not found. ERGMs will be conducted to examine the effect of emotion-based and frame-

based homophily on tie formation in the post-reply network with other factors controlled. Findings of this research could contribute to the understanding of the dynamics of cancer talks on social media and provide practical insights for health campaigns.

### **Enso: Engaging Social Network Data Collection Software**

Kate Eddens<sup>1</sup>, Ben Serrette<sup>1</sup>, Chathuri Peli Kankanamalage<sup>1</sup>, Matthew Hutchinson<sup>1</sup>

<sup>1</sup>Indiana University Network Science Institute

Proper measurement of egocentric or personal networks remains a key methodological challenge in the field of egocentric network research. Personal social network data can be used to design, implement, and disseminate health interventions; however, collecting this type of data is often tedious and time-consuming, and the interface design of most existing tools does not consider potential low literacy levels of target populations.

Enso is an open source, mobile-ready, dynamic data collection system that uses principles of clear communication and playful design to collect and deliver accurate visual personal social network data for assessment and intervention. Enso is designed to collect both egocentric (personal) and sociometric (complete, roster-based) network data. Enso can be used on computers or mobile devices with or without an internet connection, making it ready for field collection on tablets or phones. Designed to be engaging and playful, Enso allows for field collection of high quality social network data while reducing the burden on both interviewers and respondents.

In this presentation, we will 1) introduce survey design features in Enso that represent tested approaches to gathering egocentric data, including multiple experimentally tested methods for collecting ties between alters; 2) present user feedback and results from early testing of the platform; 3) encourage discussion from attendees on data collection methods or challenges they experience that that may not yet be represented in Enso, and; 4) welcome suggestions for additional methods experiments that will allow us to improve Enso and the research and practice communities' ability to accurately and efficiently collect network data.

The goal is to provide a user-centered tool that allows researchers, interventionists, social service providers, and advocates to leverage the power of social networks and technology to positively impact the lives of marginalized populations.

### **Entity Disambiguation of Corporate Network Data**

Bruce Cronin<sup>1</sup>

<sup>1</sup>University of Greenwich

As highlighted by Heemskerk et al (2018), entity ambiguities are particularly problematic in the modelling of corporate networks where small errors can greatly distort reported network structures and metrics, particularly where these concern pivotal nodes. While entity ambiguity is a major issue in modelling relationships among individuals, this is more so for corporate bodies, as these typically encompass a complex of hierarchically differentiated entities.

Two broad classes of the problem comprise name ambiguity and hierarchical ambiguity. Name ambiguity concerns the common interchange of names for the same entity, such as 'IBM', 'International Business Machines', 'IBM Inc', 'IBM Corp'. Hierarchical ambiguity concerns the appropriate unit of analysis within a corporation for the network of interest, such as the distinction between a holding company and an operational headquarters or a regional headquarters. Garcia-Bernardo and Franks (2017) provide a data-driven strategy for the latter problem. This paper reviews attempts to parsimoniously address the corporate name ambiguity problem.

While corporate name disambiguation may be initially thought to be a simple string matching issue, a number of features of corporate nomenclature makes corporate entity identification

more difficult than the identification of individuals. Beyond the wide use of synonyms for the same entity, there is typically less variation in corporate naming than the naming of individuals and corroborating attributes such as birthdate or address of individuals are often more ambiguous for corporates. Secondly, because the capabilities of corporate entities are greatly skewed, with a small number of firms having a large amount of resources, datasets recording corporate activity also tend to be greatly skewed; this creates particular challenges to probabilistic approaches to string matching. Thirdly, corporate entities are frequently subject to change in through processes of restructuring, expansion, divestment, mergers and acquisitions and both the legal registration and common description of the entities typically lag such changes.

The paper reviews previous attempts at corporate entity identification from four name disambiguation approaches; dictionary-based, rules-based, combined dictionary and rules-based, and semantic-based. Dictionary-based approaches establish unique codes and standardised names for entities, with automated cleaning of characters, punctuation, umlauts, capitalisation, spelling variations, removing common names and stripping or standardising legal form. Rules-based approaches set criteria for matching strings, such as equating 'Inc.' and 'Incorporated' or requiring attribute matches, or set thresholds of string-similarity to accept as an approximate match on the basis of character or word frequency, particularly unusual combinations. Dictionary- and rules-based approaches are commonly combined to enhance match success. Semantic, or 'word2vec', approaches identify matches in terms of the written context in which the names are used, from the spatial similarity of names in multidimensional matrices of co-occurrence of names, or name-parts, and other attributes in the dataset.

Typical implementations of each approach are compared in an exercise matching US patent data with Orbis data. The impact of differing error rates, thresholds and computational requirements on the structure of a co-patenting network structure are discussed.

**Session:** This abstract is related to Corporate Networks

### **Entrepreneurial Bureaucrats: A Social Network Analysis of Lomma and Staffanstorp Municipalities, Sweden**

Evangelia Petridou<sup>1</sup>, Per Becker<sup>2</sup>, Jörgen Sparf<sup>1</sup>

<sup>1</sup>Mid Sweden University, <sup>2</sup>Lund University

Policy (or political) entrepreneurship (PE) is an actor-based framework to examine and understand policy change. Rooted in Kingdon's (1984/2003) Multiple Streams approach (MSA), the policy entrepreneur is defined as "a special kind of actor, embedded in the sociopolitical fabric, who is alert to opportunities and acts upon them; he or she amasses coalitions for the purpose of effecting change in a substantive policy sector, political rules or in the provision of public goods" (Petridou, Narbutaité Aflaki, and Miles, 2015, p. 1). Political entrepreneurship refers to the agentic capacity of political actors operationalized as (i) access to resources such as information and personal contacts; (ii) alertness to recognize opportunities and take advantage of them; (iii) the willingness to take risks, and (iv) leadership skills. The strategies these actors use to navigate the policymaking process are a function of their agentic capacity and the context in which they find themselves operating. Though considerable scholarship has been devoted to policy entrepreneurs in the policy formulation stage of the policy process, entrepreneurship in bureaucracies and especially at the municipal level becomes more opaque (Petridou, 2018; Petridou and Sparf, 2018). In this study, we conduct a structural analysis to compare the networks in two Swedish municipalities, Lomma and Staffanstorp in urban flood risk management (for a study on Lomma, see Becker, 2018). Our findings suggest that the actions of the policy

entrepreneur in Lomma municipality is decisive for the policy decisions regarding flood risk mitigation.

### **Entrepreneurial Ecosystems of a metropolitan region in a developing country: a Social Entry and Exit Dynamics using Generalized Location Systems and TERGM**

Loring Thomas<sup>1</sup>, Carter Butts<sup>1</sup>

<sup>1</sup>University of California, Irvine

While network dynamics has an overwhelming emphasis on understanding edge dynamics across the last decade, the case of modeling these networks with complex entry and exit dynamics provides an opening to better understand how systems grow, shrink, and evolve. In entering and leaving existing networks, nodes can contribute to changes in the overall network structure, especially when considering dependencies in node copresence in the network. Prior literature has incorporated limited versions of entry and exit using Dynamic Network Regression and Latent Variable Models (both using a conditional TERGM structure to model edge dynamics), but there has yet to be a general model for these systems that includes a full dependence structure on node participation. In this paper, I describe a new model that will incorporate this complex dependence structure for entry and exit dynamics into an existing model for dynamic network analysis by using a joint discrete exponential family factored into a vertex process and an edge process, in which the vertex process is modeled using a Generalized Location System, and the edge process is modeled using a TERGM. I analyze a dynamic network of social interactions that takes place across a month. This system includes changes in the structure of the network across this month, as well as entry and exit dynamics. Results of these analyses in comparison to prior models will be discussed. This work has implications for the more accurate modeling of complex systems that are spatially and temporally distributed. I also discuss the implications for modeling systems with incomplete information.

### **Environmental Policy Over Two Centuries: Exploring the Bipartite Network of International Agreements**

Selena Margarita Livas<sup>1</sup>

<sup>1</sup>University of California Irvine

International environmental agreements (IEAs) are a form of cooperation between nations working towards the objective of environmental control. There has been substantial debate in the last half century over the motivation for nations' involvement in these agreements. Knowing what increases the propensity for environmental agreement ratification has clear policy implications for the drafting and negotiation of future IEAs. Previous studies have often overlooked variation among treaties and nations when modeling the ratification process, leading to a poorer understanding of the diversity of their subgroups. This study aims to fill the gap in the prior literature by exploring the clustering of agreements and nations. Through this, we may better understand which types of agreements are more likely to be ratified as well as the ways in which nations choose to cooperate with one another. This study constructs a bipartite treaty ratification network using data from over 1,300 multilateral IEAs from the year 1800 to 2019 to explore questions related to cooperation among nations and differences among treaty types. By parsing out these different connections among nations and treaty types, we can open up the potential for integration and competition of multiple theoretical lenses instead of monolithic theorizing that attempts to encapsulate the entire phenomenon of environmental treaty ratification.

**ERGM inference for un-observed inter-organizational ties based on key informant reports**

Johan Koskinen<sup>1</sup>, Christopher Steven Marcum<sup>2</sup>, Dimitris Christopoulos<sup>3</sup>, Christophe Sohn<sup>4</sup>

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The role and importance of organisational network ties is well established in the literature, yet studies based on independently defined organisational ties, such as financial transactions or collaborative agreements, are rare. It is tempting to rely on organizational representatives as informants for constructing networks of inter-organisational ties but it is not clear how individual reports relate to actual organisational behaviour. We propose to address this through positing the assumed true inter-organisational network as an unobserved, undirected network that is reported on with error by organisational representatives. The measurement model draws on the cognitive social structures data collection paradigm and the organisational network is assumed to follow an exponential random graph model a priori. The target of inference is two-pronged: simultaneously aiming to infer the network mechanisms of tie-formation of the unobserved network and to assess the competencies and cognitive biases of the informants. The resulting methodological framework can be seen as explicitly modelling the famous duality of individuals and groups. We illustrate the procedure using data on organisations involved in transportation and cross-border collaboration in European countries where the number of organizational informants range from single individuals to a few organisational members. Our preliminary results suggest that the underlying interorganizational collaboration network arises in an ERGM fashion from a combination of triadic closure, preferential attachment, and anti-territoriality. From the measurement model results, we observe heterogeneous effects of informant false-positive and true-positive rates on tie report probability and a strong dependence between the density of the latent network and the informant reports.

**ERGM parameter estimation of very large directed networks: implementation, example, and application to the geography of knowledge spillovers**

Alex Stivala<sup>1,2</sup>, Alfons Palangkaraya<sup>2</sup>, Dean Lusher<sup>2</sup>, Garry Robins<sup>2,3</sup>, Alessandro Lomi<sup>1,4</sup>

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The recently published Equilibrium Expectation (EE) algorithm for exponential random graph model (ERGM) parameter estimation has allowed such models to be estimated for networks far larger than previously possible. Here we demonstrate the extension of this algorithm to directed networks, with an implementation that overcomes some technical problems limiting the sizes of networks that could be practically estimated. We apply this method to estimate ERGM parameters for an online social network with approximately 1.6 million nodes, and a patent citation network with approximately 3.8 million nodes. The latter model allows us to test the geographic knowledge spillover hypothesis (that knowledge spillovers are geographically localized) using patent citation data, without having to treat the patent citation network as exogenous.

**Ethnic friendship segregation, dislike, and physical violence: A multiple network investigation in German secondary schools**

Mark Wittek<sup>1</sup>, Clemens Kroneberg<sup>1</sup>, Kathrin Lämmermann<sup>1</sup>

<sup>1</sup>University of Cologne

This study examines the role of ethnic background for friendship, dislike, and violence networks in secondary school. We analyze data on multiple networks from a large-scale study of more than 2500 seventh-graders in Germany. In addition to ethnic homophily in friendship networks, our

results reveal a tendency among students to dislike ethnic outgroup members (ethnic heterophobia). In contrast, students are more likely to engage in violence towards same-ethnic peers than outgroup members. This is partly due to the greater prevalence of violence among students who are close in the friendship network and students who spend time together outside school. Moreover, schools marked by stronger ethnic homophily in friendships tend to display higher levels of ethnic heterophobia but exhibit higher levels of intra-ethnic rather than inter-ethnic violence.

### **Evaluating the extraction of signed networks from bipartite projections**

Zachary Neal<sup>1</sup>, Rachel Domagalski<sup>1</sup>

<sup>1</sup>Michigan State University

Although interest in signed networks and negative ties has increased, obtaining this type of data remains a key challenge. In addition to the typical challenges associated with collecting network data, in some contexts asking about negative relations is not permitted (e.g. from children in classrooms) or impractical (e.g. from self-presenting politicians). A range of techniques recently developed to extract the backbone from bipartite projections can be used to extract signed backbones. However, these methods have not been compared and the relative validity of the extracted backbones has not been evaluated.

In this paper, we will focus on two related approaches for extracting signed networks from bipartite projections, the fixed degree sequence model (FDSM) and the stochastic degree sequence model (SDSM). Both methods are conceptually similar, generating a null model bipartite projection to derive probability distributions of each edge weight in the bipartite projection under the null hypothesis that two actors are not coordinating their selection of artifacts. When the edge weight between two actors exceeds what is expected under the null hypothesis (at a given alpha level), they are viewed as having a positive edge, while when this edge weight is less than expected under the null hypothesis, they are viewed as having a negative edge. The methods differ only in the constraints they apply when generating the null model: the FDSM requires that the row and column sums of the random bipartite data used to create the null projection match those in the observed data, while the SDSM only requires that these sums are approximately the same as in the observed data. While it is anticipated that the SDSM is faster than the FDSM, this remains unverified, and it is unknown whether either yields valid inferences about an unobserved signed network.

To evaluate these methods, we first provide a conceptual overview of signed backbone extraction. Second, we evaluate and compare the computational complexity of FDSM and SDSM. Third, we will evaluate and compare their ability to recover synthetic ground truth signed networks from bipartite data with varying levels of noise. Finally, to provide a concrete illustration, we will apply them to empirical data on bill co-sponsorship in the US House and Senate to examine whether they offer similar or different answers to the question: Is the US congress becoming more polarized (i.e. more balanced)? This paper will also introduce a new R package that implements both the FDSM and SDSM, as well as a procedure for generating bipartite data that corresponds to a synthetic signed ground truth with specified properties.

### **Evaluation of Indiana Public Health Departments' Use of Facebook to Meet Community Health Information Needs Using Semantic Network Analysis**

Natalie Lambert<sup>1</sup>, Meghana Rawat<sup>1</sup>, Eric Wiemer<sup>1</sup>

<sup>1</sup>Purdue University

Indiana is ranked 39<sup>th</sup> in healthcare quality and management in the United States with some of the worst rankings in air pollution, smoking, infant mortality, diabetes and obesity (Americas

Health Ranking, 2018). The Indiana State Health Assessment and Improvement Plan (2018-2021) has identified *translating the data on health assessment to the community* as one of their primary goals for development of healthcare systems in the state. Social media brings a new dimension to health care as it offers a medium to be used by the public, patients, and health professionals to communicate about health issues. Healthcare organizations' use of social media for sharing health information is particularly promising because people use the Internet as a source of health information as much as they do physicians (Fox, 2006). Prior research of health organizations communicating with patients online has examined subjects such as how organizations frame health messages online versus offline (Liu & Kim, 2011) and how university health centers and physicians convey information online and via social media (Waters, et al., 2011; Katz & Moyer, 2004). There remains a lack of understanding about what health information is provided online by local public health organizations, as well as a means of assessing how well this online communication meets communities' health information needs. These assessments are vital because public health departments provide health services and information to people who need them the most – pregnant women, people struggling with opioid addiction, and people suffering from mental health problems.

This study takes a text mining and semantic network approach to evaluating Facebook messages posted by Indiana Health Departments to assess how well they meet Indiana residents' health information needs as defined by the Indiana State Health Assessment and Improvement Plan. Posts made on Indiana County Health Department Facebook pages during 2018 were collected from a random sample of the 92 counties in Indiana. The sample represented urban, suburban, and rural counties proportionally. The posts were imported into AutoMap (Carley, 2001) and preprocessed. Semantics networks were generated of each county size so that differences in semantic networks structures could be evaluated. The preprocessing and semantic network generation procedures were repeated using data collected from the health assessment reports from these counties. Comparison of the health departments' semantic networks and the semantic network of the health reports revealed key differences between the health information needs stated in the reports and the health information shared with local communities.

Initial findings indicate that some health topics like the availability of flu shots were given equal importance on the health assessment reports and Facebook pages (mostly in urban counties), while other information like treatment of chronic disease was not (particularly in rural counties). Facebook was identified as the primary source via which the community gained knowledge of health programs over traditional media such as television. However, Facebook was mostly used as a mouthpiece to make announcements and infrequently engaged with the public. This study reveals that medical deserts in rural areas are often linked with "health information deserts" online.

#### **Event and situation based Social Network Model for before and during disaster.**

Claire Yeryung Kim-Chung<sup>1</sup>, Kon shing Kenneth Chung<sup>2</sup>

<sup>1</sup>Latrobe University, , <sup>2</sup>University of Sydney,

This paper has focused on situation and event based social network. Disaster is a not a expected situation or an event but it happens which then gives enormous effects on existing social and organisation network.

The management of disasters can either alleviate or aid in overcoming these effects. While human-made and natural disasters are typically followed by chaos, this often results from an inadequate overall response. Preparedness is the best response to emergencies, and a multi-agent-based approach to coordination decision support systems often plays a significant role in disaster management and response.

The key motivating question guiding this research is: how can the multi-level study of properties of social networks at network, actor and tie level help us understand the coordination that enables expertise access and sharing during disasters? Moreover, this study also asks: To what degree is this relationship associated with expertise coordination in a negative or positive manner before and during disaster network? How are centralisation and efficiency in an individual's social network associated with coordination? Do network constraints and tie strength in an individual's social network negatively or positively affect coordination?

The survey results from 56 managers and 66 volunteers from the State Emergency Service of New South Wales, Australia, indicated that network structure and the position and ties of knowledge workers play a crucial role in the coordination of expertise. However, staff member hierarchical networks and volunteer (organic, dispersed and ad-hoc) networks indicated differing results. In particular, closeness centrality (the extent to which one is independent in the network when accessing everyone else in the network) had a positive effect on the staff member network, but not the volunteer network.

Meanwhile, out-degree centrality (the extent to which one seeks advice from others) was found to be positively associated with expertise of coordination in the staff member network, yet the reverse in the volunteer network. Network density was found to be negatively correlated with coordination of expertise in the staff member network, while no statistically significant associations were found in the volunteer network. Moreover, strength of ties was found to be positively associated with coordination of expertise only in the volunteer network. Information and communication technology use was found to be positively related to coordination of expertise in both the staff and volunteer networks.

Among the variables that showed significance, closeness, degree, betweenness centrality, network constraint and the strength of ties best explained the overall variance for coordination of expertise (access and sharing of expertise), although professional accreditations also remained a potent indicator. These results confirm the presence of social network properties as useful indicators of coordination of expertise, particularly in informal networks. The findings are useful in the disaster management domain for organisational restructure and policy setting, and to confirm that, in occupational communities where participation is voluntary and ad hoc, these networks are crucial to understanding where expertise is needed, where expertise is located, and how to bring such expertise to bear.

### **Evolution of the Prevention of Lower Urinary Tract Symptoms (PLUS) Team Science Consortium over Three Years**

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**Introduction:** Increasing attention is being paid to the structure of scientific teams, however, it is unclear what mechanisms promote successful collaborative networks and team science. In 2015, a novel transdisciplinary consortium was funded by the US National Institutes of Diabetes, Digestive and Kidney Diseases (NIDDK) to promote research on prevention of lower urinary tract symptoms (LUTS), a novel paradigm in a field traditionally focused on identification and treatment of symptoms. This consortium, named the Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium, has integrated experts across clinical, epidemiologic, and behavioral sciences to address the complex health research problem of LUTS. The group includes approximately 50 investigators across 8 institutional-based research centers around the country, with expertise including clinical, epidemiologic and behavioral sciences. This consortium first met

in September 2015 and in-person meetings have been held every 2-4 months along with multiple weekly online meetings in between. Now that the network is three years old, we hypothesize that the network will be denser, have higher cohesion, and will be less clustered by institution and discipline.

**Methods:** At the initial meeting (2015), a roster-based baseline social network written questionnaire was administered in-person to all attendees in order to gauge the extent of prior collaboration. Ties between network members were based on egos knowing alters on a first name basis; additional questions were asked about the nature of collaborations (research, clinical, professional). A second questionnaire was administered in 2018 either online or in-person, with a validation subset given both questionnaires. Explanatory factors for tie presence included co-membership on PLUS committees and overall involvement in PLUS in-person and online activities as well as collaborations outside of PLUS.

**Results:** A total of 55 out of 61 participants named on the first or second roster completed at least one questionnaire (90.2% participation); 23 out of 61 completed both (38%). Five participants completed both paper and online versions of the questionnaire in 2018, with the total number of alters named agreeing within one alter (with no mean difference in alters named,  $p=1.00$ ). Density of the PLUS scientific team was 12.8% at baseline and grew to 60.5% at the three year follow-up. At follow-up, average out-degree (number of named alters) was 45.3 for those who completed the questionnaire at the in-person meeting, vs. 32.1 for those only completing the online survey.

**Conclusion:** The density of the PLUS Research Consortium grew considerably over the first three years of the consortium. Greater out-degree among participants who completed the 2018 questionnaire in the in-person meeting suggested that attending in-person meetings was an important mechanism in promoting network ties. We plan to analyze these data using an exponential random graph model and its temporal extensions to understand who forms ties with whom, as well as differences in network participation based on attendance at in-person meetings and online meetings.

### **Evolution of a Time Bank Transaction Network: How Uncertainty Shapes the Structure of Exchange**

Jakob Hoffmann<sup>1</sup>, Johannes Glückler<sup>1</sup>

<sup>1</sup>Economic Geography Group, Heidelberg University

In recent years, new forms of economic organization have emerged, bringing with them new modes of economic interaction. In this paper, we study a time bank, a type of platform organization which facilitates economic transactions of goods and services among its members through a community-specific currency. Time bank exchanges are often characterized by a high degree of informality and transactional uncertainty. Based on longitudinal data comprising over 4,000 transactions among a total of 192 members, we address questions pertaining to the choice of a transaction partner under conditions of uncertainty. Different theoretical strands, such as informational economics, social exchange theory and the embeddedness approach offer mechanisms for such exchange situations. Expectations regarding uncertainty-mitigating mechanisms – such as experience based trust, referral, and public reputation – are derived from theory and reviewed by utilizing Dynamic Network Actor Models (DyNAMs).

**Evolution of the Global Foreign Aid Network 1960-2015: Sticky Ties, Donor Darlings, and Aid Orphans**Liam Swiss<sup>1</sup><sup>1</sup>Memorial University

This study analyzes the evolution of the global foreign landscape as a social network of ties between countries over a 55-year period from 1960-2015. First, it presents a longitudinal description of the changing contours and scale of the evolving network of bilateral (country-to-country) aid ties over time using social network analysis techniques. Second, it examines the dynamics of this evolution through multi-variate modelling of the factors that shape the network including: sticky ties between donors and recipients; the rise of donor darling countries who suddenly receive aid from a large share of donors; and the marginalization or exclusion of so-called aid orphans from the network. Finally, the study concludes with an assessment of the strengths and weaknesses of using social network analysis to achieve a relational understanding of foreign aid.

**Exact Statistics and Semi-Parametric Tests for Small Network Data**George G. Vega Yon<sup>1</sup>, Kayla de la Haye<sup>1</sup><sup>1</sup>University of Southern California

Small network data such as team, family, or personal networks, is common in many fields that study social networks. Although the analysis of small networks may appear simplistic relative to the difficulties of “big data”, there are at least two key challenges: (1) fitting statistical models to explain the network structure in small groups, and (2) testing if structural properties of small networks are associated with group-level outcomes; for example, team performance. The first challenge we aim to address is going beyond describing the structural characteristics of small networks (e.g., density or triad counts), to testing hypotheses about small network structure. Estimating Exponential Random Graph Models (ERGMs, the lingua franca of social network analysis) for small networks is often not feasible because issues with model convergence and model degeneracy are more common with small graphs; even when multiple small networks are stacked together into one adjacency matrix using a block diagonal (“structural zero”) approach. A solution we propose is to take advantage of the small size of these networks and do exhaustive enumeration to obtain an exact, and not approximate, calculation of its’ likelihood functions. Current approaches for estimating ERGMs use simulations to avoid calculating the normalizing constant of the likelihood function due to its computational complexity (i.e., in the case of a directed graph of size 7, calculating the normalizing constant involves enumerating more than 1 trillion terms). However, modern computing makes such calculations feasible for small graphs (3 to 6 nodes). In this presentation we introduce a novel approach using ERGMs for small networks fit directly with Maximum Likelihood estimation (MLE), which allows us to overcome common problems faced when fitting ERGMs for small graphs by omitting simulation steps and obtaining parameter estimates directly by means of MLE. The second challenge we address is identifying an approach for testing if structural properties of small networks are associated with graph-level outcomes. Currently, two common methods to do this are: regression models, whereby graph statistics such as density or triad counts are used as predictors of graph-level outcomes; and simulation-based methods such as network rewiring tests. Limitations of the former approach include difficulties in achieving a good level of power because of small samples, and treating multiple network descriptive statistics as independent predictors of group outcomes. The latter strategy, while a powerful analytic tool, tends to oversimplify the problem by making assumptions such as the graph’s data generating process is solely given by its observed degree sequence. In the case of social networks, we have evidence that this assumption is not sound given the complex

endogenous and exogenous processes known to generate social systems. We propose a solution to this challenge that uses the same fitted ERGM described above, to generate null distributions for building semi-parametric tests to identify dependencies between structural features of small networks and group-level outcomes. Overall, we present the results of simulation studies used to validate these analytic approaches for small networks and describe their application to network and performance data from 42 small teams.

### **Examining the Impact of a Youth-Led Sexual Violence Prevention Initiative Using a Social Network Analysis Framework**

Katie M. Edwards<sup>1</sup>, Victoria L. Banyard<sup>2</sup>, Thomas W. Valente<sup>3</sup>, & E<sup>1</sup>

<sup>1</sup>University of New Hampshire, <sup>2</sup>Rutgers University, <sup>3</sup>University of Southern California

Despite decades of public health research, few rigorously evaluated sexual violence (SV) primary prevention initiatives for youth exist. One innovative, untested strategy is engaging youth, who are nominated by their peers, as leaders in the development and implementation of SV prevention initiatives. In the current presentation, we present data on the extent to which popular opinion leaders (POLs) are impacted as a function of participating in the youth-led SV initiative and the extent to which other peers in their social networks are impacted. These data come from an ongoing, CDC-funded project in which social network analysis was used to identify POLs among middle and high schools students. These POLs were part of a youth summit in the summer of 2018 which is followed by the roll-out of youth-led SV prevention working groups; the programming initiative is called Youth VIP (Voices in Prevention). In fall 2017 and spring 2018, over 2,300 youth (~20% Native American) in grades 7 to 10 in a school district in the Great Plains region of the U.S. completed baseline surveys that inquired about SV attitudes and experiences as well as surveys that assessed risk (e.g., alcohol use) and protective (e.g., bystander action) factors for SV experiences; there are four post-summit surveys over two academic years. In this presentation, we present trend analyses for SV victimization and perpetration and related risk and protective factors over time as a function of POL status (i.e., POL, in a POL network, not in a POL network). We hypothesize that controlling for demographics, individuals who are a POL or in a POL network will have lower rates of SV and risk factors and higher rates of protective factors compared to youth not in a POL network. Implications for research and practice will be discussed.

### **Examining the role of social norms and social influence on injection drug use cessation**

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**Background:** Most studies examining correlates of injection drug use cessation have focused on individual-level or neighborhood factors; few have aimed to understand the role of social norms and social influence on injection cessation. This analysis examines network correlates of not injecting, and specifically injection drug use cessation, among a sample of 503 PWUD in rural Eastern Kentucky.

**Methods:** Data were collected through longitudinal assessments conducted as part of the Social Networks among Appalachian People study (2008-2018). Interviewer-administered surveys, occurring at baseline and approximately every 6 months for three years, collected individual-level sociodemographic information and drug use risk behaviors (over the last 6 months), including recent (past 6 months) injection drug use. At each visit, participants were also asked to free-list recent sex, drug use, and social support partners. Listed names were cross-referenced with survey participants to construct a sociometric network at each time point. We defined injection

cessation as self-reported recent injection drug use at one visit followed by no recent injection drug use at the subsequent visit. For each individual who reported injecting drugs in at least one study visit, we calculated the proportion and number of network members who (1) did not inject any drugs in the past 6 months at the prior study visit and (2) reported recent injection cessation. We constructed longitudinal logistic regression models, accounting for repeated observations over time, to examine the effects of these covariates on non-injection status. We also conducted a dyadic analysis based on the first two time points to explore variation in network influence based on the frequency and type of interaction between two individuals. Specifically, we examined the odds of injection cessation based on his/her network member's previous injection status.

**Results:** In the unadjusted model, those who did not inject at the prior visit were 4 times more likely to report not injecting at the subsequent visit (i.e., sustained cessation was more common than a transition from injection to non-injection). Further, the odds of not injecting increased as the proportion of network members who (a) did not inject at the last visit and (b) who ceased injection drug use across the two prior visits increased (OR= 9.2 and 3.7, respectively). After adjusting for sociodemographics and recent injection at the prior study visit, the strength of these effects persisted. Furthermore, the dyadic analysis suggests that having a network member who stopped injecting drugs was strongly correlated with individual's non-injection status (OR=1.7) and that this association was stronger (but not significantly) for familial and support relationships and for those with more frequent interaction (ORs range: 2.0-3.9).

**Conclusion:** Our findings suggest that injection cessation and sustained cessation are influenced more by the relative (than absolute) number of peers who do not inject drugs or who have recently stopped injecting. Further, the network influence was stronger than that of individual-level correlates, suggesting that interventions that promote injection cessation among peer groups may be beneficial.

### **Examining variation in sexual risk behaviors with partners related to geographic proximity to and the network position of sex partners among young black men who have sex with men**

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Background: Young black men who have sex with men (YBMSM) bear a significant burden of the HIV epidemic in the US. As estimated, 1 in 2 YBMSM are expected to be infected by HIV during their lifetime. HIV epidemics among YBMSM are thought to result from a dynamic interaction between network and geographic factors. However, most of the existing research examines associations between sexual behaviors and HIV acquisition from either a network perspective or a spatial perspective. It is still largely unknown how a combination of network and spatial factors influence sexual risk behaviors among YBMSM. The current analysis aims to examine whether one's sexual risk behaviors with a partner are influenced by the geographic proximity to that sex partner and that sex partner's sociometric network position among YBMSM.

Methods: We used data collected from a population-based sample of 618 YBMSM in Chicago (2013- 2014). Participants reported sexual network characteristics (e.g., sex partners' demographics and sexual behaviors with sex partners) and home address for themselves and their sexual network members. Geographic proximity was defined as whether sex partners lived in the same neighborhood as participants; sex partners' network position (i.e., Valente's bridging) was calculated using the sociometric network data (high bridging score, an indicator of the degree to

which an individual links otherwise unconnected groups was defined as top 10%). We created 4 variables to represent the combination of geographic proximity and network position: low geographic proximity and low bridging, low geographic proximity and high bridging, high geographic proximity and low bridging, and high geographic proximity and high bridging. Logistic regression with generalized estimating equations (sex partners nested by participants) was used to examine whether sex behaviors with a partner (i.e., condomless anal sex, sex-drug use, group sex, transactional sex, and serodiscordant or serostatus unknown partners) varied based on the geographic proximity and network position of each sex partner. All analyses were stratified by participants' HIV status.

Results: After adjustment for individual demographics and partner covariates (i.e., partner demographics and partner type), for HIV-negative participants, the odds of engaging in condomless anal sex was 2-fold higher for sex partners with low geographic proximity and high bridging and 4-fold higher for sex partners with high geographic proximity and high bridging compared to sex partners with low geographic proximity and low bridging; the odds of engaging in group sex was 3-fold higher for sex partners with low geographic proximity and high bridging. Among HIV-positive participants, there was a 8-fold increased odds of engaging in condomless anal sex and 83% decreased odds of having a serodiscordant or serostatus unknown sex partner with high geographic proximity and high bridging compared to sex partners with low geographic proximity and low bridging.

Discussion: Our results demonstrate geographic proximity to and the sociometric network position of sex partners are important elements in the dynamics of HIV transmission risk among YBMSM in an urban setting. Intervention messages to reduce risk behaviors with sex partners might incorporate information on geographic proximity and the sociometric position if their partner.

### **Exploring Suicide Among American Indians: Comparing high-risk American Indian personal networks and low-risk American Indian personal networks to understand the social risk factors of suicide.**

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<sup>1</sup>Johns Hopkins University

Suicide is a crucial public health concern for American Indian and Alaska Native (AI/AN) communities. AI/ANs have the highest suicide rate compared to all other ethnic groups in the United States. Unlike the rest of the United States, where suicide rates tend to be highest among older populations, suicide rates among AI/AN populations is highest among individuals 25 years old and younger. While public health scholars have a history of working with social network scholars to understand and reduce suicide in the general population, similar efforts have not yet been made with AI/AN populations.

Social relations (i.e., kinship, extended-kin, peers, and community) are a salient fixture of AI/AN culture. Geographic isolation, shared historical trauma, and rich cultural practices establish a context in which social relationships are at the forefront of reservation life. The omission in extant literature to explore AI/AN suicide through a culturally congruent relational lens inhibits interventions and prevention efforts. Although, relational approaches to understanding health have gained considerable favor among non-AI/AN populations. Taking an empirically rigorous relational approach that is also culturally appropriate, may provide a promising intervention and prevention programming route, not yet explored.

This study uses personal networks collected among American Indians living on reservation in the Southwest. The primary aim of this study was to assess the social relationship characteristics that underlie the suicidal behavior of those who have attempted suicide (index group) compared to

their network members that have not attempted suicide. Network formation and maintenance processes have been well documented in the social network literature. Some of the governing factors that contribute to network formation include theories of homophily, reciprocity, and preferential attachment. In short, these processes have been explored in settings that are racially/ethnically diverse, geographically open, and in locations that have meaningful variation in age groups. AI/AN reservations provide a unique backdrop where these governing network principles may not be as free to operate. AI/AN reservations are often geographically isolated, have small age cohorts, and adhere to different cultural norms around social interactions. Documenting the processes that govern social connections among AI/AN that have recently attempted suicide can provide meaningful insight into the processes that may be unique to this high-risk group.

Univariate analyses will be presented to provide a description of demographic characteristics, suicide history and substance use history for both study groups (index members vs. network members). Second, we will present the results of our working hypotheses examining if individual network factors predict being an index participant: 1) a greater proportion of AI/AN who have attempted suicide will identify at least one network member who attempted suicide (lifetime, past 6 months) compared to network members; 2) a greater proportion of AI/AN who have attempted suicide will identify at least one network member who engaged in alcohol and illicit drug use (past 6 months and poly-drug use) compared to healthy controls, and 3) AI/AN who have attempted suicide will have fewer network members who provide emotional support than network members.

### **Exploring the association between occupational social networks and the justification of social inequality in Chile.**

Guillermo Beck-Villarroe<sup>1</sup>

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To inquire about the redistributive preferences that people have, necessarily, implies to link it to the question about the inequality level considered fair within a society. Empirical evidence has found that self-interest and society's normative beliefs would be key mechanisms to explain how redistributive preferences are shaped in people. Specifically, in the field of norms, values and beliefs, literature identifies distributive justice as a relevant value to explain redistributive preferences. However, that literature does not identify how the processes of socialization and social interaction may be operating to conform norms and beliefs regarding distributive justice and, therefore, on the justification of social inequality. For all of the above, it is worth asking: To what extent, features such as the heterogeneity and composition of contact networks are related to the justification of social inequality in the Chilean society?

Using the Longitudinal Social Study of Chile, ELSOC 2016 (n=2094), with a national representation, the descriptive results show that people does not justify segregated access to education, health and pensions due to economic factors. Though, it is important to highlight that, in comparison to Health and Education, Pensions have a greater agreement to justify inequality. Meanwhile, correlations between variables are high, especially between Health and Education. Additionally, surveyed people have occupational networks of 24 people, on average size, which shows a high work-related heterogeneity; that means acquaintances' networks, declared by people, come from diverse working areas. Nevertheless, in terms of composition, it is clear that respondents' networks -despite being highly heterogeneous- present a high concentration since individuals get to know, mostly, people who perform tasks associated with a low socioeconomic status.

Ordinal Logistic Regression Models were used to explore whether extensive contact networks feature (heterogeneity and composition) influence on inequality justification regarding Health,

Education, and Pensions. The primary results show that: heterogeneity indicates that those who know people from different occupations will have a lower justification of inequality for education and health. Meanwhile, for pensions, heterogeneity is statistically significant only in the presence of the composition, which indicates that those with a heterogeneous network, constituted mainly of people with low socioeconomic status occupations, will have a lower inequality justification. Regarding pensions, it is possible to determine there is a greater justification for inequality in economic terms, compared to health and Education, among Chileans.

The results show that the characteristics of extensive contact networks exert an influence on the justification of inequality that people have. Thus, studying these types of variables can help to understand the conformation of distributive justice ideals and redistributive preferences among people.

### **Exploring the Personal and Academic Networks of First generation and Continuing Generation Students at Colorado State University**

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<sup>1</sup>Colorado State University, <sup>2</sup>Colorado State University

Despite efforts to support first generation (1<sup>st</sup> gen) students at large research universities, their retention rate still does not keep up with continuing generation students (cgen). In our longitudinal cohort study of 1<sup>st</sup> gen and cgen students, we follow a sample of fall 2016 Colorado State University students to answer, how do personal and academic networks impact student retention and success? We are currently three years into our four-year longitudinal cohort study where we use network maps and semi-structured interviews to track the networks of 1<sup>st</sup> gen and cgen students. This paper reviews results of first year analysis (1<sup>st</sup> gen  $n=43$ , cgen  $n=34$ ). Data analysis from year one demonstrates that a majority of 1<sup>st</sup> gen students have smaller sized networks and less diverse networks. For both groups, the students with larger and more diverse networks had higher GPA's. Our study argues that this retention gap is an example of Rainie and Wellman's (2012) claim; the emerging divide in this world is not the 'digital divide' but the 'network divide.' As research links student networks with effective college going transitions and achievement, we must observe the persistent patterns of these networks and connect first generation students to a network for success.

### **EXPLORING THE RELATIONSHIP BETWEEN SOCIAL NETWORKS OF TV SERIES PRODUCTION CREWS AND SERIES SUCCESS INDICATORS**

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The proliferation of the television series content in recent years resulted in the obscurity of the idea of a TV project success. Existing studies focused on various features that could be major contributors to the finale outcome. However, a few scholars attributed TV series success to the individual network characteristics of those who are involved in the production process, while the concept of team formation has become one of the most critical within the industry. The topic of team formation majorly concerns the television series industry. Indeed, the project-based nature of this field implies considerable efforts of a team composed of numerous specialists such as directors, producers, screenwriters, actors, and other personnel. In the case of TV show production, technical and managerial skills become focal for the successful product to be made.

In addition, the pattern of interconnections between people who are working within the industry and the individual network characteristics of professionals play a crucial part.

The current research paper is aimed at extending the literature on the topic of TV series success indicators. We will make attempts to figure if there is any interconnection between social network characteristics of TV series production crews and the show success. The SNA indicators (degree centrality and betweenness) and the statistical tools are applied to scrutinize the relationships and positions of television series professionals within 297 TV projects released in the USA during 2005-2017. The television shows are randomly chosen from the IMDb database that provides the whole population size of 1 490 titles. The cast of the TV series (actors and actresses participating in the show) is excluded from the sample and the most significant members from the production teams are studied. The *Gephi* tool is used to visualize the networks and understand the crucial characteristics. The *Stata* tool is utilized to retrieve the relationships between these characteristics and the TV series success indicators (rating, the number of nominations and wins of the show).

Following the research question of the paper, we constructed several logistic regression models, which revealed curious insights about the factors that potentially impact the shows' success. The analysis indicated that the rating of the TV series is not at all attributed to the size of the team engaged in the production process. What is more, the experience of the crew members (the mean degree measure) had a negative effect on the rating points, meaning the more projects the members were making, the lower was the rating of the products they shot. Additionally, we figured that the number of nominations and particular genres of the television shows influenced the final outcome, e.g. the higher was the number of nominations, the higher was the rating.

### **Eyes on the Horizon? Fragmented Elites and the Short-Term Focus of the American Corporation**

Richard Benton<sup>1</sup>, J Adam Cobb<sup>2</sup>

<sup>1</sup>University of Illinois, <sup>2</sup>University of Texas

In recent years, scholars and popular commentators have expressed concerns that U.S. corporations are too focused on short-term performance, thereby undermining their long-term health and competitiveness. This paper examines how this focus on short-term strategies and performance, or short-termism, results from the dissolution of the American corporate elite network. In particular, we argue that the corporate board interlock network traditionally served as an important collective resource that helped corporate elites to preserve their autonomy and control, mitigating short-termism. In recent years, changing board-appointment practices have fractured the board network, undermining its usefulness as a platform for collective action and exposing corporate leaders to short-term pressures. We develop and apply a cohesion metric for network managerialism, derived from theory and evidence in social-network scholarship. Using three indicators that capture short-termism earnings management and shareholder returns, we identify a structural basis for managerial short-termism that links external, network-based resources to managers' decisions. The results highlight the benefits of the corporate elite network and illustrate unforeseen consequences of the network's dissolution.

"This abstract is related to Corporate Networks"

**Failure of eigenvector centrality and a new perspective**Kieran Sharkey<sup>1</sup><sup>1</sup>University of Liverpool

In social network analysis, eigenvector centrality is frequently used as a method for ranking the most significant individuals in a network. Unfortunately it is becoming increasingly apparent that it has significant flaws which make it unreliable.

In particular, I will discuss recent work in the physics literature on the phenomenon of 'localization' of eigenvector centrality. Localization in this context means that the centrality becomes unreasonably focussed on specific parts of the social network which can lead to uninformative results and incorrect conclusions.

It is reasonably well-known that localization occurs when there are highly connected individuals which take up a large proportion of the centrality. Building on some previous observations, I will extend this by proving that eigenvector centrality also exhibits significant localization problems if the network can be easily fragmented.

I will argue that these problems are symptomatic of fundamental problems with the justification of this metric. As a resolution, I suggest that eigenvector centrality should not be used as a centrality measure itself, but rather viewed as an approximation to more robust measures such as Katz centrality.

**Family Conflict and Immigrant Status Shape Associations between Peer Networks and Psychological Adjustment among Immigrant and Native Adolescents in Greece**Olga Kornienko<sup>1</sup>, Frosso Motti-Stefanidi<sup>2</sup>, Adriana Umana-Taylor<sup>3</sup><sup>1</sup>George Mason University, <sup>2</sup>The National and Kapodistrian University of Athens, <sup>3</sup>Harvard University

During adolescence, peer relationships become prioritized over family relations and contribute to psychological adjustment through peer influence and selection processes (Brechwald & Prinstein, 2011). Nonetheless, family dynamics continue to play a role in adjustment and may permeate into peer system to amplify the strength of peer influence (Steinberg & Monahan, 2007). Such interactive effects of family on peer dynamics have been under-investigated in peer network research despite the robust associations documented at the individual level of analysis (Marshall Levesque et al., 2014). Additionally, limited attention has been directed at understanding peer dynamics contributing to the psychological adjustment of immigrant youth (see Svensson et al. 2012 for an exception). Thus, the goal of this study was to address these gaps by examining contextual influences (family conflict and immigrant status) on peer selection and influence on psychological adjustment (i.e., emotional problems, conduct problems, academic achievement). Specifically, we examined these research questions: (1) is there a significant friendship network selection on psychological adjustment, (2) does the magnitude and direction of friendship selection processes vary between immigrant and non-immigrant youth and by levels of family conflict, (3) is there a significant peer influence on psychological adaptation and school performance, (4) do immigrant status and family conflict significantly moderate the strength and direction of peer influence on psychological adjustment, and (5) does friendship group composition in terms of immigrant status and family conflict contribute to an increase in psychological adjustment over time.

We investigated these questions using a sample of 1,252 adolescents (54% boys, *M*age at Wave 1 = 12.67, *SD* = .68) who were recruited from 14 middle schools in Athens, Greece and assessed at three yearly time points. Students were asked to nominate 3 best friends from their classroom and completed self-report measures of psychological adjustment. We conducted multi-group SABM analyses using *RSiena* 4.0 (Ripley et al., 2018; Snijders et al., 2010).

Results showed that youth with higher GPA were more often nominated as friends by their classmates and GPA homophily promoted peer selection. Emotional and conduct problems were unrelated to friendship selection. Family conflict moderated contributions of homophily effects such that adolescents with higher levels of family conflict selected friends who had dissimilar levels of conduct problems to them. Peer influence was documented for emotional problems, conduct problems, and GPA. Immigrant youth experienced lower levels of peer influence on conduct problems between grades 7th and 8th, whereas between grades 8 and 9 this pattern was reversed -- immigrants experienced higher levels of peer influence on conduct problems. Family conflict was not a significant moderator of peer influence effects. However, alters' levels of family conflict were inversely related to increases in ego's conduct problems. Finally, when egos reported having a greater proportion of friends who were immigrants, they reported decreasing levels of GPA between grades 8 and 9. Theoretical and applied implications will be discussed.

### Flow in Organizations

Valdis Krebs<sup>1</sup>

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People inside organizations are embedded in a tangle of connections, both prescribed (i.e. hierarchy) and emergent (i.e. advice network). In order to understand the entanglements and flows in organizations, social network scholars and practitioners have applied network analysis to map and measure organizational conversations and connections. The concepts of *centrality* and *community detection* have emerged as key to understanding what organizational structures are present and who is important within and between them.

As social network analysis *practitioners* with 30 years experience, we have observed four inconsistencies with the common approach to measuring network centrality and detecting organizational communities:

- 1) Information does *not* just travel along geodesics
- 2) Long network paths are rarely utilized in human networks, and problematic when they are
- 3) Emergent network communities are not discreet, they overlap and intersect with similar communities – group membership is fuzzy, not crisp
- 4) Communities with widely divergent contexts rarely communicate, and often have great difficulty when they do

Prominent network scholars have found limits into how far information/influence travels in human networks. Noah Friedkin found that knowledge about others had a short horizon in professional networks – usually two to three steps from ego. Mark Granovetter, studying job search, found no successful chains of job information sharing with more than two intermediaries (3 steps). A vast majority of jobs were found through very short chains of zero or one intermediary. Christakis and Fowler have observed that influence travels a maximum of three steps in human networks, and diminishes with each step, usually resulting in a very weak effect at step three.

Based on this research and our experience with hundreds of clients, we developed a set of network centrality measures and community detection algorithms, specifically for organizational networks, that focus on flows *along all network paths* (not just geodesics) *within a network horizon of two or three steps*. These metrics are both more reflective of what we see, and easier for our clients to understand and utilize. They are similar to, yet different from, the common SNA metrics used today. Advantages of these new metrics are fivefold:

- 1) reflect the pattern of people who share a common work/social context
- 2) reflect the subtleties of distance and distortion in human networks
- 3) easy to explain to non-experts and organizational clients
- 4) efficiently calculated for large networks
- 5) follow basic properties of networks
  - a) homophily
  - b) propinquity
  - c) being connected to highly central actors improves one's centrality

The intent of our presentation is to start a conversation with the academic community about these patterns and improved ways to measure conversations and connections in organizations. We look to build bridges between researchers and practitioners.

### **FOAF+: Friend of a Friend with Benefits Ontology**

Muhammad Amith<sup>1</sup>, Kayo Fujimoto<sup>1</sup>, Cui Tao<sup>1</sup>

<sup>1</sup>University of Texas Health Science Center at Houston

Ontologies are representational artifacts that describe domain knowledge in a graph-like structure. These computable artifacts link abstract concepts and use logical links that can imbue meaning from data and knowledge. There has been little work in using ontologies for social network analysis, specifically within the public health domain, where their semantic features could help to discover new knowledge and information in human social interactions.

Currently, there is a well-known lightweight social network ontology called the FOAF (Friend of a Friend) ontology, which describes relations between people. FOAF only describes a simple “knows” relationship which provides very little analysis potential. We present an extension of this work that we have in development called FOAF+ (Friend of a Friend with Benefits) ontology that aims to standardize the spectrum of human relations between individuals and rules to support them.

We will discuss the development of FOAF+ based on existing ontologies, and research and survey data using Protégé. Also, we will discuss and demonstrate some use cases that applies this ontology and future directions for prospective research endeavors. The potential benefits of our efforts will help facilitate standardization and sharing of the concepts and knowledge of human relations, support complex data store and querying capabilities of social networks, and lastly provide a computable format for machines to reason with the ontology.

### **For better or worse: closeness, conflict and complexity in family networks**

G. Robin Gauthier<sup>1</sup>, Jeffrey Smith<sup>2</sup>

<sup>1</sup>University of Nebraska-Lincoln, <sup>2</sup>University of Nebraska-Lincoln

This paper addresses recent calls to represent the complexity of social relationships more fully by examining patterns of closeness and conflict in ego-centered family networks. Most commonly, research on ego-centered networks asks respondents to list the contacts with whom they have a particular kind of relationship (marriage, friendship, discussion). Typically, no further information about the content of those ties is obtained. However, it is widely recognized that relationships are complex, containing both positive and negative elements. For example, people may report experiencing both strong emotional attachment and conflict with a romantic partner. We suggest that these multiplex relationships, where closeness and conflict coexist, are an important feature of family life, but one that we know relatively little about. Our goal is to explore such relationships in full, showing where multiplex relationships are most likely to form within families and where simpler relationships are more likely.

We empirically examine family networks using a unique ego network data set. The data were collected as part of the 2018 Nebraska Annual Social Indicators Survey (2018 NASIS). Ego-networks were elicited using an inclusive definition of family. Respondents were asked to name up to 5 people they considered family, even if those people were not traditional kin (i.e., this could include friends, romantic partners and the like). The prompt also made clear that a family member could be someone that they did not get along with, as long as they considered them family. The survey asked respondents how emotionally close they felt to each person they nominated, and how much conflict they experienced in each relationship. They were also asked to provide the same information about relationships between their alters. We take this multi-relational data and

predict which relationships are multiplex and which are purely conflictual or purely positive. Our results suggest that family relationships are often multiplex, with 56% of respondents reporting at least one multiplex relationship. Similarly, 37% of all family relationships are multiplex, incorporating both conflictual and emotionally positive elements. These multiplex relationships are most likely to exist between spouses but are found in every type of relationship, including friends and other non-relatives the respondent considers part of their family. In this way, it is not simply the kin/non-kin distinctions or the characteristics of ego that predicts which relationships are multiplex. Instead, we suggest that much of the reason why one relationship is multiplex is because of the kinds of relationships that exist around that ego-alter pair. For example, we find that people who report that their family members have multiplex relationships with each other are more likely to have multiplex relationships themselves, net of ego-alter attributes. Overall, our findings show the importance of taking a multi-relational view — where even the most intimate, emotionally intense relationships can have elements of conflict, with important consequences for our understanding of what the ‘family’ is.

### **Forecasting Election Outcomes Using the Semantic Brand Score**

Andrea Fronzetti Colladon<sup>1</sup>

<sup>1</sup>University of Perugia

This study uses the Semantic Brand Score, a novel measure of brand importance on big textual data, to forecast election outcomes based on the analysis of online news. About 35,000 online news articles were transformed into networks of co-occurring words and analyzed combining methods and tools of Social Network Analysis and Text Mining. Forecasts, made for four voting events in Italy, provided consistent results across different voting systems: a general election, a referendum and a municipal election in two rounds. This work contributes to the research on electoral forecasting by focusing on predictions based on online big data; it offers new perspectives about the textual analysis of online news, through a methodology which is relatively fast and easy to apply. This study also suggests the existence of a link between brand importance of political candidates and parties and electoral results.

### **Forecasting Tourism Demand: A Social Network Analysis and Text Mining Approach**

Andrea Fronzetti Colladon<sup>1</sup>, Barbara Guardabascio<sup>2</sup>, Rosy Innarella<sup>3</sup>

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Forecasting tourism demand has important implications for both policy makers and companies operating in the tourism industry. In this research, we applied methods and tools of social network and semantic analysis to study user-generated content retrieved from online communities which interacted on the TripAdvisor travel forum. We analyzed the forums of 7 major European capital cities, over a period of 10 years, collecting more than 2,660,000 posts, written by about 147,100 users. We present a new methodology of analysis of tourism-related big data and a set of variables which could be integrated into traditional forecasting models. Results show that models which include social network and semantic variables often outperform univariate models and models based on Google Trend data. Forum language complexity and the centralization of the communication network – i.e. the presence of eminent contributors – are the variables that seem to contribute more to the forecasting of international airport arrivals.

**Fossil fuel divestment, higher education institutions, and the corporate community: Corporate influence on institutional environmental policy**

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<sup>1</sup>Université de Moncton, <sup>2</sup>University of Oregon

Climate change campaigners have made a strong moral and financial case for universities and other institutional investors to divest from fossil fuels, even though the argument remains contested. Reflecting the ambiguity of whether divestment would concur with trustees' fiduciary mandate or would contravene to it, several higher education institutions have divested from fossil fuels whereas others have decided not to. This paper develops a structural perspective of divestment decisions among higher education institutions in the United States. Building on studies showing that the embeddedness of colleges and universities within a web of interlocking corporate directorates impacts on policy decisions through various mechanisms, we analyze how these board-level connections with the corporate community influence institutional decisions to divest or not. Using social network analysis tools, we map out the patterns of corporate connections maintained by college and university board members and trustees, with special attention to connections with the fossil fuel industry. Analysis uses quadratic assignment procedure regression to determine how the structural embeddedness of higher education boards within the intercorporate network affects the probability and level of divestment commitment by universities and colleges based in the United States. This analysis will shed light on some of the mechanisms of corporate influence in higher education, and on institutional-level environmental policy. This abstract is related to corporate networks.

**Framing Climate Change and the Problem of Embeddedness**

Fedor A. Dokshin<sup>1</sup>, Sebastien Parker<sup>1</sup>

<sup>1</sup>University of Toronto

Attitudes toward climate change are deeply divided along the lines of political ideology and partisanship. This division contributes to the political inaction on one of the most pressing issues of our time. It is also a reminder that major obstacles to addressing climate change are social and political. In this paper, we argue that current research on attitude change toward climate change is severely limited by a failure to consider the social embeddedness of communication efforts.

We begin by conducting a systematic review of three top journals that publish environmental social science (Climatic Change, Global Environmental Change, and Nature Climate Change). Our review shows that studies of framing effects dominate social science research on attitude change toward climate change. Framing research evaluates the efficacy of alternative communication strategies by comparing, for instance, the effects of emphasizing different values, highlighting different climate change impacts, and stressing the state of scientific consensus on survey respondents' attitudes. An assumption underlying much of this research is that replacing current communication strategies with optimally framed ones would reduce the attitude gap between liberals and conservatives. The model of attitude change that underlies framing studies, however, has been challenged as simplistic and as lacking external validity. Few studies, for example, consider the heterogeneity in the framing effects across different identities of the communicating parties, the consequence of counter-framing efforts, or individuals' self-selection into alternative informational environments. Attitude change is an interactive and dynamic process, in which framing plays only one part.

Drawing on a rich tradition of attitude change research from a social networks perspective, we place framing research in the context of an interactive, dynamic social system. Toward this end, we distinguish three critical and interrelated elements that contribute to attitude change: (1) the message, (2) the identities of the communicating parties, and (3) the structure of information

flow. Next, we develop a dynamic model of attitude change that integrates these three elements and use it to evaluate the conditions under which framing contributes to aggregate attitude change. We conclude that, despite their prominence in the existing literature, framing effects influence aggregate opinion only under narrow conditions, which require unrealistic assumptions. Based on theoretical results from our model, we conclude by diagnosing blind spots in current empirical research on attitude change related to climate change and make recommendations about important areas for future focus.

**Friends Matter! A Social Network Evaluation**

Gerrit DeYoung<sup>1</sup>, Jaelee Cruz<sup>1</sup>, Zachary Rossetti<sup>1</sup>

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Friendships are a key predictor of psychological, social, and vocational adjustment of school-aged students. Students with disabilities have been found to have fewer, lower-quality, and unreciprocated relationships, potentially limiting their long-term developmental outcomes.

Social inclusion of students with disabilities has long been a concern of researchers and practitioners. Inclusion of students with disabilities in general education classrooms was intended to provide equivalent access to educational and social opportunities as those enjoyed by students without disabilities. However, a number of studies suggest students with disabilities were more likely to be isolated, less likely to be considered a close friend, and more likely to be bullied and victimized, even when they were included for much or all of the day in general education classrooms. Others found students with severe disabilities were sometimes viewed as objects of pity by students without disabilities, and predominantly received paternalistic assistance rather than experience full inclusion. Establishing reciprocal, mutually beneficial social relationships has not yet been fully accomplished, in spite of policy improvements increasing opportunities for students with disabilities to fully participate in general education classrooms.

Friends Matter! is a social-emotional curriculum for elementary through middle school students designed to encourage friendships among all students, with a specific emphasis on inclusion of students with disabilities. Preliminary results from an evaluation study were first presented at the Sunbelt 2018 conference. At last year's conference, baseline data collected in Fall 2017 were presented that demonstrated that students with disabilities were more isolated in classroom social networks. These data will be reviewed, and follow-up data from Spring 2018 will be presented. While by many measures it appears students with disabilities did not occupy equivalent positions as those without after participating in the intervention, differences in betweenness centrality between students with and without disabilities were no longer significant in the Spring, suggesting students with disabilities started playing as prominent a role in their classroom social structures as students without. In addition, a number of measures in non-preferred networks also indicated greater equality between students with and without disabilities, although some measures suggested students with disabilities potentially gained prominence in the non-preferred social network, indicating a diminished role within their social networks. In addition to quantitative data, responses from focus groups and interviews were also gathered, which will be presented to provide context and nuance to the quantitative data. While some measures suggest Friends Matter! may have been effective, a number of important limitations and future directions for research will also be discussed.

These results will add to a small and growing literature investigating strategies to ensure full inclusion of students with disabilities in regular education classrooms, as well as efforts to use social network analysis to evaluate intervention efforts in educational settings.

**From a binary to a multidimensional approach: Revisiting the role of social capital for immigrants' labour market integration in Germany**

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<sup>1</sup>University of Göttingen

The nexus between immigrants' personal networks and their access to the receiving country's labour market has been thoroughly discussed in social sciences. It is well established that informal job search methods figure as an important source for immigrants to avoid unemployment (Kogan 2011), escape from poverty (Heinzmann & Böhnke 2016), earn more income (Lancee 2010), and enter into more prestigious employment (Kalter & Kogan 2014).

Previous research presents inter-ethnic contacts per se as beneficial for immigrants' labour market success (Riedel 2015; Lancee 2012). We aim to revise the common binary approach of social capital. In line with Ryan (2016), we assume that the resources accessed by social relations do not only depend on the ethnic identity of the contact, but also on their relative social location defined as horizontal and vertical social capital. Thus, we develop a multidimensional concept of social capital that also accounts for the educational level of the contacts. Accordingly, having friends with a higher level of education friends (vertical capital) compared to those with lower levels (horizontal capital) should be crucial for labour market success.

Drawing on two panel studies 'Socio-cultural Integration Processes among New Immigrants in Europe' (SCIP) and 'Socio-economic Panel' (SOEP), we examine the impact of the respondent's three best friends on the occupational status of immigrants in Germany. By running linear regressions with time-lagged-independent variables we reduce the problem of potential reversed causality (DiMaggio & Garip 2012). We adjust the previous equation of bridging and bonding capital with inter- and intraethnic contacts by further differentiating contact persons with higher and lower social positions (vertical and horizontal capital). The social location of these contact persons is measured by considering their level of education.

The empirical findings confirm our theoretical assumptions: Interethnic ties per se are not advantageous for the occupational status of immigrants. Only if these contact persons provide resources and information associated with a higher social position (vertical capital), are they associated with more successful labour market integration. Social connections to co-ethnics with a higher social position are also helpful for immigrants' labour market integration, although to a lesser extent compared with ties to natives with a higher social position. Friends with a lower social position (horizontal capital) do not improve the economic outcomes regardless of their ethnicity.

Our results highlight the relevance of further rethinking and revisiting the theoretical and empirical approach of the link between social contacts and labour market success of immigrants. The assumption, all social contacts to natives are conducive to make headway on the labour market, is too simplistic. Our study provides important insights into a more nuanced understanding of different forms of social capital for immigrants' labour market integration. Further, our results support basic assumptions of 'the theory of segmented assimilation' (Portes & Zhou 1993); labour market integration is possible having interethnic capital ('mainstream assimilation'), but also having intraethnic capital ('selective acculturation').

**From Curves to Grids: New Directions in the Simulation and Analysis of Blau Space**

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Ecological models have proven to be very useful tools for modeling competition within social environments. These models have been employed to better understand relationships among organizations (Hannan and Freeman 1977), the competition for members among voluntary

associations (McPherson 1983; McPherson and Ranger-Moore 1991), and even the spread of behaviors between groups (Brashears et al. 2017). Much of this work builds on insights from ecology and biology (MacArthur 1972; Hannan and Freeman 1977), and has been extended to social settings by imposing restrictions on social structure and homophilous association (e.g., Blau 1977; McPherson 1983; McPherson and Ranger-Moore 1991). However, while valuable, these ecological approaches to computational network research face a number of issues, particularly when it comes to utilizing ordinal or categorical variables.

Ecological models of competition have typically focused on overlap in normal or skewed distributions of populations or their consumption of resources, with the area of overlap between curves illustrating competition. But this can result in falsely concluding that competition is high when a majority of the recruitment population for the ecology is only found in this range. In addition, traditional models are restricted to continuous and interval variables; to be used, categorical variables must be transformed into an ordinal or interval variable; often by transforming them into a type of ratio. These mathematical representations impose assumptions about the degree of difference between levels of a variable, which is often incorrect (Burt 1991).

We propose to fix these problems by introducing a new method of Blau Space modeling and analysis that places sociodemographic data on a multi-dimensional grid instead of using a distribution. This approach combines existing Blau space theory with cellular automata models and urn models (a type of stochastic model for discrete outcomes). This new approach utilizes simulation through cellular automata and urn models to provide stochastic change to the ecology over a series of microsteps, which are aggregated into overall macro-ecological change. To evaluate the results of this simulation, we propose new metrics to measure the recruitment space of an organization, with focus on the range over which an organization recruits members, and the intensiveness of their attempts at recruitment in particular cells. We develop and test this model with data from two sources: randomly generated data, and data on members of the Ukrainian Parliaments from 1998 to the present.

### **From Experimental to Supplemental: The Evolution of NWS' Use of Twitter for Hazard Communication**

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The communication of hazard-related information has undergone continuous change alongside advancements in technology and available media. From sirens, to public broadcasts systems using radio and television, the predominant medium may be displaced and the way in which it is utilized may also change. In the past decade, organizations like the National Weather Service (NWS) have been adopting the use of Online Social Networks (OSNs) as potential avenues to spread strategic real-time hazard information and alerts. On these OSNs, their goal is to increase public protection through hazard awareness and preparation, which should ultimately reduce the loss of life. According to early account descriptions, the NWS began using the microblogging OSN Twitter “experimentally,” yet ten years later this experiment has evolved into a key supplemental channel for the transmission of information especially for the promotion of weather awareness. This project utilizes social network analysis and structural entailment analysis to compare NWS communication patterns and to look at how they have changed from their “experimental” phase to their current “supplemental” use. To chart the maturation of a communication media through a topic as important as hazard information provides potential insight into the adaptation and changes of communication strategies. Additionally, these findings may offer ways to improve the communication strategies of organizations similar to the National Weather Service.

### **From logical frameworks to social frameworks: the integration of SNA as a standard tool for evaluation.**

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In 2005 the American Evaluation Association's most noted publication, *New Directions for Evaluation*, devoted its issue 107 to Social Network Analysis as a promising new tool for program evaluation. Works in different areas have been appearing since, including SNA approaches for the evaluation of program implementation (Valente, et al., 2015), Cluster Development Programs (Giuliani & Petrobelli, 2011), prevention programs in healthcare (Gest et al. 2009) or educational evaluation (Penuel et al., 2007). Despite the potential that those works have recognized to SNA for evaluation, its status as a "promising new tool" somehow remains, and the truth is that has not been integrated in standard and systematic protocols for evaluation so far.

The aim of this paper is twofold. On the one hand, we will try to examine what the obstacles are that make so difficult either integrating SNA in standardized frameworks for evaluation or coming up with ready-to-use valuation protocols entirely based on SNA methodologies. On the other hand, we will use a real evaluation as case example to suggest how SNA could be introduced in order to orientate the evaluation to social impact.

### **From Mathematical Certainty to Creative Serendipity: Lessons from Japanese Advertising**

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Drawing on data from advertising contests in Japan and the author's experience as an anthropologist employed for more than a decade as a copywriter and creative director at a large Japanese advertising agency, this presentation examines the relevance of social network analysis to the study of creative processes by which new culture is generated. Instead of assuming a binary opposition between scientific and interpretive research, it argues for a multilayered approach that starts at one extreme, the mathematical certainty of random graph models, and ends at the other, the creative serendipity described in the back story of a famous advertising campaign, stopping along the way to examine how changes in media and economic fluctuations affected network properties and cultural processes.

The presentation has four parts: (1) Absolutely predictable properties of large networks; (2) Effects on networks of media-driven changes in the size and composition of creative teams; (3) A perennial debate about the role of copy and copywriters in advertising for which changes in team composition and skill sets provide crucial context; and (4) ethnographic anecdotes that illustrate the totally underpredictable serendipities that produce award-winning advertising. New data from 2011 and 2016 are added to previous data from 1981,1986,1991, 1996, 2001 and 2006 to explore effects of the rise of Web-based advertising on networks previously dominated by TV and print media.

### **From Tech- to Human - Centred: The Role of Innovation in a Blue Economy**

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Conference Session theme: Innovation Networks

The world's oceans are entering a new phase of large-scale industrialisation. Countries around the world are embracing the idea of pursuing new and innovative development opportunities in their

marine jurisdictions. At the centre of this new 'Blue' Economy lies a focus on technical and technological innovations. These innovations are designed to tackle future complex challenges, while improving knowledge of the oceans and its uses and users, creating efficiencies along value chains, and enabling connections between people engaged in ocean use and management. Despite the emphasis on technical and technological 'fixes', innovation relies on human ingenuity, expertise and perseverance. Through a series of semi-structured interviews, we conduct a social network and thematic analysis of a 'Blue' Innovation system in regional south east Australia. We uncover key players - innovators, governance (policy and people) and their interactions. Given that collaboration is central to developing complex solutions, we also explore patterns within networks (across sectors, tiers of governance, and policy) that aid or constrain innovation. Through these structural patterns and themes expressed by participants, we explore the way the Blue economy is currently being enacted, challenged and operationalised in the communities of coastal south east Australia. We find that, despite numerous attempts to foster and grow innovation, the most common and important stories of innovation involve an entirely human and organic process driven by a recognised need and an established problem. The implications for the emerging discourses around the Blue Economy are considered, in particular the limitations of technical and technological innovation as a panacea, suggesting that broader, human-centred notions of innovation may better reflect community aspirations for a more inclusive and greener Blue Economy.

Keywords: Blue Economy, innovation system, technology, key players, policy.

### **Gender and Borrowed Social Capital: An Empirical Test**

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Research shows gendered benefits from workplace social capital. While men commonly accrue benefits from more brokerage-based social capital in the workplace, the effects for women are more variable and may even be reversed. Emerging from these findings was a hypothesis that women instead benefit from borrowed social capital – particularly the social capital of a senior (male) sponsor. We can find little supportive empirical evidence of this women-borrow-social-capital hypothesis. This study tests this hypothesis. We use a form of sponsorship commonly documented in organizations: referrer-referral relationships among job applicants. By combining job applicant data and outcomes, organizational HR data, and communication network data for indicators of workplace social capital from a large US organization, we test whether sponsors' workplace social capital influences the success (i.e., being hired) of those they sponsor (sponsees, i.e., referral applicants). We further test whether any sponsor effects vary with the gender of either the sponsors or the sponsees. From these tests, we provide empirical answers to the following questions:

Our data come from one year of application, referral, and hiring data from a large (approximately 10,000 employees) U.S. firm.

For **workplace social capital**, we calculated two measures of sponsors' workplace social capital from communication network data from the firm's email server logs. The first measure is **Burt's constraint** – a direct indicator of closure-based social capital, and a reverse-coded measure of brokerage-based social capital. The second measure is the presence of a **direct tie** (via email) from the referrer **to the hiring manager** responsible for hiring for the position to which the referral applicant applies.

The **outcome** measure for sponsee success is applicant **hire**.

We regress the hiring outcome on referrer's social capital, with interactions with referrer's gender and applicant's gender. To control for all job-level factors, we conduct a within-job-opportunity

analysis. Because our outcome variable is binary, we use a conditional logit. Controls include: whether the referrer works in the same business unit as the job opportunity, and the pay level of the referrer.

Although we do find evidence that sponsees benefit from the social capital of their sponsors, our results challenge the women-borrow-social-capital hypothesis.

### **Gender and networking: Building and benefiting from ties to formal and informal leaders in the workplace**

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While organizations have significantly reduced the overt and intentional forms of sex discrimination that impeded women's careers in the past, a great deal of research suggests women continue to face informal barriers in the workplace. One such arena in which women tend to be disadvantaged is in their workplace networks. In many ways, men and women have similar networks, yet women are less likely than their male counterparts to have personal relationships with formal and informal leaders (i.e., high status employees). Scholars have long suggested that these strategic connections are valuable and may be especially beneficial to or necessary for women. Networking has long been touted as one way women can overcome workplace disadvantage by strategically developing and/or capitalizing on such networks, which can enable their success and satisfaction at work. However, networking is a considerable investment. Indeed, networking has been called women's third shift, after work and family responsibilities. As such, it is vital that we understand how women and men can best capitalize on their investments in networking. This research seeks to add to our scholarly understanding by examining the extent to which men and women can translate their networking behaviors into connections with formal and informal leaders and capitalize on those connections to enhance their performance and job satisfaction. Results suggest networking behaviors enable men and women to have friends with leaders in terms of content expertise (i.e., those with higher informal status). However, while men's networking behaviors are related to higher ranking (formal status) leaders as friends, women's networking behaviors are related to having lower ranking friends. Post-hoc analyses begin to explore the possibility that these gender differences are due to choices made by or others' reactions to male and female networkers. Results also distinguish between employees' gender and legitimacy to shed light on how and why men and women can develop and capitalize on connections to formal and informal leaders, providing practical implications for employees and organizations seeking to intervene to enable women and men to develop high status connections. This research uses multiple datasets--each using multimethod data over multiple time points--to illuminate ways in which both women and men can translate their networking behaviors into connections with leaders, workplace performance, and job satisfaction.

### **Gender and the adverse effect of social mobility on personal networks: a case study using qualitative network methods**

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Much has been written, from Sorokin to Bourdieu, on how long-range social mobility has negative and disruptive effects the personal networks of individuals. Countless studies document how for socially mobile individuals, crossing class lines means performing new attitudes and behaviors which may be frowned upon in their families of origins, making it difficult maintain connections with to their social background, including family, friends and the wider community. While this

process has been the object of a wealth of studies, little is known about whether and how gendered dispositions and role expectations might interact with this pattern of relational decay. Leveraging qualitative network methods, the present study furthers our sociological understanding of how the relational challenges associated with upward mobility are affected by gender. More specifically, I draw on 32 in-depth interviews exploring the subjective experience of low and middle-income background students attending elite liberal arts universities in France. I first chart how the acquisition of new ways of being, feeling and acting through elite education is differently received in students' family depending on their gender. In this regard, I find that displays of highbrow cultural displays are less likely to generate pride, more likely to be met with calls to order ("you're full of yourself", "you're getting above yourself"), and more often coded as 'pretentious' or 'snobbish' attempts to distinguish oneself in female students' families ("you're just rubbing your culture in our faces"), leaving them with negative affects ranging from frustration to guilt. I then turn to the strategies female students enforce to alleviate and avoid these relational frictions. Female students are expected to downplay the growing cultural differences between them and their families. Thus, they gradually learn to monitor how they behave and speak when interacting with their families. While this pattern is not entirely absent among male interviewees, it is overwhelming among female students. Overall, this study shows some of the processes through which gendered role expectations may shape the effect of social mobility on personal networks, with women being more often expected to repress the cultural markers revealing their social ascent to preserve their familial relationships.

### **Gender Differences in Depression of Single Young Adults: the Influences of Romantic Relationships and Social Network**

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The influence of romantic relationship in depression includes the romantic relationship of single young adults, and marital relationships. Past research has focused on the impact of different marital status in depression. Research consistently shows that married people report less psychological distress than those who have never married, those who are divorced, and those who are widowed. Scholars attribute these patterns not only to the stress-inducing nature of marital loss but also to married persons' greater social, psychological, and economic resources. However, compared with research on marriage, fewer studies examine the association between non-marital

intimate relationships and depression among young adults. At the same time, the education level has increased, the economic pressure of life has increased, the effects of late marriage, delaying the birth and declining birth rates in recent years have made most of the young adults (18-35 years old) in an unmarried status. Therefore, in addition to the need to find a stable job, young people also begin to develop their romantic relationships. So we know it is very important to understand the physical and mental health status of unmarried men and women at this stage. This study used the data from "Taiwan Education Panel Survey and Beyond (TEPS-b)" to study the impact of romantic relationships and social network in depression. Preliminary studies have found that single young adults have significant gender differences in depression. Men have romantic relationships and they become less depressed; women have more romantic relationships and they become more depressed. Men have more heterogeneous resources from social capital and they become less depressed; women have more homogenous resources from social support and they become less depressed.

**Gender effects on perceived professional mastery: Evidence from STEM teachers**

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Self-efficacy is a central and pervasive mechanism through which professional mastery is acquired. It refers to the belief in one's capabilities to successfully perform the duties of a given task. Belief in one's capabilities is essential to enlist the cognitive, motivational, and affective resources necessary to master the complex skills required for a given occupation. While self-efficacy research has exploded in the fields of education and health, its potential in the organizational sciences has not been fully realized. Leveraging social cognitive theory as the guiding framework, we document a gender effect in the context of STEM teaching, a profession essential to workforce development. Further, we theorize that the relationship between gender and self-efficacy is contingent on one's age and the community of practice around which the shared craft is practiced. We test our ideas using a sample of 159 STEM teachers from five geographic regions. Our findings broadly support our hypotheses, and provide empirical evidence of the socially determined nature of perceived professional mastery.

**GENDER SOLIDARITY? HOW WOMEN JUDGE OTHER WOMEN IN THE WORKPLACE**

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<sup>1</sup>University of Toronto

Two competing stereotypes apply to how women relate to other women in the workplace. One stereotype portrays women's relationships as mutually supportive. According to this view, gender solidarity leads women to be allies of other women. For instance, women friendship networks tend to be disproportionately female. Women are also more likely to rely on other women to access job opportunities and advance their career. The other stereotype, by contrast, portrays work relationships among women as difficult and competitive. For example, studies of the so-called "queen bee syndrome" have documented women in positions of authority treating subordinates more critically if they are female. Similarly, women are more likely than men to report having negative same-gender ties. While there is empirical support for both stereotypes, as well as insight on the contextual factors that make one stereotype more or less prevalent in a given situation, we lack evidence on how women and men in organizations tend to judge each other as coworkers. These interpersonal judgments are critically important to performance evaluation and career ascension in organizations. Understanding whether and how these stereotypes color interpersonal evaluations is therefore highly consequential to gender relations in the workplace. We explore this question with two datasets. The first concerns interpersonal judgments expressed by employees about their colleagues in a large North-American financial institutions. Across 23,648 dyadic observations, we find strong evidence for gender solidarity. On average, men rated other men more highly than they rated women on all criteria – including competence, warmth, and how much a colleague enabled them to get their job done. Likewise, women rated other women more highly than they rated men on all criteria. To ensure that such evidence of gender solidarity was not the mere artifact of having collected these data in a contemporary organization with a high proportion of women in its workforce and its management ranks, we replicated these findings in a dataset collected fifteen years ago in a male-dominated technology company. Here, too, 9,452 dyadic observations revealed strong evidence for gender solidarity in interpersonal judgments. Women, it appears, are good to other women in the workplace, on average. Men are equally good to other men. This evidence of gender solidarity on

the part of both men and women informs dominant models of performance evaluation, network development, and career advancement in the workplace.

### **Gendered Dependence Structures of Dialogue Networks in Films**

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<sup>1</sup>University of Manchester

We present a novel approach to empirically analysing gender representation in films by using entropy tools.

Multivariate entropy analysis is a general statistical method for analysing and testing complicated dependence structures in data consisting of repeated observations of variables with a common domain and discrete finite range spaces. Only nominal scale is required for each variable, thus making it very suitable for extracting semantic information from dialogues and scripts. Variables on ordinal or numerical scales can also be used, but they should be aggregated so that their ranges match the number of available repeated observations.

Using a corpus of movie dialogue networks, we illustrate how these tools can enhance the analysis of gender representations in films by identifying factors associated with certain tropes of gendered conversation. The observed dialogue networks are transformed into a multidimensional data set comprising multiple node and edge attributes, where the latter is coded according to conversational content between pairs of same sex characters. Under the assumptions that associations between conversational content are shared by members of the same gender group, dialogues are used to reflect a meaning structure that characterize this group (stereotypical and non-stereotypical gender portrayals). Of fundamental importance for this data is the use of joint entropies of pairs of variables. These are used to construct a sequence of association graphs that represent variables as nodes and pairwise dependencies as links between nodes. Occurring cliques in these association graphs represent connected components of dependent variables, and by comparing the graphs, we specify and test a variety of structural models of multivariate dependence.

This application yields a deeper insight into the gendered nature of dialogue in film, an area in which little systematic empirical research exists. Moreover, the multivariate entropy analysis allows for the relationships between textual attributes, production-level attributes and endogenous network attributes to be explored together. This provides a novel opportunity to situate the character networks within their industrial context in a way that provides a new layer to the development of network tools for analysing fictional narrative texts.

### **Generalizability and subgraph-to-graph estimation of ERGMs with multilevel structure**

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A question that has been asked about ERGMs is whether it is possible to generalize, in a well-defined sense, an ERGM with a given set of nodes to an ERGM with more nodes. We show that multilevel structure, in the form of level-one units (e.g., students) nested in level-two units (e.g., school classes), helps generalize an ERGM with a given set of level-two units to an ERGM with more level-two units and hence facilitates subgraph-to-graph estimation. We provide the first statistical theory to show that subgraph-to-graph estimators are close to the data-generating parameters with high probability. These results assume that the number of level-two units grows, and allow the sizes of the level-two units to grow with the number of level-two units. An example is a school that, facing a surge of demand, adds more school classes and at the same time

increases the sizes of all school classes. An example of a multilevel ERGM with edge and GWESP terms is presented.

### **Genesis and the Transformation of the Sociological Ideas since the Second Half of the 20th Century: A Bibliometric Analysis**

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The main purpose of this study is to identify the transformational path of ideas in Sociology in the second half of the 20th century. The objects in the paper are identifying the most significant publications in the second half of the 20th century and building the main transformational path of sociological ideas in the sociology of the late 1950s. Created in 1961, SCI (Scientific Citation Index) allowed scientists to apply quantitative methods in the study of science, using analysis of bibliographic information on publications. One of the emerging methods is "Main Path analysis", based on the algorithm for revealing the most significant chains of citation in the network. Obtained in this study conclusions are based on the application of this method. The result of the study is the history of the transformation of sociology in the second half of the 20th century, obtained by analyzing the citation network between publications in 10 leading sociological journals. The conclusions obtained in this paper can also be applied to a further study of the history of science using qualitative methods.

### **Global scientific collaboration and regulations on research inputs: towards a meso-model of research and innovation networks in a contested resources environment**

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Models of scientific collaboration assume either a macro-level approach (triple helix; or Mode-2) or a micro-level approach in which actors forge collaborations to conduct research and produce new knowledge and innovations. Yet, these models have generally ignored the fact that research problems, collaboration structures, resources and impacts are globally distributed and that the inputs to research (data, materials, equipment) are increasingly constrained by rules, procedures and governance structures that affect their access and use for research and innovation.

Global scientific collaborations are particularly impacted by this situation. They often pool community resources to facilitate sharing of resources for scientific research and innovation while protecting the rights associated with the research inputs and with scientists' intellectual property. Yet, our understanding is poor on how they concretely operate in this increasingly complex environment, and how they deliver critical outcomes or are sustained over time. This paper helps advance understanding of how global scientific collaboration operate as hubs for both scientific advance and for organizing the complex institutional environment related to inputs to research. We ask: 1) How can the contested resources environment be framed for study of global research collaborations?; 2) How are global collaboration initiatives managing their multiple science, regulatory and innovation objectives to facilitate resource sharing?

Considering that access and sharing of research inputs is central for well-functioning and sustained collaboration, this paper develops a framework that considers the interplay between regulations, organizations, collaborative relationships (projects) and resources as determinants of access and sharing of research inputs, which in turn affects the research processes, sustainability and science and innovation outcomes. Our expectation is that global collaborative networks actively address each of these characteristics in ways that help attain multiple goals. We apply our

framework to the field of global collaboration in coffee genetic resources and breeding. Research and innovation in coffee genetics plays a crucial role for the sustainability of the coffee global sector in a context of climate change. Effective management and improvement of coffee genetic resources (CGR) relies on the exchange of resources such as genetic material, data or knowledge between different countries and across continents. It often involves global collaboration among a range of diverse actors interested in CGR but with different capacities, aspirations and motivations. This paper draws from an empirical network analysis of an online survey conducted in December 2018 on a sample of 458 individuals involved worldwide in research activities related to coffee genetic resources and breeding as well as interviews carried out during the 2018 Annual Conference of the Association for Science and Information for Coffee held in Portland, USA. Results from the survey and interview data help identifying to what extent projects and organizations networks are used to obtain resources and overcome potential regulatory obstacles and tensions arising from the broader regulatory and competitive environment. The paper concludes by offering a revised meso-model of the research and innovation enterprise that more accurately depicts the ways in which new organizational networks are responding to global institutional regulations on inputs.

### **Global structures of knowledge-flow networks and local network mechanisms**

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The presentation addresses the global network structure of knowledge-flow networks. A knowledge-flow network operationalizes exchanging knowledge among employees. Therefore, actors in the network represent employees and ties represent receiving different kind of knowledge.

The aim of the presentation is to identify global network structures in the empirical knowledge-flow networks, to define the desired global network structure and to discuss the local network mechanisms that drive the global network structure towards the desired one. Understanding patterns and underlying mechanisms of exchanging knowledge among employees is crucial to ensure competitiveness of a company and to improve the performance and the development of employees.

Blockmodeling is applied on the empirical networks to identify the global network structure. We collected the data within a middle size knowledge-based company in Slovenia at three time points between 2004 and 2007. The evolution of the global network structures is described and the desired blockmodel type for knowledge-flow networks is defined based on the findings from the empirical network data and based on the previous studies on knowledge-flow networks.

To discuss the potential local network mechanisms, the algorithm for creating and dissolving links is proposed. It considers different local network mechanisms mainly selected based on the previous studies on the emergence and dynamics of the knowledge-flow networks. Such mechanisms are popularity of the employees, their hierarchical position, the network distance between two employees, transitivity, tenure and others. The global network structures of the generated networks are compared to the desired ones.

### **Golden Skirts: Busy Women Directors on the Boards of the UK FTSE350**

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In recent years, there has been a scholarly interest on the subject of busy or overboarded directors. The debate on this subject revolves around whether directors with multiple appointments can commit sufficiently to each appointment and be an effective director.

However, the interplay of director's gender and busyness is often neglected, where directors are often treated equivalently in analysis.

The literature addressing the role of gender and director busyness emerges from studies of the Norwegian case. In Norway in 2006, a number of quotas were imposed regarding the representation of women on boards (Huse & Seierstad, 2013; Seierstad & Huse, 2017; Seierstad, Warner-Søderholm, Torchia, & Huse, 2017). Although this resulted in an increased representation of female directors on Norwegian boards, it also created a small group of elite women sitting on multiple boards of directors (Noon, 2012; Seierstad, 2010). These women have been referred to as "golden skirts" and could be viewed as overboarded female directors (Seierstad & Opsahl, 2011). This mirrors the "old boys' network" to some extent, therefore often holding negative connotations when discussed in public forums or policy settings (Huse, 2016).

We provide an exploratory analysis of the male and female directors serving on UK FTSE 350 boards of directors for 2010 to 2018, using Network Analysis measures of centrality and cohesion, as well as an examination of the degree distribution of directors. The purpose is to identify whether the number of female busy directors has increased since 2010, and whether these busy directors hold structurally equivalent positions in the interlock network. We also consider some characteristics of the busy directors, such as their age, their roles on the boards, and sectoral composition of boards they sit on. We are interested to see whether an increase in busy female directors has led to the rise of so called "golden skirt" directors in the UK. We do include male directors in our analysis, in order to make comparisons. We have selected 2010 as the initial point for our data, as it represents an important milestone for gender diversity on UK boards of directors, following the establishment of the 30% Club.

We find that there has been a slight increase in the proportion of busy female directors, whilst the level of busy male directors is slowly decreasing. The sectors where busy female directors are most prevalent include the financial sectors and service sectors.

### **Google matrix analysis of worldwide football mercato**

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The worldwide football transfer market is analyzed as a directed complex network. The football clubs are the network nodes and the directed edges are weighted by the total amount of money transferred from a club to another. The Google matrix description allows to treat every club independently of their richness and allows to measure for a given club the efficiency of player sales and player acquisitions. The PageRank algorithm, developed initially for the World Wide Web, naturally characterizes the ability of a club to import players. The CheiRank algorithm, also developed to analyze large scale directed complex networks, characterizes the ability of a club to export players. The analysis in the two-dimensional PageRank-CheiRank plan permits to determine the transfer balance of the clubs in a more subtle manner than the traditional import-export scheme. We investigate the summer 2018-2019 mercato concerning 8080 player transfers, 1326 clubs, and 153 player nationalities for a total effective transfer amount of 10.3 billions of pounds. We retrieve the fact that Big Five leagues are the most efficient football player importer and exporter. The transfer PageRank-CheiRank balance is determined globally for different types of player trades (defender, midfielder, forward, ...) and for different national football leagues. Although, on average, the network transfer flows from and to clubs are balanced, the discrimination by player type draws a specific portrait of each football club. We investigate the sensitivity of the market to the possible modifications of the trades of a specific club, e.g., sensitivity of Big Five leagues to the player transfer ban of a club resulting from non respect of UEFA financial fair play. We also determine the gini coefficients measuring wealth distribution of

football clubs and national leagues. The reduced Google matrix method allows us to construct the network of the most influential clubs highlighting the most prominent direct and hidden money transfer flows between these clubs.

**Health Care Provider Networks and Health Care Integration**

Julian Fares<sup>1</sup>, Kon Shing Kenneth Chung<sup>2</sup>

<sup>1</sup>Lebanese American University, <sup>2</sup>The University of Sydney

While there are a plethora of network studies in health care, very few have investigated the extent to which health care providers engage with one another on professional and non-professional levels and no studies to date have associated this with health care integration.

In this research, a whole network study was conducted with 56 health care providers in regional New South Wales, Australia. They were asked to report on their network relationships and the extent to which services are integrated within the geographic region. A cross-sectional survey was used to explore five types of service relationships (thus networks): 'refer to', 'refer from', 'team care arrangements', 'socialise' and 'advice to'. The survey also involved an integrated care measurements instrument which has been used to evaluate integrated care across its various dimensions: clinical integration, professional integration, functional integration, normative integration, organisational integration and system integration.

In this paper, we determine the optimal network structure and composition for integrated health care service networks, along with the results regarding the extent of integration for each of the five network relationships explored. Findings show that social network structure (ego-density), position (degree, betweenness) and relation (tie strength, functional diversity) have a vital role in integrating health care services. Moreover, it is demonstrated that social network analysis can be utilized to understand the extent of service integration, and that is by interpreting network density and centralization, clique structures and brokerage roles.

**Health-related homophily in networks of public housing residents**

Neha Gondal<sup>1</sup>, Brenda Heaton<sup>1</sup>

<sup>1</sup>Boston University

Public housing is a national model in the US that provides housing for the urban poor. Despite the original conception to serve as a refuge and safe haven, many public housing settings have instead become focal areas of poor health and health behaviors that negatively affect residents irrespective of any preexisting health conditions. This is due to the complex interplay of the physical and social environment. First, the selection forces that lead to residency in public housing developments result in a nearly homogenous population with respect to social factors and associated implications for disease risk. Additionally, housing developments consist of several buildings containing tightly clustered households. This facilitates the formation of dense social networks within residential communities enabling the spread of disease but also of information and resources. In light on these factors, our goal in this paper is to analyze social networks in such communities and assess their potential as leverage points for promoting health-related behaviors in this population.

Towards this goal, we analyze self-reports of health within social networks among a population of public housing residents in Boston. More specifically, we investigate if residents construct social networks that are homophilous along various health dimensions. Homophily is relevant because it has been shown to have a positive effect on the adoption and spread of health behaviors. Yet, homophily of networks along health attributes also implies that healthy behaviors can remain ensconced within network neighborhoods and not spread to other groups where unhealthy behaviors are prevalent, which has implications for health interventions. Using multilevel logistic

regression models, we find that ego networks are strongly homophilous along overall health status, oral health status, consumption of sugar-sweetened beverages, as well as sugar-sweetened foods. We also find that the type of tie connecting ego to alter has no bearing on health-related homophily. Our findings suggest that health is a socially clustered phenomenon. Much like homophily demonstrated along other notable health-related dimensions like smoking and drinking, orally healthy persons and those that have oral health-promoting habits tend to befriend others who are similar to them. We discuss the implications of our findings for health-related interventions in the context of public housing.

### **Hemodialysis Clinic Patient Social Networks and Living Donor Discussions**

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Understanding the social support networks of people with end stage renal disease (ESRD) treated with hemodialysis represents a unique opportunity to examine patient peer support networks and improve care in a chronic disease model. Despite living donor transplantation being the preferred treatment for ESRD, there are many barriers to living donation, including the patient's reluctance to make a requesting for donation. As a result, the most common treatment for ESRD is in-center hemodialysis. In-center hemodialysis is unique as patients are receiving a lifesaving treatment in a group setting, spending several hours next to each other in assigned seating, three times a week, for several years. During the hemodialysis treatment the people with ESRD are seated next to each other and can talk with each other. We examine the formation of patient social networks and whether these networks influence patient making living donor requests.

Survey and observational data collected between 8/2012 and 2/2015 were used to observe the formation of a social network of 46 hemodialysis patients in a newly opened clinic. A separable temporal random exponential random graph model (STERGM) was used to model the formation of the hemodialysis clinic over ten 3-month periods.

Forty-six patients participated in the study upon admission to the clinic. The mean age of participants was 54yrs, 58% were male, 39% Hispanic and 30% African Americans. Thirty-two (70%) participants formed a social network, with 44% discussing transplantation with other patients. Upon entry to the study, 11 of the 39 participants (28%) who wanted a living donor transplant had requested one from a family member, spouse, or friend. By the end of the study, 24 of 39 (61%) of the participants who wanted a living donor transplant had made a request. Eighty seven percent of the participants who discussed transplant with other patients had requested a living donation from individuals outside the clinic setting compared 35% of the participants who didn't discuss transplant with other patients ( $p = 0.01$ ). Five patients who requested a transplant after entering the study discussed transplant with other patients and an additional four participants were connected to a patient who discussed transplant with other patients. We examined structural (edge;  $-7.82, SE = 0.62, p < 0.001$ ; gwesp0.55;  $0.82, SE = 0.11, p < 0.001$ ) and nodal attributes to predicting the formation of the hemodialysis clinic network and report the log odds. Women were less likely to form a link than men ( $-0.51, SE = 0.21, p = 0.015$ ). Participants tended to link with the same race/ethnicity ( $0.74, SE = 0.26, p = 0.004$ ). Participants that discussed transplant with other patients tended to link with each other ( $0.68, SE = 0.26, p = 0.008$ ).

We examined the formation of a hemodialysis clinic social network and found that patients who discuss transplant with each other are more likely to request a living donation from members of their extra-clinic networks. These findings suggest HD patient social networks can potentially be used for social network interventions to address patients' reluctance to request a living donation.

**Heterogeneous N-mode networks in social, epistemic and semantic dimensions: Socio-semantic networks of science communication**

lina Hellsten<sup>1</sup>, Loet Leydesdorff<sup>1</sup>

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We present a heterogeneous n-mode approach to mapping academic publications as networks in three or more dimensions. In scientometrics—the quantitative branch of Science & Technology Studies (STS)—social networks among authors and epistemic networks among journals at the field level have been mapped separately from the semantic content—such as title words and keywords of the publications at the micro-level. The three approaches—social networks of authors, epistemic networks as latent dimensions of journal networks, and the semantic networks of words contained in or attributed to the publications—provide complementary views on scientific developments.

Building upon actor-network theory, we propose to consider social relations, semantic attributes, and latent (epistemic) dimensions as attributes to the documents. We show a methodological approach that allows for combining an unlimited number of such attributes into a single network analysis and visualization. This “whole-matrix” approach makes it possible to integrate heterogeneous units of analysis—authors producing publications, journals publishing the articles, and the subject categories attributed to the publications—into the semiosis of an “actor-network.” Different variables (in our example, journal names, author institutes, and Medical Subject Headings) are attributed to documents as cases in an asymmetrical (2-mode) matrix. This allows us to add variables to the analysis without limitations. Matrix algebra enables us to generate all relevant 1-mode matrices from this 2-mode matrix. All links can be considered as co-occurrences of different categories at the document level. The resulting multi-modal approach enables us to model different types of variables at different levels of aggregation both separately and in terms of relations among the levels and dimensions.

The methodology is illustrated by using the study of the Brugada Syndrome as a well-defined medical specialty to map the social, intellectual, and textual attributes to the publications into a single analysis and network visualization. We collected the data using the Web-of-Science (WoS) database for the co-authorship and institutional networks, and the PubMed database for the Medical Subject Headings (MeSH) using the search term “Brugada Syndrome” in both databases for publications that were published between 2006 and 2016. We use a set of 1,335 publications that were retrieved from both databases.

The proposed n-mode network can be extended beyond scientific data; a dynamic extension—a future perspective—would allow us to model co-evolutions in more than two dimensions.

**Holding a Peripheral Position within an Unpopular Clique: A Risk Factor for Early Adolescents' Self-Esteem / Occuper une position sociale périphérique au sein d'une clique non-populaire : un facteur de risque pour l'estime de soi des jeunes adolescents.**

Olivier Gaudet, Marie-Hélène Véronneau, Johanne Saint-Charles, Cécile Mathys

UQAM, Université de Liège

Early adolescence is characterized by a drop in self-esteem. In parallel, adolescents place greater value upon popularity and affiliation to a group of friends, called a clique. Literature shows that being part of an unpopular peer group is related with low self-esteem. Also, youth belong to a social hierarchy within their clique, which can be estimated with a centrality score. We hypothesized that youth who hold a peripheral position within this hierarchy are more likely to experience decreases in self-esteem than the central members. In addition, we suppose that being a peripheral member of a clique is a risk factor that could result in greater drops in self-

esteem for youth who are part of an unpopular clique than for those who are part of popular cliques.

The goal of this study is to explore the moderation effect of clique popularity on the link between centrality and adolescent self-esteem over a one-year period. We controlled for age, sex, individual popularity and self-esteem at baseline.

**METHOD:** 470 adolescents (54% girls, mean age 13 years) in the 1<sup>st</sup> and 2<sup>nd</sup> years of a secondary school in Belgium were assessed twice, one year apart. A French version of the *Rosenberg Self-Esteem Scale* assessed self-esteem (10 items,  $\alpha = .81$ ). Friendships among participants were identified through reciprocal nominations to the question “Who do you like the most among your grade mates?” Cliques were identified using the algorithm Girvan-Newman of UCINET 6. A centrality score was computed for each clique member using UCINET 6. Most-popular and least-popular peer nominations to the question “Who are the most and the least popular among your grade mates?” were combined to assess participants’ popularity. Clique popularity was computed from the average of clique members’ popularity scores. However, this calculus excluded the target participant. Centrality and clique popularity scores were dichotomized using minus one standard deviation as a threshold, in order to isolate peripheral members and unpopular cliques.

**RESULTS:** Moderation analysis on Mplus 7.0 showed that centrality positively predicted self-esteem over time ( $\beta = .35, p < .01$ ) and that clique popularity negatively moderated this link ( $\beta = -.47, p < .01$ ). Further analysis showed that only peripheral teenagers within unpopular cliques were likely to experiencing a decrease in self-esteem over one year.

**CONCLUSION:** These findings highlight that peripheral teenagers of an unpopular clique are at particular risks of experiencing low self-esteem over time. This indicates that prevention efforts should target this category of youth in order to cope for the negative influence of this at-risk social context on their self-esteem.

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Au début de l’adolescence, une diminution de l’estime de soi est notée. En parallèle, les adolescents accordent une importance grandissante à leur popularité et à l’affiliation à un groupe de pairs, appelé une clique. La littérature démontre qu’être membre d’un groupe de pairs non-populaire est relié à une faible estime de soi. Par ailleurs, les jeunes occupent une position dans la hiérarchie sociale construite au sein de leur clique. Cette position peut être estimée par un score de centralité. Nous émettons l’hypothèse que les jeunes en périphérie de la clique sont plus susceptibles que les jeunes centraux de subir une baisse d’estime de soi. De plus, nous supposons que la relation négative entre la position périphérique et l’estime de soi serait accentuée si les jeunes font partie d’une clique non-populaire versus d’une clique populaire.

Cette étude mesure l’effet modérateur de la popularité de la clique sur le lien entre la centralité et l’estime de soi des jeunes sur un an. L’âge, le sexe ainsi que la popularité et l’estime de soi individuelles sont des variables de contrôle.

**MÉTHODE :** 470 adolescents (54% filles,  $m = 13$  ans) en 1<sup>re</sup> et 2<sup>e</sup> année du secondaire d’une école belge ont été sondés deux fois, à un an d’intervalle. Une version française du *Rosenberg Self-Esteem Scale* mesure l’estime de soi (10 items,  $\alpha = .81$ ). Les amitiés entre participants sont identifiées via les nominations réciproques à la question « Qui aimes-tu le plus parmi les jeunes de ton année scolaire? ». Les cliques sont identifiées en utilisant l’algorithm Girvan-Newman de UCINET 6 et ce logiciel permet aussi de calculer un score de centralité intra-clique pour chaque membre d’une clique. Les nominations « plus-populaire » et « moins populaire » à la question « Qui sont les jeunes les plus et les moins populaires dans ton année scolaire » sont combinées pour mesurer la popularité individuelle. La popularité de la clique est mesurée par la moyenne des scores individuels de popularité des membres de la clique, en excluant le participant ciblé. Les

scores de centralité et de popularité de la clique sont dichotomisés à moins un écart type, pour isoler les membres en périphérie et les cliques non-populaires.

**RÉSULTATS :** Des analyses de modération sur Mplus 7.0 montrent que la centralité prédit positivement l'estime de soi dans le temps ( $\beta = .35, p < .01$ ) et que la popularité de la clique modère négativement ce lien ( $\beta = -.47, p < .01$ ). Des analyses post-hoc démontrent qu'uniquement les jeunes en périphérie d'une clique non-populaire sont à risque de subir une baisse d'estime de soi en un an.

**CONCLUSION:** Ces résultats démontrent que les membres en périphérie d'une clique non-populaire sont les plus à risque d'avoir une faible estime de soi dans le temps. Cela suggère le développement d'interventions préventives qui ciblent cette catégorie de jeunes afin de pallier pour l'influence négative que leur situation sociale à risque peut avoir sur leur estime de soi.

### **Homophily, gender and individual outcomes: A longitudinal analysis of the impact homophily has on the performance of men and women**

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While much has been done to promote women's participation in organisations, women's representation in senior positions remains excessively low. In these organisational contexts, where men hold a disproportionate number of high-status positions, we believe the existence of homophily (i.e., a tendency to form same-sex network ties) can harm women's performance, thus reinforcing pre-existing gender inequalities.

Homophily has long been associated with gender inequality within organisations. Indeed, classic research, such as the work by Kanter (1978) and Brass (1985), has frequently reported a tendency for men and women to form homophilous, sex-segregated networks. This pattern of homophily within organisational networks is assumed to have a detrimental impact on women, as resources that are critical for job effectiveness and career advancement are often located within male networks. The decision to avoid relying on same gender ties should, therefore, be advantageous for women. Ibarra (1992), in a study on a male-dominated advertising firm, was the first scholar to observe that women do not passively languish within homophilous female networks. Instead, Ibarra found evidence of women using heterophily (i.e., forming opposite-sex network ties) as a strategy for locating resources within male information networks.

Taken together, research suggests men and women should use different network strategies to improve work related outcomes. Specifically, women should benefit from the use of heterophily, and conversely, men should benefit from the use of homophily. Therefore, in the present study, we use a longitudinal design to investigate the impact homophily has on the performance of men and women. Within the context of a male-dominated work environment, we test the following hypotheses: *hypothesis 1*, we anticipate that homophily should be negatively associated with the performance of women, and positively associated with the performance of men; *hypothesis 2*, the use of heterophily should be positively associated with the performance of women, and, in contrast, should be negatively associated with the performance of men.

The data for the present study was obtained over a 4-year period. The survey was distributed annually to employees working within an engineering consulting firm. Variables included: gender, location, tenure, hierarchy, turnover data, and performance. Network data were based on a question asking employees to indicate who they went to for information within the department from a roster of approximately 140 people each year.

The data was analysed using a panel regression model. Overall, we found evidence to support our hypotheses, *ceteris paribus*, the interaction between gender and homophily had a significant effect on individual performance. This result indicated that homophily was negatively associated

with the performance of women, and, as anticipated, was positively associated with the performance of men. The inverse was also true, the use of heterophily was associated with higher performance amongst women, whereas, heterophily was associated with lower performance amongst men. In summary, our results highlight how homophily influences the performance of both men and women, with access to the male information network predicting higher levels of performance amongst both genders. Based on our findings we highlight the management implications of homophily in network relationships.

### **Honest brokers: Network state versus trait predictors of leader attainment**

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How does your position in an organization's social network affect your likelihood of emerging as a leader of that group? Further, can strategic networking behaviors affect your likelihood of emerging in a leadership position? There remains a fundamental uncertainty behind network strategies for leadership attainment: are network associations causal or spurious? If causal, then there are identifiable networking activities – mutable network states – that increase a person's chance of becoming a leader. If these network states matter, then the chance of becoming a leader varies with individual networking behaviors. If spurious, then there are stable individual-level traits associated both with network position and leader attainment. If these network-related traits matter, a person lacking these traits is unlikely to alter her or his chances of becoming a leader via strategic networking. One, both, or neither of these trait and state antecedents may be present, but while traits are fixed, states are not, and networking advice towards becoming a leader applies only to the network-state antecedents of leader attainment. What are these antecedents, if any?

We answer this question by comparing the network predictors of leader attainment from a between-individual analysis with the predictors from a within-individual analysis on the same dataset. In doing so, we disentangle this state-trait puzzle. This analysis requires the rare situation of people having multiple opportunities to become a leader. We find and leverage precisely this situation in the form of the elected governing bodies of undergraduate dormitories within a scholarship program operating dormitories across multiple universities.

Our dataset includes 673 students eligible for election to student leadership positions during their sophomore and junior years (1,346 election opportunities) across 14 different schools. We use conditional logistic regression for a within-individual analysis, which controls for all static individual factors, whether observed or unobserved. We control for year of data collection and whether the student is a junior.

The network predictors include degree and brokerage in directed networks and including both positive and negative ties. The strongest, most consistent, and significant effect across both between-individual and within-individual results is the honest broker effect. Honest brokering is the brokerage structure where the broker is equally (symmetrically) tied (incoming, outgoing, or mutually) via positive ties to two actors who are negatively tied to each other. Honest brokers are more likely to attain leadership positions, while brokers with asymmetric ties to negatively tied others are significantly less likely to attain leadership positions. This finding of a clear network state antecedent for leadership attainment that cannot be attributed to individual traits provides clear guidance for networking strategies likely to assist individuals in their pursuit of leadership positions.

**Hospital Performance and the Structure of Physician Networks**Matthew Crespi<sup>1</sup>, David Krackhardt<sup>1</sup><sup>1</sup>Carnegie Mellon University

In this paper, we examine the relationship between hospital performance and the structure of the physician networks inside those hospitals. Using Medicare data on patient referrals from one physician to another, we construct over 2,500 hospital-level networks for facilities that provide acute inpatient care. The analysis is at Level 0, treating entire networks as single observations while focusing on the shape and properties of the hospital networks as a whole.

By combining these network metrics with other hospital information, we create a novel dataset (so far the largest of its kind) and explore four areas, selected for being both open questions in the literature and of interest to practitioners. Specifically, (1) we find that hospitals with highly hierarchical network structures perform well according to Medicare's Total Performance Scores (a blended metric of hospital performance), though a lack of hierarchy doesn't necessarily indicate poor performance. (2) We also find that the E-I Index (Krackhardt and Stern, 1988) positively predicts better patient safety (e.g., fewer hospital acquired infections), while proposing an extension of the index that incorporates directional information to differentiate between patients entering and leaving the hospitals. (3) We discuss the role of Simmelian ties in care delivery, in particular with how medical case complexity and hospital type affect the impact of those structures. And (4) we show that having a shorter average geodesic (which would allow for more efficient patient routing within a hospital) is a necessary but not sufficient condition for hospitals to reduce costs and treat Medicare patients in a financially efficient manner.

While these results suggest specific areas for deeper exploration, we believe the larger contribution of this work is to make the general case for more broadly incorporating network-level metrics into healthcare research. Level 0 analysis not only provides useful new hospital-level explanatory variables, but also points to levers that administrators or policymakers could use to improve the quality and efficiency of patient care.

**How Are Multi-Issue Identities Stitched Together in a Connective Action**Yiqi Li<sup>1</sup><sup>1</sup>University of Southern California

Bennett and Segerberg (2012) point out that the logic of the contemporary social movement is increasingly personal and requires less organizational resources or control. Under such logic, there are self-organizing networks that does not see much formal organization participation or involvement, and also organizationally enabled network in which we could see the presence of some organizations, but whose role is less central and identities less salient in the movement than in the more traditional movement settings. This renders the framing process of the social movement ever more complex, and there often exists a misalignment of the personalized frames and the macro-frames proposed by the organizers, and emergence of multi-issue movements (Ganesh & Stohl, 2013). Bennett and Segerberg (2011, 2012) have also worked on finding the complexity of framing processes in contemporary social movements and pointed to a lack of empirical analysis.

To understand the complexity of framing and fill in the theoretical gap of understanding a movement contains both a collective and connective action logic, a multi-issue social movement on Twitter (connected by a shared hashtag: "#DeleteUber") is studied. To explain tie structures underlying the online movement, the categorization theory is utilized to explain the stitching power of frames, or category spanning decisions of activists, and the frame is treated as a connective action logic that helps to stitch the online movement together.

The Twitter data was collected from the two days when the social movement under the shared hashtag #DeleteUber was most heated. After eliminating the isolates and pendants, a network of 553 activists was extracted for structural analysis. 19 frames were coded through conventional content analysis (Hsieh & Shannon, 2005). The categories include being dissatisfied with Uber's service (consumer rights), criticizing Uber's mistreatments of their employees (labor), anti-immigration ban, anti-Trump administration (political issues), feminist issues, or taking this chance to advertise their businesses (like Lyft, taxi or other types of entrepreneurial car share businesses), human rights, journalist rights, etc.

This study first employs descriptive network tools including block modeling and correspondence analysis (CA) to explore the overall reduced structure of the network and identifies subnetworks for further structural analysis. Based on the descriptive analysis, the network has been partitioned into smaller clusters.

To understand the role of frames, a multilevel network approach is employed. An activist-level network was constructed based on all activists expressed their grievance in that issue category. On the issue category level, the tie represents the level of similarity between the nodes, and the tie weight was calculated by the Jaccard similarity distance between pairs of categories based on their co-occurrence in the posts. On the meso level, the ties represent the support activists expressed towards the issue categories in their posts.

The qualitative analysis result indicates that counter-movement frames in this social movement is far from the other frames and occupy network periphery. Other frames do not show any clustering, meaning people tweeting about those issues retweet each other. The next step is to conduct multi-level ERGM analysis behavioral differences within the clusters.

### **How Different Types of Networks Affect Productivity and Influence in a Networked Organization**

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<sup>1</sup>Interdisciplinary Centre, <sup>2</sup>Ryerson University, <sup>3</sup>NetLab Network

We use visible metrics of researcher networks to consider the effect of different types of social networks--acquaintanceship, advice, and coauthorship—act in conjunction with social media on productivity and influence. Unlike static studies of networked work, we look at how changes in the networks of researchers spread across Canada affected their performance and influence. Using interviews, surveys and archival analysis, we investigate if network members have more productivity and influence: when their networks are cohesive, when they are central in their networks or linked to central players, and when their work has more opportunities to disseminate through diverse, often non-redundant, ties. We find quite different phenomena: While the connectedness of these networks was positively associated with their performance, it was the non-redundant effective size of the networks that was positively associated with their influence.

### **How do Education Innovations Diffuse and Persist?: Strong Ties and Classroom-Integrated Robotics**

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Drawing on a mixed methods study of K-8 classroom-integrated robotics across 9 Ontario school boards, this paper examines how and why educational innovations diffuse and become institutionalized. The classic network theory of diffusion argues that novel information, ideas, and behaviors spread through a network via weak ties. In the case of educational innovations, the hypothesis is that teachers use their weak ties to reduce risk and uncertainty by learning how things are done by other teachers in other schools. However, adopting new educational

innovations such as classroom-integrated robotics in highly institutionalized environments like education requires complex and risky behaviour changes. This suggests that educational innovations may diffuse more like complex contagions, which require prolonged exposure via strong ties. Based on this theory, we hypothesize that innovations are more likely to diffuse when teachers have repeated and prolonged exposure to trusted peers who have already adopted the innovation.

Our findings suggest that weak ties are a source of ideas and inspiration for teachers who are already motivated to adopt the innovation, but they are insufficient because of the high-level of risk and uncertainty involved in the educational context. Close ties seem to play a more important role, but not in the way suggested by complex contagion theory. In fact, we find that nearly all teachers in the study lack strong connections with peers who have already adopted the innovation. Instead, they discuss their ideas and problems with their local peers who have \*not\* adopted the innovation, which enables them to reduce perceived risk and uncertainty. We conclude by considering the implications of this analysis for educational policy.

### **How Do Perceived Brokers Interact in Collaboration Networks?**

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Some people are critical in connecting up disconnected others in collaboration networks. The aim of this study was to ascertain the location of perceived brokers within a network of collaboration ties, while at the same time investigating the role of personal attributes (e.g., sex, age, experience) that might account for one's reputation as a broker.

Participants were from an Australian university (n = 162) and an Australian national research agency (n = 49). An online network survey consisted of a range of social network questions that asked about various types of collaborative activities between the university and the research organisation, and of whom they would go to for information or help in gaining access to the other partner. The network survey also asked a range of individual attribute questions about demographics.

An autologistic actor attribute model (ALAAM) was run in MPNet (P. Wang et al., 2018). Results showed that perceived brokers tended to be linked together within the network. This indicates that being seen as approachable is shared within specific collaborations. Notably, perceived brokers were not active in the collaboration network more widely, tending to report fewer collaboration ties overall. Instead, their collaborations emphasized quality over quantity, with a greater number of reciprocal (mutually acknowledged) collaboration partnerships. Those in leadership positions, women, and research agency employees currently studying at the university, were also more likely to be perceived as brokers to the other organisation.

### **How machine learning and social media surveys can be used to assess ecological grief in personal networks of the Caribbean: A comparative study**

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Small Island Developing States (SIDS) are climate change hotspots because of their extreme vulnerability to the impacts of occurrences including hurricanes, sea level rise, and droughts. These changes cause emotional and psychological losses in residents known as ecological grief from: 1). physical losses in ecosystems and its effects on livelihoods and culture; 2). disruptions to traditional and local ecological knowledge systems and loss of identity, and 3). fears and anxiety from anticipated future losses of place and land. Researchers have flagged this

issue as a growing public health issue of the Anthropocene which affects people living in areas with high climatic risks and intersecting vulnerabilities.

This research proposes a natural experiment to conduct a comparative assessment of the mental health of Caribbean residents by assessing their public social media posts over a three-year period. Their posts will be quantified and randomly assessed over the three research periods that cover before, during and after the 2017 Atlantic hurricane season which had 10 active hurricanes with recorded damages totalling \$282.27 billion (USD).

Recent advances in machine learning systems have shown that by utilizing geo-analytics, algorithms can mine and process large amounts of information at low costs needed in developing countries. In this study, we use algorithms to assess the mental health of social media users over the research period based on natural language use and imagery. Public posts will be assessed as positive or negative as defined by Linguistic Inquiry and Word Count software (LIWC2007). These posts will then be ranked on challenges identified by users quantified along a continuum of acute experiences associated with disruption in their sense of place and connection to the land, from sadness, despair, anger, fear, helplessness, hopelessness and stress. Chronic mental health conditions related to these experiences will also be categorized from elevated rates of mood disorders such as depression, anxiety, and pre- and post-traumatic stress; increased drug and alcohol usage; increased suicide ideation, attempts and death by suicide.

Participants will be randomly selected with the following inclusion: 1). residence in the Caribbean region, 2). at least one year posting history Jun to Dec 2016 (before) Jun-Dec 2017 (during) and June to December 2018 (after). This assessment will be conducted via verbal expressions on social media (Twitter, Facebook and/or Instagram).

We hypothesise that acute and chronic mental health conditions will increase after the 2017 hurricane season and will be greatest on islands such as Dominica, Antigua and Barbuda that were directly impacted by hurricanes. We further anticipate that on islands that were directly impacted that users will show differences in chronic and acute mental health impacts due to socioeconomic and demographic characteristics (age, urban-rural setting, gender). Further, researchers have suggested that ecological grief as in other psycho-social conditions may be affected (lessened or increased) based on the connectivity (number and quality of ties) in the social network. The issue has become increasingly relevant because it fits into the global climate financing setup, so there is a growing audience in SIDS for this research.

### **How puberty affects activity behaviors and friendships during late adolescence**

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With the onset of puberty and adolescence, youth begin to choose their own social environments and develop activity patterns, making it a vital sensitive period to study how social and biological factors impact behavioral health trajectories as they transition to young adults. Part of one's environment is one's social network, and it has been established that social relationships and pubertal development are important determinants of activity behaviors such as physical activity, screen time, and sleep. However, little research has attempted to evaluate the contribution of these social and biological factors jointly, because they tend to be studied in separate scientific disciplines. Thus, it remains unknown how puberty shapes networks, and how pubertal influences on activity behaviors may counteract, reinforce, or be otherwise confounded by peer influences on behaviors. The goals of this study were to determine how pubertal status (i.e., an individual's level of physical maturation) may shape friendship formation, and to examine the role that pubertal timing (i.e., physical maturation relative to same-aged peers) has on how adolescents socially influence one another's activity behaviors (PA, ST, sleep sufficiency). Two schools in the

National Longitudinal Study of Adolescent to Adult Health were evaluated to estimate stochastic actor-oriented models of network formation and activity behavior change while testing for the role that pubertal development plays. Late adolescents who developed earlier received more (and sent fewer) friendship nominations than peers at one school. There was evidence that puberty modified the relationship between network influence and screen time at one school. This study provides suggestive evidence that pubertal development is an important part of the puzzle in helping to explain declining healthy activity behaviors among youth, which is linked to obesity. Sensitivity analyses explore the interaction of gender and race with pubertal timing in shaping friendship formation. To the best of our knowledge, this study is the first to analyze the prospective association between different measures of pubertal development (status and timing), friendship formation, and activity behavior change using a rigorous statistical social network modeling approach.

### **How SNA Uncovers the Intersection of Health Care Needs, Solutions, and Professionalization in Ontario**

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Our interest in lay referral health networks was initially influenced heavily by Bernice Pescosolido (1982, 1986, 1988), Nancy Howell Lee (1969), and Barry Wellman (1979, 2001). My major focus has been to explore how Torontonians cope with a specific health problem (individual level), their patterns and combinations of help-seeking (network level), and the social and medical context influencing these strategies (institutional level). We do this by looking at people with low back pain and how they go about finding care from orthopaedic surgeons, chiropractors, and Alexander Teachers (Wellman 1995). We have been examining linkages between 300 Toronto-area patients visiting a range of health care providers (family physicians, chiropractors, traditional Chinese medicine doctors/acupuncturists, naturopaths, and Reiki Healers) and their 1,344 health ties. We investigate what types of ties are associated with which kinds of health support for patients, assessing the strength of ties, the basis of the network relationships, and the access that patients and network members have to each other. Studying health care providers, our other main interest is in the association between social networks and moving ahead professionally. Using standard network questions and in-depth open-ended questions, affiliation matrices, and qualitative reports allows us to look at both intra-organizational and inter-organizational contacts. Most recently, we have been exploring how Torontonians find their way to integrative health care centers that combine medical doctors with complementary health care practitioners to solve their long standing chronic conditions.

### **How social capital and social support differs for construction workers with and without psychological distress**

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<sup>1</sup>Queensland University of Technology

**Aim:** The purpose of this research is to explore how protective factors such as social capital (friends, family, work colleagues) and social support (emotional, tangible, informational, and companionship) might differ for construction workers with and without psychological distress. In so doing, this research aims to compliment the existing construction worker literature, which focuses on negative working conditions impacting on psychological distress by examining differences in perceived availability of social capital and social support. **Design:** A cross-sectional sample of civil construction workers completed a structured interview process to obtain their social capital and social support availability, with a survey to assess their level of psychological

distress. Interview information collected data in relation to workers social capital using the free-recall name generation method. The perceived closeness to the social capital was also collected. For social support, the perceived strength of the different types of social support was assessed for each of the capital nominated from the participant during the interview. **Method:** Using UCINET to create individual sociograms, a social network analysis adopting an ego-net approach was carried out on site workers ( $n = 14$ ) to visually explore differences in the size, strength, and composition of their social networks. Ego-nets were created for each worker for social capital, in addition to each of the social support types received from the nominated capital based on their strength/perceived availability. A visual comparison was performed between ego-nets of social capital and each type of social support to determine if any differences exist between construction workers with and without distress. **Results:** Construction workers without distress tended to have a larger networks with more sources of social capital available, in addition to closer relationships when compared to those workers who were experiencing distress. Further, workers without distress had more emotional support availability which was available from a variety of sources. There appeared to be no differences in the size, strength, and availability between workers without distress, and those with distress for social support related to tangible, informational, and companionship. **Conclusion:** This micro-level analysis approach to exploring differences in social capital and social support indicates that access to a variety of social capital and perceived closeness to the capital is potentially important for these workers. Further, the perceived availability to access (and potentially utilise) high amounts of emotional support may be important in protecting against psychological distress in construction workers. This research provides information on how construction workers use their networks and support systems. Further, this study gives insight into the important relationships for construction workers and how these relationships may be influencing psychological wellbeing and distress. This knowledge may be used for further research to explore how workplaces can engage and utilise employees as an additional and effective form of social capital and promote social support to workers to assist in promoting psychological wellbeing.

### **How to Capture Relational Processes in Accessing Scientific Resources? A Conceptual and Methodological Framework for the Geography of Innovation**

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In the resource-based perspective, innovative projects are driven by a logic of strategic resource needs. Regarding the current complexity of inventions requires more frontier knowledge, division of labor and specialization of manpower, and larger levels of funding, to achieve innovative projects (Richardson, 1972; Kogut and Zander 1992). In other words, projects can no longer be developed on the basis of firms' internal resources only; how project leaders have to find external resources (skills, equipment, financing, facilities, etc.) became a crucial issue when analyzing innovation process.

However, little attention has been given to the question of how project leaders have accessed to external resources to feed the current debate about the geography of innovation. Authors generally focus on the visible part of innovation, on projects implementation. When integrating the problem of resources, they mainly question absorption capacities (Cohen and Levinthal, 1989). They either concentrate on relationships resulting from this search for resources regarding patents, publications, research partnerships, etc. The hidden part of innovation – the genesis of project and the resources access - is more difficult to assess - given the unavailability of data - and thus neglected.

In the same way as Granovetter (1974) proposed to deal with jobs access (to understand professional mobility), we propose to focus on resources access to question the geography of innovation mobilizing his seminal thesis on social embeddedness. The embeddedness process appears indeed structuring in the access to external resources. For instance, finding a partner could result from *interpersonal ties* built between researchers (1); the search to external resources could be also delegated to *service intermediaries* or collective research centers (2); it could similarly come from the *search of information* on the internet (3). The way project leaders' access to resources can impact the geography of innovation. Zucker et al. (1998), Almeida and Kogut (1999) or Breschi and Lissoni (2001) have observed in this respect that interpersonal relationships used by star scientists to find a partner lead to the formation of local partnerships.

To capture this relational process in accessing resources and advance the analysis of the geography of innovation, we primarily define the concepts used and our analytical positioning; we then propose a coherent methodological strategy based on the relational chain method. We finally operationalize our approach to study the formation of University-Industry partnerships and start-up.

For the first study, the collection and treatment of data about the partner' access for 244 partnerships reveals that 1) 43% of partners access were made possible by interpersonal ties; 2) this weight remains particularly stable whatever scientific field or partner location; 3) non-professional relations significantly influence local partnerships contrary to professional and educational ties.

For the second study, data about resources accessed by the founders of 53 start-up highlight that 1) 56% of the resources access situations involve interpersonal relationships that are mainly professional (80%); 2) these relationships are strongly present in the initial phase revealing the gradual relational decoupling of the start-up from the founders' relationships; 3) interpersonal relationships tend to promote access to local resources.

### **Humans vs. Bots: Fake News Bot Analysis from Twitter Hazard Data**

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The Internet can facilitate settings where social actors remain anonymous throughout communication. Under these conditions, new avenues for the spread of false information have emerged as individual social actors are not bound to their own identities, allowing for artificial social actors to influence the social space. Through software robots—colloquially known as “bots”, one can program software to mimic the behaviors of human social actors in a credible manner, allowing for the artificial inflation of support for a particular belief, idea, or agenda. Bots serve as social actors with the same capabilities of information transmission as humans, allowing for a network of bots to spread false information in a highly effective manner. The spread of false information at the hands of networks of bots can have disastrous effects on the hazard and disaster response topic-space, as in some cases misinformation can mean the difference between life and death. In observing the methods and capabilities of bots spreading false information within the hazard response topic-space, this study looks into fake news bots' social influence patterns in the hazard and disaster response space on Twitter by drawing comparisons between human and bot networks on Twitter, and observes commonly employed disruption tactics by groups of bots, as well as communication and account differences between bots and organic social actors within the same space.

**Humpback whales in Bahia Malaga-Pacific coast of Colombia: health and anthropogenic stressors**

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During the migratory route of the humpback whales through the Colombian Pacific Coast, local communities have made use of this natural resource through the organization of whale watching tourism activities. Most studies show the impact of the tourism industry on cetacean populations, although there have been an emphasis on the biophysical dimension and mono-disciplinary perspectives. This paper has two goals. One is to understand the system of whale watching from a socioecological point of view. The second is to characterize the reticular properties of the socio-ecological structure of whale watching activity in Bahía Málaga, Colombia's Pacific coast. The methodology combines the perspective of Social Network analysis with quantitative and qualitative instruments such as prospective analysis and participatory tools. The study was conducted in the three main communities that base their livelihoods on whale watching tourism (Juanchaco, Ladrilleros, and La Barra). The preliminary results show: 1) conflict, self-organization, learning, and reticular cooperation networks reflect the socioecological structure and trajectory of whale watching activity; 2) mapped networks demonstrate the need to enable the consolidation of a polycentric system; 3) maintaining the current trajectory of SSE can lead to the collapse of the studied socio-ecological system, generating negative long-term effects on local livelihoods, and the response capacity and viability of the humpback whale population. Finally, this paper offers several ideas to improve related public policies at the regional and national levels.

**I'm Not Here to Socialize: Intentional and Incidental Interaction Contexts and Alter Embeddedness Profiles**

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Personal networks are lived out in the various contexts in which people interact: workplaces, restaurants, homes, and voluntary associations. Some—workplaces, educational institutions, and clubs—are what Feld (1981) termed foci. Others, like homes and bars, are simply settings where relationships are enacted. We argue there is an overlooked but theoretically significant distinction between different interaction contexts. Some, such as homes and restaurants, are contexts in which people interact with the express purpose of interacting with the specific others whom they encounter there. Others are settings entered for other purposes and where social contact is incidental to the primary purpose. We argue that these interaction contexts nurture relationships that play different roles in egos' networks.

In this paper, we consider the interaction profile of alters in ego networks, a concept that includes not only their level of embeddedness, but the ways in which they are embedded in different parts of egos' networks and their structural position in those networks. We seek to understand: (1) What kinds of interaction contexts foster domain-specific ties? (2) Does type of interaction context predict the extent to which an alter is embedded in other parts of the network? (3) Does type of interaction context predict the extent to which ties hold bridging or bonding positions within the network?

We analyze data from a web-based survey in which 622 respondents, reporting on 6,081, ties completed a name generator and were subsequently asked to indicate the contexts in which they interacted with each alter and to complete a dyad census, providing the full structure of the ego network. We find that different interaction contexts are associated with different embeddedness

profiles. Alters who interact in incidental-interaction contexts are more commonly domain-specific ties, limited to single contexts of interaction. Conversely, ties enacted in purposeful-interaction contexts are more likely to bridge across clusters and those in incidental-interaction contexts more likely to be located within clusters. We develop a typology of embeddedness profiles and examine how they are associated with contexts of interaction, contexts of tie formation, and tie content.

Our findings suggest a potentially theoretically fruitful approach for broadening our understanding of the ways in which foci and interaction contexts structure ego networks.

### **Identification of patterns of social behavior in political groups in online social networks by the method of blockmodeling**

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The information space of social networks, as a special social and communicative environment, is a subject to social engineering. In the Internet space, attempts are regularly made to influence attitudes and social behavior on a large scale through online media or individual groups and individuals in order to have the desired effect on the target population. And online social networks play a key role in this influence, because, firstly, they provide access to specific target audiences, and, secondly, they open up the possibility of using the latest advertising mechanisms and promoting ideas and attitudes.

For a long time already communities in social networks (especially in Facebook) work according to a debugged scheme. The structure of roles existing in a group allows one to create and maintain user interest in certain political topics. There are not only administrators, moderators and “all other members” who constitute an online group. First of all, users are divided into active and inactive. The latter can also be of several types: who joined the group by chance, who is in it for a while and forgets to quit or who just quietly watches what is published and discussed in the group. Among active users may be moderators, content creators, information hubs, likers, reposters, commentators, bots, etc. Identifying the structure of roles and positions, firstly, helps to reveal manipulation schemes that exist in online groups, and secondly, allows political communication members to understand how to work effectively with specific groups.

In our research we analyze and compare structures of online political groups in Moscow area by defining the roles and positions of group members with a help of blockmodeling technique. Modeling of block structures allows to select cohesion, center and periphery in the structure and to carry out ranking. Moscow political online groups have a certain structure, slightly different from group to group. There are opinion leaders in almost every analyzed group, which set topics and moderate discussions on them, and often these are not official group administrators and moderators.

### **Identifying Criteria for Peer Change Agent Selection to Support Development of An Effective Diffusion Model: Modeling Study**

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Background: Even as new HIV infections in the United States have stabilized over the past decade, the population of young, black MSM (YBMSM) has consistently experienced rising HIV incidence over this period. In Chicago, for example, the number of new HIV infections among YBMSM between 13-29 years of age from 2004-2014, were annually at least five times higher than among their White counterparts. Individual-level interventions have had limited impact among YBMSM, and network interventions that rely on identification of peer change agents (PCAs), are

hypothesized to be effective at increasing the use of newer prevention modalities such as preexposure prophylaxis. Recent work has also shown that PCA-based HIV interventions are most likely to be effective if formal mathematical and computational techniques are used to assess network structure. While such assessments have received attention in the literature, the longevity over time of PCAs is a critical, yet often overlooked, consideration in PCA identification. For example, it is not known if PCAs will retain their critical network position a year after the assessment.

**Methods:** Respondent Driven Sampling (RDS) was used to recruit eligible YBMSM from the South Side of Chicago and adjacent suburbs between June 2013 and July 2014. Participants answered a biobehavioral survey in person at two study visits approximately one year apart. Study participants were also offered an opportunity to provide Facebook data at both visits, allowing us to use Facebook to enumerate the set of potential influencers of YBMSM. Facebook data were collected using a custom web app. With privacy protections in place, the algorithm used by this app unambiguously linked friend lists of all consenting uConnect respondents. We used Facebook to collect network data because there is no member list for our population of interest, and capturing a large whole network using standard sociometric methods was impossible. Friendships between nonrespondent friends of study respondents were not observed. These unobserved friendship data were imputed using exponential random graph models. To identify candidate PCAs at two waves, eigenvector centrality was used, which has been found to be useful to identify agents in critical positions for diffusion of information. At Sunbelt 2018, we presented the imputation and PCA identification results from one wave of analysis. This year, our results will concern the durability of PCAs identified across two waves.

**Results:** Of the 618 study respondents, Facebook data were obtained on 298 respondents at baseline and 403 respondents at follow-up. PCAs identified on 100 imputed networks using eigenvector centrality showed high stability across the imputation. PCAs identified using eigenvector centrality also showed high durability across two waves.

**Conclusion:** PCAs identified using eigenvector centrality show high stability when social networks are imperfectly observed at multiple waves. Our study provides guidelines to health researchers using online network data to operationalize health interventions.

### **If I can make it there. I'll make it anywhere? A look into the black box of EU lobbying through discourse network analysis combined with inferential network analysis**

Harald Sick<sup>1</sup>

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Focus of the paper will be a methodological approach to analyze the role of interest groups in the EU policy process, based on a case study analyzing the Community Strategy to reduce CO<sub>2</sub> emissions from passenger cars and light-commercial vehicles. Therefore, I'll show in a first step, how to generate two-mode discourse networks, consisting of all relevant actors and their frames. On the first level are the actors, who shared their opinion during the EU policy formation – from interest groups to member states and EU institutions as well as their members, like political parties or executives. On the second level are their frames, by which they express their standpoint within the policy debate.

In doing so, it is possible to trace the discourse structure in a time-dependent manner. By modeling the legislative proposal as well as the final legislation as an actor – or following Bruno Latour, as a non-human actor – with the frames it includes, it can be shown, who holds the discourse hegemony at the different points of time. Therefore, we can conclude who influences the draft in which stage of the policy process. On the same time, we can analyze the frames of the specific actors and their framing strategy, they use to gain or maintain the discourse hegemony.

To get insights, how the actors do that, we have to extend the methodological approach by inferential network analysis. By analyzing the two-mode discourse networks through Temporal Exponential Random Graph Models (TERGMs), we are able to make inferences about a range of questions: Who was capable of influencing the decision-making? Which types of actors were able to do so, and which frame-clusters did they use under which discursive circumstances? To answer these questions, it is important to analyze the inherent relational dimension of the discourse network structure consisting of endogenous variables like the participating actors, the coalitions they form and their frames, respectively their used frame-combinations. As exogenous control variables serve for example the status of the different actors (NGO, business interest, trade union, member state, political party, etc.) as well as the overall composition of the actor population in the case. Through social selection models, we can examine these influences on the discourse network structure.

The case was selected, because several other researchers used it as an example to measure lobby influence in the EU, whereby different methodological approaches can be compared.

### **Immigrants' Social Capital in Canada: The Role of Membership in Voluntary Associations**

Maria Majerski<sup>1</sup>

<sup>1</sup>Bishop's University

The present study examines the sources of social capital, including memberships in voluntary associations, comparing immigrants and native-born. The study finds that immigrants are active in fewer voluntary associations in comparison to native-born, an important source of social capital. The paper also finds that recent immigrants and immigrants who entered in the 1990s participate in fewer voluntary organizations than native born; both groups with significantly lower social capital than native-born. Other factors related to social capital attainment and voluntary associational activity include language, race/ethnicity and educational attainment. This study contributes to scholarship by establishing the mechanism by which volunteering in multiple organizations may affect immigrants' social capital. The paper concludes with the study implications.

### **Impact Evaluation by Using Relational Approaches in Web Surveys**

Cathleen M. Stuetzer<sup>1</sup>, Stephanie Gaaw<sup>1</sup>

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Web surveys in higher education are particularly important for evaluating the quality of academic teaching and learning. Traditionally, mainly quantitative data is used for quality assessment. Increasingly, questions are being raised about the impact of attitudes of individuals involved. Therefore, especially the analysis of open-ended text responses in web surveys offers the potential for impact evaluation.

Despite the fact that qualitative text mining, sentiment analysis, and network analytics are being introduced in other research areas, these instruments are still slowly gaining access to evaluation research. On the one hand, there is a lack of methodological expertise to deal with large numbers of text responses (e.g. via semantic analysis, linguistically supported coding, etc.). On the other hand, deficiencies in interdisciplinary expertise are identified in order to be able to contextualize the results. The following contribution aims to address these issues.

An annual online survey of lecturers regarding the quality of academic teaching and learning was conducted within a selected university in Germany between 2013/14 and 2017/18. Information regarding the open-ended question of what is particularly important in the teaching process were extracted by applying text mining methods and evaluated by using sentiment analysis and network analytic metrics. The results of the analysis of the text data of 791 respondents (lecturers)

show their different attitudes towards the quality of teaching. This will be combined with results of the annual quantitative online survey of students (n=6.615, between 2013/14 and 2017/18) regarding the question what is actually conveyed in teaching processes. Comprehensive results are still work in progress.

The contribution will show how this case study contributes to the field of impact evaluation and reveals methodological implications for the development of text mining, sentiment analysis, and network analytics in evaluation processes.

### **Implementation Capital: Merging Frameworks of Implementation Outcomes and Network Social Capital to Support the Use of Evidence-Based Practices**

Jennifer Watling Neal<sup>1</sup>, Zachary P. Neal<sup>1</sup>

<sup>1</sup>Michigan State University

#### **BACKGROUND:**

The implementation of evidence-based practices (EBPs) is a social process that requires social support and communication among multiple actors, including researchers, developers, support staff, information brokers, organizational leaders, and front line providers in a multitude of service sectors (e.g., health, mental health, education). However, despite a growing recognition of EBP implementation as a social process, the conceptualization of social capital in implementation frameworks remains under-developed. In particular, these frameworks often conflate bonding social capital, which focuses on norm enforcement and trust, with bridging social capital, which focuses on the circulation of resources. This conflation makes it difficult to concretely operationalize social capital and limits the concept's utility for explaining implementation outcomes.

**THEORETICAL FRAMEWORK:** In this presentation, we propose a new framework of implementation capital that merges an existing conceptual framework of implementation outcomes (Proctor et al., 2011) with an existing network operational framework of social capital (e.g., Burt, 2001; Neal, 2015). First, we will briefly review Proctor et al.'s (2011) conceptual framework of implementation outcomes, which includes features of providers' perceptions of EBPs (acceptability, appropriateness, and adoption), providers' use of EBPs (feasibility and fidelity), and setting level features (cost, penetration, and sustainability). Second, we will describe an operational framework of social capital that grounds bonding and bridging social capital in the structure of providers' social networks. Third, we will bring these two frameworks together to create a merged framework of implementation capital that shows how specific aspects of social capital can support specific implementation outcomes. Perceptual implementation outcomes of acceptability, appropriateness, and adoption are linked to bonding social capital through mechanisms of trust and norm enforcement, while use implementation outcomes of feasibility and fidelity are linked to bridging social capital through mechanisms of increased access to information and resources. Additionally, setting-level implementation outcomes of cost, penetration, and sustainability are associated with small worldliness at the setting level, which simultaneously optimizes both bonding and bridging social capital in a setting.

**CONCLUSION:** We will illustrate how the implementation capital framework is helpful because it separates two distinct forms of social capital – bonding and bridging – that are often conflated in the implementation literature, and offers concrete ways to operationalize them by examining the structure of providers' social networks and the networks of their settings. We will offer future directions for measuring and studying how these forms of social capital are associated with implementation outcome. Moreover, we will use the framework to offer specific guidance about how individual and setting networks might be shifted to support implementation outcomes.

**WORKING PAPER:** A full version of the working paper for this presentation can be found at the following link: [http://www.msu.edu/~zpineal/real\\_implementation\\_capital.pdf](http://www.msu.edu/~zpineal/real_implementation_capital.pdf)

### **Improving PrEP Availability and Access for Populations at High Risk for HIV**

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The first inclination of public health researchers responding to the call for increasing use of PrEP among populations at high risk for HIV is to focus on research and interventions that target patients in those populations. However, this only partially addresses the problem. Patients who seek PrEP from their physicians will only be successful if their care providers know about and are willing to prescribe PrEP. That is to say, we cannot increase PrEP utilization in high risk populations unless PrEP is accessible and available to them. Thus, our focus in this R34 is on care providers. We propose to develop a novel tool that uses medical claims data to infer physician networks and then use those networks to determine how to best implement targeted interventions to encourage primary care providers to offer Pre-Exposure Prophylaxis to their patients at risk for HIV. This will increase access and availability of the treatment, thereby increasing the likelihood of uptake and adherence, critical for strengthening the clinical impact of this highly effective treatment modality. We will use regression models that incorporate data gleaned from the probabilistic physician network we create from claims data to explore whether PrEP prescribing clusters by local physician subnetwork, is associated with connections to infectious disease specialists, or to geographic variation related to features of the HIV epidemic, such as stigma. These models, adjusted for social network statistical dependencies, will help us operationalize and understand the relative contribution of three alternative processes: social influence among physicians, social learning (physician education and diffusion of information), and non-network geographic variation. The results of these analyses will guide identification of appropriate intervention targets for education campaigns by Gilead or interested third parties and identification of possible physician 'change agents' for peer-based interventions based on social learning and social influence processes. Physician targeting tools will be designed and tested based on these findings via simulations on the network we create and via direct contact with a small group of physicians we have identified as targets and change agents. In this talk I will introduce the study and present our progress to date, focusing on our methods of network imputation from medical claims data, our processes for gathering allied data sets, and our plans for modeling.

### **In context disambiguation and automatic tagging of semantic discourse fields: The linguistic technology of *Sémato* for socio-semantic network analysis**

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In the last four decades, there has been an impressive rise in the number of publications that simultaneously consider social and semantic relationships. *Semantic networks* traditionally designated a network of words or, to be more generic, a network of elements of discourse (words, expressions, topics, etc.) through which scholars seek to better understand the way these elements are structured. The diversity of methods used to select the elements of discourse that will be considered in analyzes is bemusing. Most of these methods entail, upstream of any analysis, preprocessing stages including: tokenizing, uniformising, cleaning, reducing... The cleaning operation usually consists of stop words removal and lemmatizing or stemming tokens. Reduction calls for the selection of the elements of discourses (*types*) that will be submitted to analysis, often done through distributional analysis of specific elements of discourse in the corpus

(words, expression, topics, tags, etc.). Some research puts an additional linguistic in-context layer, for instance by lemmatizing based on POS-Tagging or by extracting multi-word phrases or Named Entities. Few of them though add semantic layers based on a full thesaurus of a specific natural language either for in-context disambiguation during reduction or for identifying semantic fields expressed through discourse elements to be analyzed.

The aim of this talk is to present how all the above mentioned strategies are implemented in *Sémato*, a university (UQAM) developed and linguistically based online software for textual analysis. Examples of use will illustrate its relevance for socio-semantic studies.

### **Increasing Cross-Race Friends of Friends**

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In most western societies, there is considerable racial segregation and disproportionately few black-white friendships. Having few cross-race friends can lead to unfamiliarity and an increased risk of fear and hostility that can further reinforce the segregation and increase the problems it causes.

The fact that friends have friends opens up the possibility that many more whites and blacks might at least have some contact or at least more positive awareness of members of the other group. However, if friends are nearly all same race, and their friends are nearly all same race, then those friends of friends may not be any more integrating than the friends themselves. While possible, this paper suggests that such extreme second order segregation is not inevitable, and that certain patterns in networks can lead to considerably larger numbers of cross-race friends of friends

In general, we know that for any personal characteristics that are positively correlated with numbers of friends, friends have higher average values on those characteristics than people do. However, even when numbers of white friends and black friends are negatively correlated with one another overall, as we expect in a racially segregated society, it is possible that friends will have more cross-race friendships than people do. Specifically, we show that the extent to which there are positive covariances between numbers of white and black friends among whites and blacks separately determines the extent to which there will be more cross-race friends of friends than would be expected from the small numbers of cross-race friendships alone. A simple implication is that even a relatively few people from either group with large numbers of both white and black friends create cross-race friends of friends for many others.

We present the mathematics underlying the numbers of cross-race friends of friends. We describe network structures that lead friends to have more cross-race friends. We present some simple illustrative networks to show how it works. Then, we consider some circumstances that make this especially likely to occur.

### **Increasing virulence of HIV with age at infection: a network explanation?**

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A growing literature seeks to understand not just how sexual networks cause sexually transmitted pathogens to spread differentially within populations, but also how they can feed back to shape the evolution of the pathogen itself. HIV in particular is an extremely rapidly evolving virus. One of its key features is set point viral load (SPVL), the amount of virus typically present in the blood serum of an individual living with HIV during the long period of chronic infection. This trait is partially inherited from one partner to another at the moment of transmission, and it impacts

both survival and likelihood of further transmission. It is thus a measure of virulence, and is fundamental to both individual health and population outcomes.

Recent network modeling work combining egocentric behavioral data, epidemiology and evolution has shown that, under some conditions, those who are at the lowest risk for HIV acquisition can counter-intuitively end up with the highest SPVL if they do become infected. However, the nature of this selection effect depends on the exact structure of the network. For instance, a model suggested that men who have sex with men (MSM) and are exclusively insertive should average higher viral load than MSM who are at least sometimes receptive, although this will depend on whether short- or long-term relationships predominate; empirical analysis confirmed this finding. Additional network structures like the level of concurrency further complicate the relationship between individual sexual behavior and viral evolution.

In this paper, we extend this line of work to identify the extent to which it can explain an enduring (but little-focused on) finding in HIV epidemiology: that people who are infected later in life average higher SPVL. The general assumption has been that this is an immunological effect related to weakening immune systems with aging. However, the same principle of differential selection by network risk may apply here.

To explore this issue, we extend our existing dynamic, stochastic, network model of HIV transmission and evolution to consider multiple network factors relating to age and their impacts on the relationship between age of infection and SPVL. We parametrize this model using egocentric behavioral data from sub-Saharan African heterosexuals, as this is the setting where the age effect has been most commonly observed. We include data on age mixing, declining mean degree with age, increasing relational duration with age, and declining coital frequency within relationships by age. We also consider underlying individual heterogeneity in per-act HIV acquisition risk to test whether this can create a similar effect, either alone or in combination with network predictors. We present results on the conditions under which our models are able to reproduce observed patterns. This study, and the lineage of which it is part, demonstrates that the effects of sexual network structure on pathogens goes beyond the direct effects on channeling them differently in different populations, and can actually feed back to affect the evolution of the pathogen itself, creating additional less obvious differences in health burden.

### **Individual and Network Change in the Sexual Transmission of HIV: Simulating HIV Networks**

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Sexual relationships present complex questions of motivation, especially in the light of sexually transmitted infections such as HIV. Individual and dyadic motivations and decisions create network structures that can facilitate or restrict the transmission of infection. These network structures are created by many simultaneously operating social processes. One social process is serosorting, by which a person chooses partners depending on HIV status; HIV- persons select HIV- partners for self protection, while HIV+ persons motivated by partner protection avoid selecting HIV- partners. Successful serosorting reduces the chances for HIV transmission.

A second process is seroadaptation by which a person differentially selects particular behaviors depending again on HIV status of self and partner. An HIV- person might self-protect by selecting more protective behaviors with a partner who is seen as more likely to be infected. Effective seroadaptation reduces the probability of HIV transmission.

Sexual relationships are not always permanent. As relationships form and terminate, networks change, and these changes are a third social process that may impact HIV transmission. Self protection can lead to termination of a relationship with a risky partner; partner protection can lead an HIV+ person to terminate a relationship with an HIV- partner when protections become

burdensome. Structural change may facilitate or inhibit transmission of HIV: closed networks reduce transmission while open networks facilitate transmission. As information on partner risk become clear over time, a relationship may change its level of protection. At the same time, a motivation of relationship preservation may threaten an intimate relationship if protection is taken to imply a lack of trust.

A fourth process involves the changes within relationships that, for as long as the relationship lasts, can increase or decrease chances of transmission.

Analytically distinguishing these separate processes can be difficult. A useful way to distinguish these processes is through simulations. By modeling each of the four social processes and performing simulations where each process is consecutively added to a baseline model, important insights into the separate effects of each process can be highlighted. However, the data requirements for such simulations are severe.

A series of investigations in high drug use neighborhoods of Houston Texas provide the raw data for informing such simulations. A two-wave longitudinal study and a 14-wave longitudinal study were conducted. Data on sex and drug use partners were collected at each wave. HIV was tested for annually and study participants reported their subjective estimates of their partners' HIV status, along with other relationship data. Data collected from 494 persons describing almost 2000 risk relationships (sex, drug injection) provided estimates of parameters for constructing a series of simulations.

Results from the simulations suggest that network turnover can be seen to have a large impact in increasing opportunities for infection. This impact is somewhat reduced by the network structure in Houston. Small, relatively closed networks limit opportunities for transmission and are somewhat protective. In addition, within-relationship longitudinal adjustments also have a protective effect. Results of this study show how simulations can provide an analytical mechanism to disentangle complex social processes.

### **Individual social capital and subjective wellbeing: How do community-level perception, interaction, and participation matter in Taiwan?**

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The widely used ego-centered network measures such as the position generator demonstrate how network social capital might affect how one finds a job, provides, and receives social support; yet how one's network social capital affects various aspects of subjective wellbeing remains an intriguing theoretical and empirical puzzle. Moreover, it is unclear whether and how community-level perceptions and behaviors such as the sense of community, social interaction with neighbors, and group participation might influence how individual network social capital is associated with subjective wellbeing in an emerging democratic society like Taiwan.

Based on data from the 2017 Taiwan Social Change Survey, we use the position generator and daily contact as the proxies of individual network social capital. Subjective wellbeing includes self-rated health, general happiness, and life satisfaction. The community-level perception covers community awareness, belonging, and affinity; the measures of community-level social interaction are the approximate number of neighbors whom survey respondents greet and visit. Group participation addresses whether respondents participate in religious, political, and leisure organizations or none. In addition to socio-demographic backgrounds, we control general social trust, a proxy of cognitive social capital that links to one's subjective wellbeing.

Preliminary results showed that the number of accessed occupations is significantly associated with health, happiness, and life satisfaction; the effects remain significant for general happiness after considering community-level perceptions and behaviors. Similarly, the significant effects of

daily contact disappeared on two out of three wellbeing measures; in other words, more daily contact links to better self-rated health after holding other covariates constant. Higher level of sense of community and frequent neighboring behaviors generally lead to better wellbeing. In particular, respondents with higher sense of community affinity are happier, perceive better health, and report better life satisfaction. Last but not least, more frequent visit to neighbor's house is associated with higher level of general happiness. Unsurprisingly, one's general social trust leads to improved wellbeing in the full model, illustrating how one's cognitive social capital may compensate the lacking of structural social capital when it comes to one's subjective wellbeing. We will further analyze whether gender and educational differences exist in patterns of network social capital, neighboring behaviors, group participation, and how they are associated with subjective wellbeing.

Using the case of Taiwan, this study has two contributions. First, the results will inform the social capital literature in delineating the effects of individual structural social capital versus cognitive social capital as well as how one may benefit from developing sense of community and engaging with neighboring behaviors. Second, this study offers insights into the social cohesion literature by showing how community-level perceptions and behaviors may be considered as elements of social cohesion at the community level.

#### **Informal agrarian networks and agroecosystem diversification**

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Agroecosystem management has evolved from a focus on the application of ecological principles to agricultural practice, into an approach that engages the entire agrifood system by seeking broad integration of actors and knowledge systems in a social-agroecological system. Within these systems, strategies to enhance biodiversity and land use diversification in the agricultural landscape can curb many of the negative impacts associated with current food production systems. Yet, the social drivers of introducing agrobiodiversity and managing biologically complex agroecosystems remain elusive. This talk will draw upon ten years of social network research from the cocoa-growing regions of Ghana to illustrate the network metrics that best explain the adoption of agrobiodiversity and pro-environmental management practices. Using both standard techniques and advanced modelling approaches, findings empirically show that i) the management of diversity in agroecosystems is highly dependent on the structure of information networks among producers and with institutions, ii) migrant farmers play a brokerage role in transferring climate adapted agricultural knowledge, and iii) land-use change is correlated to social network density. More recent research asks: What information network structures or motifs lie within rural agricultural cooperatives? And what structural, demographic, and/or environmental attributes best predict the formation of these information networks? We show that farmers with more biomass accumulation from the adoption of agroforestry practices also tend to be popular advisers to their peers at the local level. Yet commonly observed individual-level results might not scale to the collective community level. Cumulatively, we contribute assessments of the universality in the structural and attribute elements across multiple networks and empirical evidence to the growing literature on drivers of sustainable practices in social-agroecological systems.

**Informal Clinical Integration in Medicare Accountable Care Organizations and Mortality following Coronary Artery Bypass Graft Surgery**K. Dennie Kim<sup>1</sup>, Russel J. Funk<sup>1</sup>, John M. Hollingsworth<sup>2</sup><sup>1</sup>University of Minnesota, <sup>2</sup>University of Michigan

**Background:** When collaboration across organizational boundaries is important, informal interactions may be unreliable or inefficient, and formal networks may be established to foster integration among members through contractual and financial mechanisms. Accountable Care Organizations (ACOs) are networks of healthcare providers and provider groups that emphasize formal clinical integration through contracts to improve collaboration among members in the delivery of patient care. However, formalization alone may overlook the importance of informal interactions between providers with whom they actually share work in driving patient outcomes.

**Objective:** To determine whether informal clinical integration relates to a health system's performance, in terms of patient outcomes, within a formal ACO network.

**Research Design:** We analyzed national Medicare data (2008-2014), identifying beneficiaries who underwent coronary artery bypass grafting (CABG). After determining which physicians delivered care to them, we aggregated across episodes to construct physician networks for each health system. We used network analysis to measure each system's level of informal clinical integration (defined by cross-specialty ties). We fit regression models to examine the association between a health system's CABG mortality rate and ACO participation, conditional on informal clinical integration.

**Subjects:** Beneficiaries age 66 and older undergoing CABG.

**Measures:** 90-day CABG mortality.

**Results:** Over the study period, 3,385 beneficiaries were treated in 161 ACO-participating health systems. The remaining 49,854 were treated in 875 non-participating systems or one of the 161 ACO-participating systems prior to the ACO start date. ACO systems with higher levels of informal clinical integration had lower CABG mortality rates than non-participating ones (2.8% versus 5.5%;  $P < 0.01$ ); however, there was no difference based on ACO participation for health systems with lower to relatively moderate informal clinical integration. Regression results corroborate this finding (coefficient for interaction between ACO participation and informal clinical integration level is -0.25;  $P = 0.01$ ).

**Conclusions:** Formal clinical integration through ACO participation may be insufficient to improve outcomes. As such, health systems with higher informal clinical integration may benefit more from ACO participation.

**Keywords:** accountable care organizations, physician networks, formal integration, informal integration

**Informal communication structure as a determinant of employees' satisfaction in educational institution**Elena Veretennik<sup>1</sup>, Daria Vasileva<sup>1</sup>, Sofia Slepova<sup>1</sup>, Aleksander Pronin<sup>1</sup><sup>1</sup>St. Petersburg school of economics and management, National Research University - Higher School of Economics

This research is aimed to identify and explore the nature and the features of the relationship between employee's satisfaction, loyalty and informal communication structure in an educational institution.

In a long-term perspective, the level of engagement affects employees' attitude and trust to the supervisor and overall corporate loyalty. Researchers state that control and evaluation of employee's satisfaction are of importance for business (Rachel, Yee & Yeung, 2010, Harsky, 2003, Hajdin, 2005). However, these studies do not take into consideration social networks among

employees as one of the aspects influencing loyalty level. Moreno (1951) and Wasserman (1994) determined the crucial role of social networks in understanding formal and informal communication structure and establishing the productive system of cooperation in a company. In our research employee's loyalty is presented as a set of employee's characteristics caused by his/her qualities and organisational qualities, which influence the attitude, the behaviour and the intentions of the employee. To collect quantitative data on employees' loyalty and satisfaction we created an offline-distributed questionnaire. The questionnaire consists of three groups of questions, each one taking into consideration unique features of the educational institution (college). We use NPS (net promoter score) and JDS (job diagnostic survey) as a basis for the questionnaire (Hackman & Oldham, 1975).

In order to depict and to measure the structure of informal communication, we address the social network theory. The importance of the social ties cannot be underestimated both for management and employees themselves (Lawson et al.,2009). Shared social ties result in similar views and attitude towards different aspects. That is why it may also be a reason for a level of loyalty (Tamer et al.,2012). We use two groups of sociometric questions to measure trust-related and work-related networks. In-degree, out-degree and betweenness indices are used to depict quantitative measures of networks.

The population consists of 50 employees of one of the professional colleges in St Petersburg, Russia. The group of employees is represented by masters, subject teachers and administration and specialists. The initial sample method is the census.

We use multivariate linear regression with control variables to explore the nature and the features of the relationship between informal communication structure indices and satisfaction indices and level of loyalty.

### Results

1) The higher the level of work relationship involvement (betweenness), the higher employees are satisfied with the administration of College. According to the value of standardised regression coefficient, the betweenness is as important as experience in College to predict satisfaction about the administration.

2) The higher the level of trust relationship involvement (betweenness), the lower the overall satisfaction with colleagues and attitude towards college. We notice that the sign of the relationship between informal communication structure and satisfaction/loyalty changes once we change the nature of the relationship from work to trust. We call this effect satisfaction hypocrisy. Employees are less loyal to the college, colleagues and superiors if they keep trust-related communication in mind. Moreover, on the contrary, employees are more satisfied with superiors if they discuss work-related communication.

### Innovation capability: Development and validation of a sociometric scale

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Nowadays countries, as well as firms, need to focus on their knowledge-based activities in order to develop innovation, which allows them to remain competitive worldwide. In addition, due to the changing environment, firms need to possess certain abilities that allow them to unravel their potential to innovate. This has led to an increase research interest to examine a firm's innovation capability in order to understand the factors that help its development. However, given the complexity of the phenomenon, there is still debate regarding the nature and definition of innovation capability. Specifically, even when scholars have recognized at a conceptual level that innovation capability is a multi-dimensional construct, most of the empirical studies focus just on one dimension, mainly product innovation capability. Concretely, within the literature studying

the so-called dynamic capabilities of firms, scholars have suggested that the phenomena should be understood on the basis of the different kinds of interactions (social, collaborative, support, etc.) between the actors engaged in the processes of organizational innovation and change. However, most studies continue to operationalize the construct using psychometric techniques, thus neglecting the social dimension.

Therefore, by considering the previous limitations, the aim of the study is to develop and validate a sociometric scale to measure a firm's capability to innovate. To achieve this, an extensive literature review was conducted to identify the main dimensions of the construct. Then, a survey was applied to 61 members in the biotechnology area of a Mexican university inquiring about their different kinds of interactions. In addition, for the validation of the scale, informal relations and knowledge sharing are examined as determinants for innovation capability. The data is analyzed using the procedure of multiple regression quadratic assignment procedure (MRQAP). This study makes two contributions to the management and innovation literature. First, the study examines a firm's innovation capability from the perception of several employees within the firm to examine the social aspect of the construct. This is achieved through the integration of tools and theories from the social network paradigm, which allow to develop a sociometric scale with the objective of avoiding asking a person about the performance of "groups" or "firms" and instead ask them about the specific individuals within the firm. The findings reveal that when innovation capability is measured at a dyadic level from a socio-structural perspective, instead of measuring it at the group level with a psychographic-cognitive proxy, the respondents do not distinguish the dimensions that have been found in a psychometric instrument. Second, the study empirically shows that informal relationships become the base for knowledge sharing and at the same time it also has a positive impact on a firm's innovation capability.

### **Instructional fingerprinting, network analysis of Framework for Interactive Learning in Lectures (FILL) data**

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Instruction that engages students in 'active learning' results in improved student outcomes over passive lecture. These outcomes include conceptual understanding and course passing rates across science disciplines. However, active learning is an umbrella term not tied to any one pedagogy or instructional approach. This results in ambiguity about the practices and enactment of active learning. Accordingly, an active research area is the development of classroom observation protocols that capture instructional practices and moves in order to better understand active learning and connecting these instructional practices to student outcomes. One observational protocol, developed at University of Edinburgh, is the Framework for Interactive Learning in Lectures (FILL). The FILL focuses on instructor actions during active learning lectures and includes six codes for lecture activity. The data generated from the FILL is a set of codes along with time stamps. These codes are transformed into a network representing transitions from instructional activity to another. Accordingly, these networks of instructional activities allow us to generate a characteristic of instructional practice. We draw on FILL data collected from five semester-long analyses of lectures across three courses and four instructors to provide a network fingerprint of instructional practice. The resulting networks are directed and weighted. A network dyad and triad census, transition analysis, and the use of generalized ERG models allow us to identify the fingerprint of an instructor and to search for the characteristic fingerprint of various instructional practices that all would be considered active learning. We present results that

illustrate the network analysis of FILL data and propose further elaborations of how the method could be extended as part of an overall instructional evaluation protocol.

### **Inter- versus Intra-Group Friendship Effects on Students' Intergroup Contact Attitudes**

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With the rise in ethno-racial diversity in the U.S. since the 1960s due in large parts to immigration reform, questions about the state of inter-ethnic relations and its effects have become increasingly important topics of research. Intergroup contact theory, popularized by Gordon Allport (1954), suggests that intergroup contact, under certain conditions, can effectively reduce prejudices and conflicts between groups. In a context like the U.S. with continuous immigration, it is important that examinations of intergroup contact expand beyond ethno-racial boundaries to encompass differences in immigrant generational status. In this study, we ask: 1) Do cross-ethnic and cross-generation friendships have positive influence on adolescents' intergroup contact attitude (ICA)? 2) Do same-ethnic and same-generation friendships moderate the socialization effect of friends on adolescents' ICA? We address these questions using data on friendship networks of students from two large, ethnically diverse high schools in the Midwestern U.S. collected as part of the Teen Identity Development and Education Study (TIDES). We use a Stochastic Actor-Oriented Model that controls for effects of ICA on friend selection, and thereby offers insight to how adolescents select into inter-group friendships.

### **Inter-group bridging dynamics affecting organizational connectivity**

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Work is often organized in formal work groups to complete complex tasks. These groups need a social structure for effective internal collaboration, and they need external connections to gain new information. With the rise of digital technologies, the internal and external collaboration of groups has become easier, especially on Enterprise Social Networks (ESNs). This is because on ESNs, groups are easily formed, and they facilitate formal as well as self-organizing work groups. Connectivity between these organizational groups is important for the creation and diffusion of knowledge in organizations because information can flow from one group to the other. Social networks like ESNs are often connected through small world network structures: they are highly clustered, yet have short path lengths.

However, how exactly such groups become connected is still unclear. Groups can be directly connected because people are a member of both groups. Depending on the type of ESN, employees can be invited for and join many groups. Some become active members in multiple groups and as result connect these groups. These connectors, or "bridging members", are important in terms of the social structure between groups. They can transfer relevant information from one group to another and thus increase the information flow throughout the organization. The role of the bridging member is underemphasized in existing network research, and is the primary antecedent of organizational connectivity in this paper.

The bridging member is the most important type of member on ESNs in terms of connecting groups and creating social structure between groups, where the bridging members represent the ties between those groups. An analogous type of network is the small world network, referring to relatively short paths between clusters in a network. Our baseline argument is that bridging members connect groups in such a way that a small world network arises, which enhances organizational connectivity. Departing from this assumption, we further investigate what happens over time when the small world network changes, given the dynamic and changing position of

bridging members. Some bridging members may continue to connect the same groups which results in a stable connection between these groups. Others may connect groups infrequently, and yet others will continuously bridge different groups. Investigating bridging members will therefore shed light on how they bring about stability and flexibility in the network of groups and how this influences organizational connectivity.

Our contribution addresses how bridging members affect organizational connectivity over time. We draw on longitudinal data and regression analyses of ESN data which we will complement with interviews with identified bridging members from the ESN of a Dutch youth-care organization. We find that some bridging members consistently connect the same groups, others connect the same groups occasionally, yet others do both, and some bridging members connect different groups infrequently. The connected groups form a small world network, and our tentative findings show that both stability and flexibility constitute organizational connectivity. In the full paper, we will report on the data analyses.

### **Inter-Organizational Networks and Third Sector: Emerging Features from two Case-Studies in Southern Italy**

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In the Italian social context, the transformations of local welfare and the introduction of the “Third Sector Code” have recently given new impetus to the debate if and how new forms of collaborations among civil society actors would be able to face the challenges of these changes and contribute to the development of territorial communities. The use of the concepts of network, network intervention and network governance, has been a rather widespread refrain in many local welfare systems; however, in most areas this reference remains at an essentially evocative level without leading to widespread and shared network strategies, based on theoretical and methodological awareness. The rare studies carried out on this issue in Italy show a considerable difficulty - if not a real reluctance -, by the Third Sector organisations, to promote and develop forms of partnership that can effectively be considered as network-governed partnerships.

The objective of this paper is to show how the metric properties of the collaboration networks can be useful indicators to monitor and evaluate the network governance of social interacting organizations, and to act as coherent and reliable descriptors of the social processes that govern their functioning. In this regard, we will present some methods of analysing the network structures of public and Third Sector nodes starting from two case studies. The combined use of ego-network and whole-network strategies is the proposed methodological approach for the identification of the network boundaries: a leading ego-node is chosen by considering its high representativeness with respect to the specific network goal of interest; then all nodes of the ego-network are interviewed by using a whole-network perspective thus determining the weighted collaboration among the actors.

The graph resulting from this procedure is called the “ego-whole” network. The study of structural parameters of the two ego-whole networks will provide information on the “health status” of the analysed networks and their effectiveness. The analysis of the structural components that we propose can be considered as an essential preliminary step for studying the elements which contribute to the effectiveness of governance in this type of networks and for identifying suitable actions aimed at improving the network's interactions and strategies. The two egos of the corresponding networks considered in this article are the Caritas of the Diocese of Aversa (RCA) and the Caritas of the Diocese of Benevento (RCB), both active in Southern Italy. The analysis of two case studies showed that the two networks exhibit, albeit in differentiated modes and

intensities, a weak degree of relational embeddedness, measured through the degree of reciprocity. Moreover, it is pointed out a more consistent level of structural embeddedness, measured through the coefficient of clustering and transitivity, although by weighting the potential mobilization of the network more than the actual experiences of collaboration and exchange of resources. The structural configuration of the RCA network is undoubtedly characterized by the role of coordination played by Caritas, oriented to activate clusters of nodes to some extent already connected to each other for some reason - such as having experienced in the past actions of mutual collaboration. The RCB network structure, on the other hand, appears less centralized and more widespread, although the nature of the nodes that have supported Caritas as a hub is very close or similar to that of the "generative node." [INCOMPLETE]

### **Interbank exposures: an empirical examination of credit risk spillover effect between financial institutions in Russian Federation from 2000 to 2017**

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Stability of financial systems has always been of interest to researchers, though for different reasons over the years. With multiple financial crises over the last few decades, many research studies are dedicated to the analysis of the interbank lending market as a substantial distribution channel for financial distress. In particular, current changes to the Russian banking system and the Central bank policies aimed to stabilize the banking system as Russia builds free market economy, significantly affect the financial sector. This paper is an attempt at examining the evolution and principal factors of contagion risk between the actors of Russian banking system for the period from 2000 to 2017. To conduct the analysis, we used the information on Russian interbank lending market and bank financial statements. The goal of this research is to assess the changes in the level of credit risk spillover as a factor of systemic risk minimization. The hypothesis of our research could be formulated as follows: the policy of the Central bank of Russia influenced the shift in the structure of interbank market from the model where banks had relatively symmetric links to more centered system and as a result decreased the contagion risk in the financial system comparing to the previous periods. The first part of the study, presented here, show the preliminary results on the Russian bank network composition and network predictors of fund movements between the banks. In this study to test the hypothesis stated, we used a number of statistical methods of analysis: regression analysis, statistical forecasting, etc. Most importantly, the network analysis is applied to model the network of Russian financial institutions, where the nodes represent the banks and the links describe the type and the size of financial flows between them. Preliminary results show that some banks form directional connections with other banks that only allow them to receive, not send, the funds via interbank exchanges. Also, it appears that some node attributes, such as being located in the same region, also reduce the probability of a new tie formation (in this case, ability to send or receive funds to those banks which were not connected before), also reducing the default risk. The results of this study could be used both by banks and regulatory authorities to improve the methodologies of credit scoring, when making a lending decision and to conduct stress-testing more efficiently for individual bank and for financial system as a whole.

### **Interdisciplinary Colonization: Scholar-Idea Migrations in Academe**

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Human migration is of great concern to modern societies, and yet little work explores how human migration relates to the migration of culture and ideas. Few studies analyze how people and/or

ideas flow in different directions across groups, establishing a larger system of social and cultural exchange. In this paper, we develop such a perspective by studying the academic migration of people and ideas across thousands of university departments for over a million doctoral recipients (people migration) and their intellectual output (idea migration) over three decades. In so doing, we (a) introduce a typology of migration patterns between group origins and destinations based on the migration of people and ideas, (b) identify those mechanisms (matching, status, discrimination) which predict certain forms of exchange across groups, and (c) contribute to the science of science literature specifically. We find that people and ideas move within rather than between fields; within or down status levels; and across fields when some social groups are numerous (women) and others few in number (non-White scholars). Additionally, academic colonization occurs from STEM to non-STEM: they send people and culture outside of their niche, while adopting non-STEM ideas but not people.

### **Interlocking Directorates and Firm Performance: Role of Brokerage in UK FTSE350**

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To address the competition in the business environment, firms need to continuously upgrade their knowledge, in order to improve their corporate strategy. An avenue for acquiring such knowledge is through interlocking directorates.

The research on interlocking directorates suggests different paradigms as explanations for why interlocks are created. Over the years, the idea of interlocks as a controlling mechanism has changed into interlocks as a transfer mechanism. The resource dependency paradigm (Pfeffer & Salancik, 1978) suggests that interlocks are established to reduce uncertainty through ensuring access to resources not available internally. In line with this approach, interlocks can be considered a transfer mechanism. Hence, interlocking directorates allow firms to update their knowledge base as directors sitting on multiple boards create connections with the associated firms, and these connections result in the transfer of knowledge between firms (O'Hagan & Green, 2004).

In this paper, we investigate the interlocks created between FTSE350 companies from 2010 to 2018, paying specific attention to the connections made between various sectors, by female and male directors. We intend to apply the two-mode brokerage analysis proposed by Jasný and Lubell (2015). This approach allows for a more in-depth investigation into brokerage roles (as defined by Gould & Fernandez, 1989), and whether there is a significant propensity for these roles. In addition, this approach allows us to observe whether these roles truly emerge because of brokerage, rather than centralisation or path closure patterns. We then analyse whether there is a relationship between brokerage roles of firms and their performance, based on Return on Capital Employed (ROCE).

The number of brokerage roles in the observed data is calculated (at the network level). We consider the sectors of firms and the gender of directors when looking at the two-mode brokerage roles. An Temporal Exponential Random Graph Model (as introduced by Hanneke et al., 2010) is then implemented. The model specification contains the centralisation, alternating path parameters and the tendency for each group (sector/gender) to establish a director-company tie (and nothing more). This model is then used to simulate 1000 networks. From this distribution of networks, we then test whether we observe the roles significantly more or less than in the simulated data. This approach allows for a robust test whether the roles occur more or less than by random chance, and even goes a step further allows to assess whether these roles truly emerge and are not just a product of network centralisation or path closure processes.

We then test whether holding a true brokerage role in the network one year is associated with higher levels of firm performance at following years. We investigate whether brokerage, by providing access to information and resources is associated to improved performance and explore in depth cases where business performance and network prominence are negatively associated. "This abstract is related to Corporate Networks."

### **Interpersonal trust and criminal network resilience: Computer simulations of law enforcement interventions.**

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The dynamics of trust is a scarcely studied concept in the context of criminal networks. In the present paper, we investigate how trust between actors in a criminal network impacts the network's vulnerability to law enforcement interventions aimed at dismantling and disrupting such a network. We use computer simulations to estimate how quickly a criminal network will be dismantled by law enforcement intervention given varying trust parameters. We simulate a network characterized by high trust, and the same network characterized by low trust, and compare a range of law enforcement strategies under these two conditions. Using computer-generated models, we incorporate targeting strategies used in previous research on criminal network adaptation (see Bright et al., 2017): targeting actors by maximum closeness centrality (here found to be most effective), maximum betweenness centrality (previously found to be very effective), money targeting, maximum degree centrality, and targeting actors randomly (previously found to be least effective). We found that the network breaks down quicker when connections depend on trust. Low trust between actors renders the network more vulnerable, both when trust is randomly assigned and when trust is assigned according to dyadic connections. Here, the dyadic connections appear to engender greater network resilience.

### **Interplay in corporate governance network: A multilevel network analysis of board and executive director selection and collaboration process in Denmark**

Slobodan Kacanski<sup>1</sup>

<sup>1</sup>Roskilde University

This paper investigates network structures that evolved as a result of the executive and non-executive directorship selection processes in a Danish corporate governance context. Primarily, the paper focuses on discussion of legitimacy of a board and top management selection processes that emerge on two fronts – supervisory board selection of cooperatives, and their choice of executive directors (top-management). The paper utilizes the exponential random graph models on Danish corporate governance data for the period of five years (2010-2014) to reveal network structures in order to estimate tendencies for the social selection processes. This method is applied to enable unfolding of a discussion on how different interests and scarce resources over preferable social actors (team members) create network dynamics, and how legitimate those processes are. Findings show that corporate governance network in Denmark tends to evolve around the most active top-managers and supervisory board members, while homophily effect related to knowledge and experience of actors plays significant role only within the supervisory board level, while not in the network between supervisory board members and top-managers.

### **Interprofessional education in primary care: an evaluation using social network analysis**

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**Background:** Due to multimorbidity and geriatric problems, older people often require both psychosocial and medical care. Collaboration between medical and social professionals is a prerequisite to deliver high quality care for community-dwelling older people. Effective, safe, and person-centred care relies on skilled interprofessional collaboration (IPC) and practice. Little is known about interprofessional education (IPE) to increase IPC in the context of community care for older people. This study evaluated the impact of a previous developed IPE programme on IPC in primary care using a social network analysis.

**Method:** A before- after study using social network analysis was performed to evaluate the effectiveness of the IPE programme on IPC of primary health care professionals who deliver health and social care to community-dwelling older people. The IPE programme included primary care professionals such as general practitioners, practice nurses, district nurses, social workers, physiotherapists and pharmacists from three districts of the city Utrecht, The Netherlands. The outcomes satisfaction and applicability of the IPE in practice were evaluated with a questionnaire among participating professionals (n=22). The effectiveness of the IPE programme on the interprofessional network of health care professionals (N=55) was evaluated by a social network survey. This social network survey measured the number of contacts with other professionals, reciprocity of contacts, diversity of contacts, and the value of contacts among participating and non-participating professionals.

**Results:** Participants regarded the IPE programme positively. It was applicable in clinical practice. In all districts, an increase in the number of contacts was observed among the participants (on average 2 contacts) and among non-participating professionals (on average 1.2 contacts). Suggesting an increased collaboration between IPE participants and other professionals in the district who did not participate in the IPE programme. The reciprocity in the districts' collaboration networks increased after the IPE programme with 15% in district 1, 2% in district 2 and 13% in district 3. Suggesting that health care professionals' contacts had more mutual contacts after the IPE programme than before. The diversity of contacts increased over time with 10% (p value <.001) in district 1 and 6% in both district 2 (p value .055) and in district 3 (p value .371). This indicates that the IPE programme contributed to a more diverse network of health care professionals. Participants from district 2 valued their collaboration with other professionals significant higher after the IPE programme (0.2 %; p .022). r, This significant increase was not found in districts 1 and 3 (p .341; p .267).

**Conclusion:** The IPE programme increased IPC among health and social care professionals providing care to community-dwelling older people. Participants regarded the IPE programme positively and applicable in practice. Participating as well as non-participating professionals gained a larger, more collaborative, and diverse interprofessional network in primary care, suggesting a ripple-effect of networked interventions. Future studies are needed to explore whether this effect and improved collaboration may have an impact in the quality of care in this population.

**Investigating effects of most-liked comments in news: patterns of opinion diversity in Internet news platform**

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In the era of digitalized news consumption, the effects of online comments on news are taking on a new aspect, based on the development of communities with collective behaviors. Recently, there was a significant social issue in South Korea: Naver, one of the dominant news aggregator and internet portal at the same time, decided not to show the most-liked comments on political news to prohibit occurrence of illegal manipulation of comments. Accordingly, advantages and disadvantages of exposing most-liked comment system has been discussed. However, little is known of whether (a) reading the most-liked comments increase users' amount of expression of opinions, and whether (b) such expressions increase interest in others' opinions and diversifies social interaction. For the empirical verification of the effects of most-liked comments, authors chose common topic (issue of increasing minimum wage), collected actual data (3,251 articles and its comments), and compared categories of news based on the existence of most-liked comments system. Semantic network analysis is accomplished by all of words from comments using UCINET, K-Means clustering, and Cosine similarity. Results show how the comment system in Internet news environment affect news consumers' commenting behavior.

*Keywords: commenting behavior, most-liked comment, news community, collective action, discourse networks*

**Investigating the Network Structure of Public Administration Journals**

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This paper is a presentation of the results of social network analyses of the journal citations in public administration within the Web of Science. The authors analyzed the network structure of public administration journals to determine the relative prestige of the journals within the network and how it changed over time. In the analyses, the authors used the citation data from the Web of Science database for 2005, 2010, and 2015. The authors tested whether the citation networks have the characteristics of the small world model and/or a scale-free network. To characterize the citation networks, the authors used multiple measures, including degree centrality, Bonacich centrality, core periphery, clique analyses, and the Small World Index.

The results of the centrality and core-periphery analyses yield a picture of a centralized network among public administration journals. More specifically, the network increasingly became more centralized over time with increasing number of citations being directed toward two journals: Public Administration Review (PAR) and the Journal of Public Administration Research and Theory (JPART). The core-periphery analyses confirm that PAR and JPART were the core journals and their core-ness increased between 2005 and 2015. The centrality analyses also show that JPART became more prominent over time and it may surpass PAR in the near future. This finding about the trend is important because it shows that the centrality measurements will coincide with the Journal Impact Factor (JIF) measurements in public administration. The centrality measures are based on long-term citations, compared to the short-term JIF, and they measure the reach of a journal across different journal titles. The sharper upward trajectory of JPART in centrality scores seems to be closing its gap with PAR; if the trend continues, JPART will become more central than PAR.

The clique analyses show that there were groups among public administration journals that became more discernable over time. More specifically, public policy journals formed more discernable clusters, particularly in 2015.

The results of the clustering coefficient analyses and the Small World Index analyses suggest the citation network public administration journals had small-world characteristics. Although the analyses do not directly confirm the existence of a scale-free network, or a Power Law distribution, among the citations in public administration, the authors speculate based on the analyses that there was “preferential attachment” to the central journals of the public administration networks in the years we analyzed.

The whole network analyses conducted here reveals various characteristics of the public administration journal network. In terms of centrality, the two central actors, JPART and PAR, are becoming more prominent each year. Regarding network centralization, the network increasingly became more centralized over time with increasing number of citations being directed toward JPART and PAR. The core-periphery analyses confirmed the prestige of JPART and PAR but also showed that JPART is becoming more prominent over time and could surpass PAR based upon the level of change.

### **Isolation, Cohesion and Contingent Network Effects: the Case of School Attachment and Behavioral Problems**

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How do the network features of a context shape individual outcomes, like health, mental health and deviance? This is a core question for researchers interested in the effect of the social environment on individuals. For example, past work has found that more cohesive schools and neighborhoods tend to have better outcomes, like lower crime rates, fewer suicides and higher levels of attachment. One of the main assumptions in network studies of contextual effects is that the good produced from the contextual feature is a public one, where all actors benefit equally from the larger social environment. In the case of social cohesion, this would mean that all actors, regardless of network position, fare better when cohesion is higher. In this paper, we argue that some, but not all, outcomes have the characteristics of a public good, with important implications for the well-being of both individuals and communities. Our goal is to identify the conditions where the contextual effect is universal, and where it is more contingent, necessitating that an individual hold some position to receive the full benefits of the larger, network product. We focus particularly on the case of cohesion and isolation, analyzing isolation and cohesion as part of a holistic, multi-level system. In general, we may expect a cohesive network to create positive feelings of belonging. Similarly, we may think that a cohesive network will exert stronger control over its members, offering clearer and more consistent norms to follow. But do all actors share equally in this collective benefit? Or do only those actors who are embedded in the network (i.e., not isolated) gain access to these collectively produced goods? We explore these ideas using the case of adolescents in school (using the Add Health data), focusing on the joint effect of isolation and cohesion on two outcomes, school attachment and behavioral problems. Empirically, we find that cohesion works very differently for isolates and non-isolates, depending on the outcome of interest. We find that non-isolates become more attached to the school as cohesion increases, while isolates actually feel less attached in high cohesion settings. On the other hand, all actors, regardless of isolation status, are ‘better behaved’ when cohesion is higher. Isolation and cohesion thus combine to create very different experiences, depending on the position of the student and the social cohesion of the school. For example, in high cohesion schools, non-isolates are completely integrated, with high attachment and few behavioral problems. Isolates in high cohesion schools, in contrast, are regulated, with few behavioral problems, but without the added benefit of feeling attached to the school. Overall, the results clearly show the importance of taking a systematic, multi-level approach. Network processes operate at both the individual and

contextual level, and it is fruitful to analyze them together, offering a rich picture of how networks matter.

### **Joint production motivation in interdisciplinary networks**

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In health care education, increasing efforts are made to train professionals to transcend traditional disciplinary boundaries, and to approach patients from a holistic viewpoint. As health care consists of many different interdependent professional services (e.g. surgeons, cooks, social workers), educational programs are set-up to cultivate in professionals such interdisciplinary skills. In this research, we focus on programs with the specific aim of developing such interdisciplinary skills in students through interdisciplinary networks. Specifically, we research how the structure and interdisciplinarity of cooperative networks affect its members' motivation to cooperate, and how this in turn affects individual learning experiences. In interdisciplinary networks, individuals from disparate disciplines, with oftentimes different organizational backgrounds, cooperate to strive towards shared objectives. One of the questions, then, is how such individual cooperative efforts can be nurtured and mediated, for interdisciplinary cooperation to actually reach its goals. In this paper, we offer the concept *joint production motivation* (coined by Lindenberg & Foss, 2011) as theoretical micro-foundation explaining cooperation in interdisciplinary networks. Joint production motivation entails an individual's willingness to collaborate with others to achieve a common goal. This motivation rests on perceived task dependence and is cognitively shaped by an individual's cooperative context: this means, theoretically, that joint production motivation flows through network interactions. One is motivated to work if (s)he sees others cooperating too.

Research on interorganizational networks focuses on explaining ecological contexts in which cooperation emerges, often implicitly taking a rational choice perspective as an individual's underlying reason to cooperate. This exchange perspective brings forth a structural focus on networks by reasoning individuals cooperate rationally towards some expected mutual benefit. Focusing on joint production motivation nuances this image as it allows for motivation to spillover between individuals. Second, we investigate how interdisciplinarity within interorganizational networks affects the motivation to cooperate in such networks. Interdisciplinarity is a key premise of interorganizational networks, as individuals from different knowledge domains and with different skill sets offer complementary benefits to parties involved. We attempt to uncover how the structure and shared understandings between individuals within teams affect learning outcomes regarding interdisciplinarity. This research focuses on so-called "learning networks" in the Dutch health care sector. Learning networks are interdisciplinary collaborative efforts consisting of students and professionals from different disciplines and organizations aiming to enhance professional skills of members through its collaboration. Analytically, these networks offer the opportunity to compare several collaborative teams within a specific sector to analyze how team composition affect individual member's joint production motivation and learning outcomes. Data will be collected by surveying student members (n=±130) of learning networks. Participants complete our survey at three points in time, allowing for a longitudinal analysis of change in perceived network ties, network effectiveness, and joint production motivation. Hypotheses are generated on the individual and dyadic level, with network ties, institutional and organizational backgrounds, and perceived task division as independent variables, explaining joint production motivation as dependent variable. Data will be gathered starting in May 2019, and our intention is to discuss analytical strategies and preliminary results at Sunbelt.

**Journals in the field of SNA: Derived networks and temporal analysis**Daria Maltseva<sup>3</sup>, Vladimir Batagelj<sup>1,2,3</sup><sup>1</sup>IMFM, Ljubljana, <sup>2</sup>UP IAM, Koper, <sup>3</sup>International laboratory for Applied Network Research, Higher School of Economics, Moscow

The presentation is a part of analysis of bibliographic data about the field of SNA. The study is based on the analysis of articles from the Web of Science Clarivate Analytics data base containing the keyword “social network\*”, as well as those published in the main journals in the field. The first part of the data set was collected in 2008, and the collection of networks obtained out of it was labeled SN5 and was used as a challenge data for the Sunbelt 2008 Vizards Session (7,000+ papers). The second part consisting of 60,000+ papers published in the last ten years was collected in June 2018. Thus, the updated data set which is being analyzed includes 70,000+ publications with a complete description.

From the collected data the citation network and two-mode networks linking articles with authors, keywords and journals were constructed. In the analysis we are following and improving on the already proven scheme used in earlier studies (Kejžar et al., 2010; Batagelj and Cerinšek, 2013, 2014; Batagelj et al., 2014, 2017, etc.). The approach to temporal network analysis (proposed by Batagelj and Praprotnik, 2016) was applied on large bibliographic networks for the first time.

The obtained derived networks allow analyzing citation and co-citation (bibliographic coupling) among journals. We identified the journals having the large number of citations to others and, using islands approach, groups of journals connected to each other by the relations of citation and co-citation. The methods used were extended to temporal versions of networks providing an insight into the dynamics of relations.

**Keep Delegating and Nobody Explodes: Team Communication Dynamics in a Series of Cooperative, Simulated Bomb Defusal Tasks**Sean M. Fitzhugh<sup>1</sup>, David Chhan<sup>1</sup>, Katherine Gamble<sup>1</sup>, Derek P. Spangler<sup>1</sup>, Ryan Robucci<sup>2</sup>, Jean M. Vettel<sup>1</sup>, Nilanjan Banerjee<sup>2</sup>, Justin R. Brooks<sup>1,2</sup><sup>1</sup>U.S. Army Research Laboratory, <sup>2</sup>University of Maryland - Baltimore County, Department of Computer Science and Electrical Engineering

Communication plays an important but indirect role in shaping group outcomes. Teams researchers have long recognized that group processes---such as coordination and conflict management---and group states---such as trust, efficacy, and social cohesion---shape group outcomes such as performance. Interactions within the group shape the emergence and evolution of these states and processes, but the influence of temporal dynamics is not well understood. Temporal features such as time lags, feedback loops, and path dependency have largely been understudied because we have lacked access to dynamic, high-resolution interaction data coupled with dynamic, high-resolution attribute data. In this paper, we address this gap using a longitudinal (9-week) study where several 4-person teams play *Keep Talking and Nobody Explodes (KTANE)*. In this cooperative video game, individuals must coordinate and consolidate incomplete snippets of information to solve a series of puzzles in order to defuse a bomb. Interaction (who speaks to whom, for how long, and what was said) and physiological data (heart rate, respiratory rate, etc.) were collected continuously as the team played multiple rounds of *KTANE* during a single session once per week; we also collected survey data pertaining to individual assessment of team states and processes at the end of each weekly session. During the course of data collection, a number of practical challenges arose that when addressed, helped us improve the quality of the data and subsequent modeling efforts. Such challenges included: (i) isolation of a single participant's speech in the audio data collected by microphone, and (ii)

accounting for the physical effects of speaking on respiration in order to better model psychological constructs based on physiological recordings. To characterize network dynamics in this setting, we used a relational event modeling framework to analyze the timing and structure of team communication and the dynamics of processes such as coordination and routinization across teams' repeated sessions playing *KTANE*. We further this analysis by examining how individual attributes correspond to the timing and structure of communication and demonstrate how this relational event modeling framework and repeated measurement of group states and processes provide insight into how communication dynamics shape the emergence and evolution of group states and processes. Finally, we provide a discussion of the practical issues that arose during the course of our study and provide recommendations for similar experiments seeking to collect high-resolution, multi-modal data.

**Leaders as Prisms: How trust in direct superiors influences the negative effect of cross-unit knowledge sharing on perceptions about the organization's ethical compliance**

Manuel Gómez-Solorzano<sup>1</sup>, Sebastian Leon Schorch<sup>2</sup>, Giuseppe Soda<sup>3</sup>

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Individuals contribute to firms' success by sharing their knowledge and ideas with others. Extensive evidence suggests that sharing knowledge across organizational boundaries is seen positively as it facilitates innovation and coordinated action in organizations. Much less discussed are potential negative consequences of cross-boundary knowledge sharing for the individuals involved, such as increased role stress, role conflict, and role ambiguity. In this study, we seek to expand our understanding of the potential negative consequences of cross-boundary knowledge sharing and the role that trust in immediate superiors can play in shaping these effects.

More precisely, we argue that increased interaction with members of other organizational units not only raises employees' access and awareness of potentially useful information, but it simultaneously raises employees' awareness about malicious practices and unethical behavior within the larger organization. Consequently, perceptions of the overall organizations' ethical compliance are likely to be lower among employees that engage in cross-unit knowledge sharing. However, the inferential process leading to these perceptions is subject to cognitive biases that can be traced back to the relationship of employees with their direct superiors. Positive relationships to direct superiors (approximated through trust) likely relate to positive perceptions among employees regarding their immediate work environments. Consequently, organization-level inferences will likely be subject to a positive confirmation bias, which marginalizes the influence of negative information that is derived from cross-unit knowledge exchanges in building such judgments. Additionally, trust in the immediate superior may inspire optimism about the future conduct within the larger organization. Therefore, perceptions of ethical compliance may be shaped by projections of an ethically compliant future that the trusted superior can enable, rather than being a neutral assessment of the present state. From a networks perspective, this argument provides important insights into how pipes (cross-unit knowledge sharing ties) and prisms (the relationship to a leader and projections that are associated with the leader as a positive change agent) can complement each other in shaping employees' perceptions about organizations as a whole.

We measured knowledge-sharing behaviors, employee-superior trust, and perceptions of ethical compliance among 2,416 employees in a multinational manufacturing corporation, distributed across 36 countries. After controlling for a variety of alternative explanations, we find empirical support for the moderating influence of the employee-superior relationship on the effect of cross-unit knowledge sharing on perceptions about the organization's ethical compliance. While cross-

unit knowledge sharing decreases employees' perceptions of ethical compliance, the trust between employee and superior increases employees' perception of ethical compliance and diminishes the negative effect of cross-unit knowledge sharing.

### Leading Teams Over Time Through Space

Alina Lungeanu<sup>1</sup>, Leslie DeChurch<sup>1</sup>, Noshir Contractor<sup>1</sup>

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Among the remarkable team challenges NASA faces in long distance space exploration missions is the need to maintain team shared mental models among the crew. Team shared mental models characterize the degree to which members hold similar knowledge structures about their task and team interactions. Shared mental models are robust predictors of effective teamwork processes and performance. There are a large number of factors that affect shared mental models, and many of these factors change over time, as the team develops and conditions change.

In groups who live and work together for extended periods of time, the quality and pattern of social relations within the group will likely affect how shared mental models develop and change over time. Leadership is an especially meaningful aspect of team functioning. Team members pay more attention to the beliefs and attitudes of those whom they consider to be leaders, they seek advice from these individuals, and ultimately, shift their own beliefs to align with those whom they view as having influence within the group. In this way, team leadership relations are an important social driver of shared mental models. We sought to understand *how the structure of leadership relationships in teams affect shared mental models over time*.

We leverage computational modeling and naturalistic observation to explore this question. To do this, we first programmed an agent-based model, rooted in prior theory and research, that specifies a set of rules explaining how personal, situational, and interpersonal factors affect mental models in teams. We then observed four, 4-person teams living and working together in a NASA space analog for 30 days. We assessed team task mental models daily using a pairwise similarity measure designed to capture the individual's mental model.

We implemented the model using NetLogo ABM and we parameterized the ABM using these empirical data so that we could then generate hundreds of in-silico teams, like the ones we observed, but that vary systematically in their pattern of leadership relations. We then place the in-silico teams in "virtual 30-day missions" matching the ones experienced by our four analog teams, and observe the mental models that emerge over time. Next, we manipulated leadership structures to create 7 patterns of leadership: Shared, hierarchical, and connected have been previously investigated in studies of team leadership. Factionalized, disenfranchised star, and disenfranchised chain represent leadership structures that have been described in ethnographic research on small groups who live together in isolation for extended periods of time. Lastly, we captured the case where there were no leadership relations within the team. For each leadership structure, we created 400 in-silico teams, 100 that were spawned from the model parameterized using each of our four observed crews.

Results show that mental models exhibit meaningful variation across structures and over time. On any given day, shared, connected and star leadership structures led to the highest level of shared mental models, followed by factionalized, disenfranchised star and disenfranchised chain structures, which in turn were higher than shared mental models in teams without any leadership structure.

**Legislative Effectiveness Hangs in the Balance**Samin Aref<sup>1,2</sup>, Zachary Neal<sup>3</sup>

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Starting in the 100<sup>th</sup> (1987-1988) session of the U.S. Congress, there has been a steady decline in the fraction of bills introduced that eventually become law. This decline in legislative effectiveness has occurred in parallel with rising levels of political polarization, however the link between effectiveness and polarization is unclear.

In this presentation, we have two goals. Methodologically, we compare three approaches to measuring political polarization by examining balance in *signed networks*: *triangle index* (the fraction of balanced triangles), *algebraic conflict* (the smallest eigenvalue of the Laplacian matrix of the network), and *frustration index* (the smallest number of edges whose removal leads to balance). Substantively, we use a measure of bipartisanship derived from the frustration index to examine the impact of bipartisan coalitions on rates of bill passage.

We use signed networks of legislators inferred from bill-cosponsorship data for U.S. Senate and House of Representatives between 1987 and 2016. Previous research on the same data has shown an increase in polarization in the U.S. Congress when measured by the triangle index, which provides a locally-aggregated index of balance.

Analyzing balance of these networks over time, we observe that the three measures are all highly correlated, providing nearly identical assessments of the degree of balance in each chamber and session of congress. However, the measures have substantial differences. Algebraic conflict relies on the spectral properties of the network, and thus offers a global index of structural balance. The frustration index also takes the overall network structure into account, but unlike triangle index or algebraic conflict, provides a partitioning of the vertices. This offers a unique advantage: it is possible to compute a measure of bipartisanship by examining the party memberships of legislators in the largest, and therefore controlling, partition.

Computing the frustration index, in principle, involves searching among all possible ways to partition a given signed network into (at most) two groups in order to find the partitioning which minimizes the total number of intra-group negative edges and inter-group positive edges. To tackle the intensive computations, we initially provide upper and lower bounds for this number, then solve an optimization model which closes the gap between the two bounds and returns the frustration index alongside the optimal partitioning of vertices.

In the U.S. Congress, a bill receiving a majority vote in the chamber where it was introduced does not become law until it also receives a majority vote in the other chamber and is signed by the president. Therefore, it might be expected that a chamber's bills are more likely to become law when the other chamber and the presidency are controlled by the same political party.

Using our numerical results based on the optimal partitions; however, we show that bipartisanship in the originating chamber is more important, which ensures that bills sent to the other chamber and president for consideration are less marked by partisanship extremes.

**Leveling ties in two-mode networks**David Schoch<sup>1</sup>

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Networks can be made of various kinds of ties, but (often implicit) assumptions embodied in network-analytic tools do not necessarily apply to all of them. Centrality indices, for instance, build on the assumption that it is always beneficial to add more ties. Consequentially, networks that include ties with a negative sentiment require different concepts of centrality. We here highlight a third general type of tie, the leveling tie, which is neither positive nor negative but an

indication of commonality. We argue that these ties occur particularly often in one-mode projections of two-mode networks which therefore restricts the applicability and interpretability of standard network analytic tools in such cases. We introduce a set of alternative methods to analyse networks with leveling ties, guided by their formal connection with the class of interval graphs. The practical and theoretical considerations are illustrated with two-mode networks from different contexts. These include the derivation of ideological alignments of legislators in U.S. congress based on bill co-sponsorship and co-voting patterns, and socio-economic status based on occupations of married couples.

### **Leveraging Home Visitation Program Network to Address Obesity Disparities**

Sarah-Jeanne Salvy<sup>1</sup>, [Kayla de la Haye](#)<sup>2</sup>

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Low-income and underserved mothers and their young children are at increased risk for obesity and related diseases. Lack culturally-competent obesity prevention programs and interventions further contributes to these disparities. Over the last seven years, our network of researchers, families, and community stakeholders has integrated evidence-based nutrition and physical activity components into an engaging obesity intervention as part of existing federally-funded home visitation programs targeting underserved families.

This talk summarizes findings from our pilot work and from two ongoing randomized clinical trials evaluating the implementation of these interventions in Southern California (mothers and 6-24 months infants) and in Central Alabama (mothers and 3-5-year-old children). Specifically, these two-arm, parallel, randomized controlled trials (RCTs) test the effectiveness of a targeted obesity intervention (HABITS) delivered as part of ongoing home visitation services, compared to the existing home visitation services without obesity-related content on mothers' and children's obesity risks. HABITS focuses on habit formation and modifications of food and activity cues in the family, home, and community to support habit formation.

Assessments of young mothers (weight, waist circumference, and habit strength of targeted behaviors), children (rate of weight gain), and the food/activity household environment will be conducted at enrollment, post-intervention (9-12 month), and one-year post-intervention follow-up. This research is poised to have a substantial impact because the delivery modalities of current obesity efforts disproportionately restrict the reach and engagement of underserved, low-income children and their caregivers who are most at-risk for health and obesity disparities.

### **Local and expert knowledge structures in flood management: A multiplex semantic network analysis**

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Managing flood hazards is a complex task for which intellectual resources of any single group are insufficient. Until recently, flood defense activities relied on natural and applied sciences, and the institutionalized expert knowledge. However, managing flood hazards solely with scientific knowledge and the expertise of institutionalized actors has proven inefficient. Consequently, since the beginning of the 1990s, there has been a gradual shift in flood hazard management policy and practice. The new approach to flood management seeks for community engagement in flood-related decision-making and bringing together local and expert knowledge enabling their interpenetration. Yet, studies report limited community engagement and appropriation of

institutionalized expert knowledge in the knowledge structures of local flood-prone communities. Aiming to explain the low levels of community engagement and limited influence of institutional knowledge on the knowledge of local communities, researchers refer mainly to exogenous factors, such as the culture of political participation, risk perception, and the socio-political context. There is, however, little research into the structure and content of knowledge in flood-related decision-making. This hinders both research and practice.

We study how institutionally imposed expert knowledge on flood management affects the corresponding local knowledge of flood-prone communities. Namely, we conduct a mixed-method co-occurrence-based semantic network analysis of a corpus of textual data gathered during our pilot ethnographic study of a flood-prone village in South-East England in 2015. We jointly examine diverse types of texts produced by three groups of stakeholders involved in flood risk management in the area: two local groups of community flood activists and an institutional body officially responsible for managing flood risks. We use these texts to map three semantic networks representing knowledge structures produced by each of the stakeholders, qualitatively examine these networks, and apply exponential random graph models for multiplex networks to examine the effect of institutional semantic networks on the semantics of two local groups.

While both local groups appear to reproduce institutionally imposed knowledge structures typical for the field of flood risk management, these are only basic terms and phrases. As to more complex knowledge structures, institutionally imposed knowledge is contextualized locally, i.e., it is complemented with local knowledge and often gains different sense. Moreover, local knowledge structures tend to consistently diverge with more complex institutionally imposed knowledge structures. Subsequent qualitative analysis locates the specific points of divergence between the local and the expert knowledge.

### **Longitudinal Online Profile Sampling – A Method to Measure Changes in Self-Ascribed Identity**

Jason J. Jones<sup>1</sup>

<sup>1</sup>Stony Brook University

In many online contexts, people describe themselves with short texts. On Twitter, for example, new users are asked to fill in a biography field with the prompt: *Describe yourself in 160 characters or less*. In this talk, I will describe methods and software for collecting millions of such self-authored mini-biographies and for constructing networks of words based on their usage. For example, consider the weighted adjacency matrix containing the joint probability of any two words appearing in a biography. The nodes in this network are chosen to represent social roles (e.g. mother, father, entrepreneur, teacher, gamer). The edges between them are weighted by their probability of co-occurrence. The full network paints a picture of the organization of personal identities over the population as a whole.

Now consider a different network of words. The nodes remain the same – a list of social role signifiers. But rather than an adjacency matrix, this network is based on the transition matrix. The adjacency matrix was constructed from co-occurrence at one point in time. The transition matrix weights edges based on conditional probability over two points in time - specifically, the probability that a new word is added at time 2 given that the previous word existed at time 1. This network describes how individuals transition between roles. Where do newly declared entrepreneurs come from? Where do gamers go when they stop calling themselves gamers?

The current work consists of social role signifier networks constructed from the profile biographies of 3.5 million unique users of Twitter active through the years 2015-2018. I will discuss the methods used to create the networks and present open source software and open datasets I will make available for others interested in conducting similar work.

**Making a space for taste: Structure and discourse in the specialty coffee scene**James Lannigan<sup>1</sup><sup>1</sup>University of Toronto

Connoisseur consumption has continued to grow in popularity, with more niche retailers and specialty firms servicing a diverse multiplex of increasingly discerning consumers. While the role of interlocutors transmitting cultural knowledge and cues in the specialty industry has been studied, the applied processes of re-shaping consumer tastes is relatively undertheorized. In particular, despite the wealth of consumer data from social media platforms, there has been little empirical focus on how consumers make sense of their experiences when exposed to changes in taste. In order to scrutinize the process of distinction making in practice and reception, this study employs a mixed methods approach to triangulate the production, reception, and practice of taste-making at four coffee fairs held in Toronto, ON, and Hamilton, ON. Through ethnographic fieldwork, conventional content analysis, and a discourse and social analysis of social media usage from attendees, this study finds that there are ten key discursive themes utilized by retailers, organizers, consumers, and press to understand and shape their experiences, but that there are important empirical differences between the discourses used in-person and those utilized online.

**Making Friends to Make a Difference: A Study of Youth Social Networks in Victoria's Environmental Youth Alliance**Yasmin Koop-Monteiro<sup>1</sup>, David Tindall<sup>2</sup><sup>1</sup>University of Brit, <sup>2</sup>University of British Columbia

Friendship is a key element of social movements as individuals come together for a shared goal and form new ties along the way. Although friendship is particularly central among youth, less is known about its role within the context of youth in social movements. In this study, we analyze close friendships within a network of 39 members of the Environmental Youth Alliance in Victoria, B.C. using QAP regression, cohesion analyses, and exponential random graph modeling. The results suggest that prior project collaboration and/or studying at the same school are significant predictors of friendship development among the youth activists, and their effects on friendship are amplified when combined. In addition, we find a significant level of closure within the network, suggesting a high degree of cohesion. In contrast, the effects of selective mixing by gender are insignificant. These findings suggest that in order to facilitate friendship development, opportunities for youth to work together must be available within communities, preferably within each school.

**Making haste slowly: Interaction pacing and group dynamics during entrepreneurial networking events**Balint Dioszegi<sup>1</sup>, Anne ter Wal<sup>1,2</sup><sup>1</sup>Imperial College Business School, <sup>2</sup>ETH Zurich

Forging stable and valuable connections is key to entrepreneurs' success, making networking events an important vehicle for the accumulation of social capital. Yet it is unclear how entrepreneurs manage the tradeoff between diversity and bandwidth during such events. While moving from one stranger to the next at a quick pace may allow for a rapid accumulation of potentially valuable ties, a slower-paced approach building on transitive ties may lead to a more positive impression on others, and thereby more stable - if less numerous - ties. The ability to skillfully manage this delicate balance is likely to have a significant effect on the kinds of networks entrepreneurs build. To better understand the mechanisms at play, we plan to observe emergent networking behavior and group dynamics during an entrepreneurial networking event, utilizing sociometric badges to track movement and social dynamics in high detail. In addition, we plan to

collect social network data (both before and after the event), as well as data on the kinds of impressions that participants made on others. Through this research, we hope to deepen our understanding of the microfoundations of networking behavior, as well as of the ramifications of these behaviors for social capital creation and maintenance.

### **Mapping Gender Inequalities for Young Adults with ASD Using Egocentric Social Network Measures**

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**Background:** Over 66% of young adults with Autism Spectrum Disorder (ASD) are disconnected from opportunities for work or schooling in the first few years after high school. <sup>1</sup> Unequal access to social capital (resources and connections) from work, community and school contexts could adversely impact their transition to employment and other lifecourse outcomes. <sup>2-4</sup> Our study represents the first attempt to use modern social network methods to investigate the social networks of transition-age youth with autism to investigate social capital inequalities during transition.

**Objectives:** To conduct a preliminary investigation of the social capital of youth with ASD post transition by using pilot data from self-report egocentric social network surveys to identify resources and connections and investigate variation across gender.

**Methods:** A purposeful sample of 17 young adults between the age of 19-28 were asked to identify up to five important people and the supports they provided to the young adult. The young adults also identified network connections among identified supporters. Using ORA <sup>5</sup>, we computed the density of the team of identified supporters, the percent for each role type and the percent for each type of supporter. Descriptive statistics suggest that participants represented a racially homogenous (88% white), relatively advantaged group of 17 young adults, with a mean age 23.25. Overall, 82% had ever attended college and 35% were living independently. 59% were male (n=10), 29% female (n=5), and 12% were gender non-conforming (n=2) (Table 1).

**Social Network Results:** Pilot data suggest that youth were not isolated, with mean networks size = 4.88. Few support networks included professionals (n=2). Types of supports provided by network members varied. Friendship (75%), emotional support (74%) and advice (73%) were more frequent while employment support was less frequent (24%). Median network density for males was 100%, while female or gender non-conforming persons median density was 60% (Mann–Whitney  $U = 13$ ,  $p = .03$ , two-tailed). (Figure 1) Role types of supporters varied by gender. Family members were marginally more present in males' support networks (median 68%) than female and gender non-conforming persons' (median 40%; Mann–Whitney  $U = 17.5$ ,  $p = .09$ , two-tailed). In contrast, community members were more present in the support networks of females and gender non-conforming persons (median 40%) than in the support networks of males (median 12.5%) (Mann–Whitney  $U = 53$ ,  $p = .08$ , two-tailed). Family friendship also varied by gender, where males had on average a marginally greater percentage of family members who provided friendship (median 60%) than females and gender non-conforming persons (median 40%) (Mann–Whitney  $U = 15.5$ ,  $p = .06$ , two-tailed).

**Conclusions** Pilot data suggests that youth were not isolated and that gender is salient for diverse sources of social capital acquisition, as male young adults with ASD in this study relied primarily on family network members, while females and gender non-conforming persons had more diverse networks that included family and community members. The lack of professionals present in support networks illustrates the adverse impact of the service cliff, as identified in previous studies

**Mapping Queer Womxn's Desire: A Network Analysis of @\_personals Dating Ads**Kirsten Gibson<sup>1</sup>, RM Barton<sup>1</sup><sup>1</sup>Purdue University

When the Instagram account @\_personals launched in 2016, it was a novelty among other dating applications and websites by providing an online space specifically for queer, trans, nonbinary, and gender-nonconforming users. The founder of the account took inspiration from dating ads written in the lesbian erotica magazine "On Our Backs" and allowed users to express themselves in short, colorful blurbs rather than in images. The @\_personals account nods to queer history while creating a virtual community space for groups marginalized by mainstream online dating culture. @\_personals puts no limitations on the language users can employ to communicate their gender identities and expressions, sexualities, and interests to the account's nearly 60,000 followers. By avoiding the binary labels that other dating applications rely on and allowing users to define themselves, @\_personals provides an opportunity to study the autonomous dimensions of queer desire and their patterns, which often fall outside of binary understandings of gender and sexuality and indeed subvert the heterosexism and cisnormativity that are perpetuated by dating sites. Here, users are able to freely express their gender and sexuality.

Previous research has explored relationship data in print personals advertisements (Gonzales & Meyers, 1993; Lynn & Bolig, 1985) but has focused primarily on heterosexual expressions of desire or, in some cases, cisgender homosexual male desire (Bartholome, Tewksbury, & Bruzzone, 2000). Little scholarly attention has been devoted to understanding queer desire in virtual spaces dominated by women and trans people. The unique queer woman-centered content on the @\_personals page provides an opportunity to address this gap.

This study uses a network analysis approach to determine how self-described gender identity is linked to the same or other gender identities. With the current sample of 100 randomly selected ads, we identified seven categories of gender and linked each instance of gender with the gender sought in the ad. These gender categories were mapped onto a data matrix and each instance of "gender sought" was counted into a weighted network. The data matrix was into NodeXL (Smith et al., 2012) and graphed to express edge weight, in- and out-degree, and reciprocity.

The initial findings showed that femmes had the highest representation in the network (n=23) and they also had the highest in-degree. The gender categories with the lowest in-degree were genderqueer, non-binary, and androgynous. Non-binary had the highest out-degree, while genderqueer and androgynous had the lowest out-degree. The highest reciprocity in pair ratios was found for femmes, the lowest for androgynous people, and the highest imbalance of reciprocity was for non-binary people. Though the ubiquity of butch/femme gender dynamics in lesbian communities has changed over time (Crawley, 2001) our study shows that butch/femme relationships are still commonly sought after but not exclusively by women who identify as lesbians; trans and gender-nonconforming people are also using these terms to describe themselves and their desires. However, those who identify with genders outside of the gender binary may have more trouble finding others who desire their specific gender category.

**Mapping the networks of social entrepreneurs in a fellow community through strategic interconnectedness**Rushi Pandya<sup>1</sup>, Mika Westerlund<sup>1</sup><sup>1</sup>Carleton University

Social entrepreneurship has emerged as an innovative and thriving approach to develop, fund and implement solutions to various social, cultural and environmental challenges. Despite portrayed as entrepreneurs, social entrepreneurs are not business people in a traditional sense, rather change-makers who use their business and creative skills to help identify and solve social

problems on a large scale. As a consequence, social entrepreneurship has become subject of interest to many scholars and practitioners alike. Although there are numerous platforms and communities for social entrepreneurs, one of the most interesting gaps in the literature is how social entrepreneurs representing diverse areas are interlinked with each other. Our research focuses on strategic interconnectedness of social entrepreneurs working in different domains and regions. So doing, we perform a thematic analysis of the introductions of 3315 social enterprises from the Ashoka Fellowship program. Ashoka is an international organization that promotes social entrepreneurship by affiliating social entrepreneurs into the Ashoka organization. Ashoka fellows are connected with entrepreneurs in order to help the fellows succeed in implementing their social ideas. Each fellow's profile on the Ashoka website provides a short introduction and mission summary, as well as more detailed information of their idea, key problems to be solved, and strategy. Our research method has two steps. First, we apply a machine learning based text analysis tool called topic modeling to identify the key themes in Ashoka fellows' profiles. The themes provide an understanding of the participating social enterprises/entrepreneurs based on their strategic views, i.e., an implementation approach, problem identification, and focused areas. Second, we apply a social network analysis of the Ashoka fellows using the identified topics as connecting factors. In other words, the topics reflect strategic interconnectedness between social entrepreneurs on an international fellow community platform. As a result, we hope to introduce a method to combine machine-learning based textual data analysis with social network analysis. Beyond the scope of operations and the contributions to research methods, our results provide more extensive insights into new social networks of Ashoka fellows based on strategic aspects.

### **Maxmin-omega: A New Threshold Model on Networks**

Ebrahim Patel<sup>1</sup>

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We present "maxmin-omega", a new threshold model, which is grounded on the rule that nodes in a network require a fraction,  $\omega$ , of incoming input before processing their own state. The new state is then transmitted to nodes downstream, and the this sequence of events is repeated until some periodic behaviour is observed; such behaviour can represent 'viral' uptake of fads and trends, and seasonal epidemic outbreaks. This intuitive rule for nodal update times is represented by a simple recurrence relation, and has a natural interpretation in max-min-plus mathematics, which has originally been applied to model periodic scheduling, manufacturing, and timetabling. Thus, maxmin-omega is distinguished from both stochastic systems (e.g., SIR-type) and traditional threshold models, which are halted once the threshold is reached. Crucially, maxmin-omega is reliant on feedback, i.e., the recurrence of the above processes until periodic behaviour. We further show that this behaviour can be deduced from the reduction of maxmin-omega to a smaller, simpler, system, where redundant network edges are discarded and only the 'fastest' edges are retained.

Consider the increasing sequence of update times of each node; the differences in these update times form a periodic sequence after a transient time. By recording the transient time, period, and the average inter-update times (the cycletime), we notice that regular and random graphs exhibit period and transient time peaking when  $\omega$  is 0.5, whilst cycletime is almost linearly increasing with  $\omega$ . The one departure from this trend comes from small-world or heavy-tailed networks, which have a few hubs and a large proportion of nodes with very small in-degree; here, all three recorded measures are almost always constant with  $\omega$ , and make sudden, brief, jumps to larger values. This suggests that maxmin-omega dynamics on 'real-world' networks such as neuronal and social networks are, for most values of the threshold  $\omega$ , less interesting (and more predictable) than networks with a more heterogeneous in-degree distribution. In terms of

a neuron network, the aforementioned jumps might indicate sudden increases in brain activity, which soon settle, suggesting that, most of the time, the brain is conserving energy, expending it only when required. A ready-made application in this social media age is Twitter. Thus, suppose that people are likely to pass information on ('retweet') when a sufficient number ( $\omega$ ) of their friends have tweeted them. If the timings of people's tweets are periodic, a correlation with the periodic behaviour of the maxmin- $\omega$  system may potentially be established. Tweet dynamics could therefore be modelled by maxmin- $\omega$ . Overall, maxmin- $\omega$  thus provides a new and compelling view of dynamics on networks of the real world.

### **May We Have a Word? Understanding NGOs' Social Media Salience through Machine Learning and Social Network Analysis**

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In democratic societies, issues, especially salient and controversial issues are discussed in the public sphere and solved through the dialogue, collaboration, competition, and conflict among issue stakeholders. In the process of addressing an issue, public attention is a critical resource. Webster (2011) noted that "the widening gap between limitless media and limited attention means it is harder for any offering to attract significant public attention" (p. 44). NGOs often are formed to address social issues and they have recognized the importance of public attention.

In the current study, we reviewed previous studies and identified two prominent approaches that offered recommendations on how NGOs can attract public attention on social media. The strategic communication approach argues that the most important factor is the communication strategy such as the number of tweets sent, the content of tweets, number of followers, etc. The network approach shifts attention to the basic structure of digital media, and focuses instead on what network positions facilitate or constrain NGOs' ability to attract public attention. Both approaches have been validated by research. However, no consensus has been reached regarding which approach is more important. Also, it remains unclear whether different combinations of strategic communication strategies can afford NGOs the ability to become influencers through multiple paths. Finally, little research has looked at the differences/similarities between the topics promoted by influential NGOs and that of the general public.

To address these questions, we combine three research methods. First, we collected Twitter data on two refugee crisis related news events in 2016. The first news spike (April 18–19), and the topic of the media coverage focused on the impact of the refugees and migrants on the Brexit debate. The second news spike (August 29–31), focused on the migrant aid and rescue operations. From each spike, we collected the mention and retweet networks of all accounts mentioned our search keywords "refugee" and "illegal immigrants". In addition, we use keyword search to identify NGOs accounts. Members of the research team verified those accounts manually. We then used ORA (Carley & Reminga, 2018) to calculate the network characteristics of all accounts.

Second, we used a machine learning method, regression tree, to assess the importance of different factors. Regression tree applies supervised classification and decision tree methods to identify critical factors and thresholds in large scale data (Breiman, 2017). Regression tree uses automatic feature selection and does not require users to specify the model in advance and therefore can reveal unknown patterns. Moreover, the approach does not require similar assumptions such as none-interdependency among observations and is useful for data involving social network measures (Lantz, 2013). The regression tree compares the effects of the strategic communication approach and network approach at multiple decision points.

Third, the decision tree identified a number of NGOs as “influencers”. We further applied topic modeling to analyze these NGOs’ tweets and that of the general public. Our findings reveal areas in which top influential NGOs’ discourses are similar or diverge from general topics.

### **Measuring “Truth” and “Risk-Taking” through Shared Language in the Enron E-Mail Dataset**

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While philosophers have been arguing for millennia about the definition of “truth”, we propose a simple natural language-based machine learning approach to categorize the perception of “truth”. Our system uses deep learning to group text into two categories: “truth” and “lies” based on word usage. It is based upon the premise that journalists of mainstream media are paid to report the truth, while politicians are elected for saying not truth but what their voters want to hear. We have built a word analysis system that has been trained in two categories. The first category are the “politicians”, this category has been trained with the Twitter streams of all US members of Congress and the Senate, the second category are the “journalists” which has been trained with the tweets of all journalists of New York Times, Washington Post, and Guardian. We created two additional categories “risk takers” and “stock traders”, trained with the Twitter feeds of wingsuit fliers, cave divers, and other people taking huge risks, and with Twitter feeds of day traders and stock brokers for the “stock trader” category. This system is an extension of our “tribefinder” system introduced earlier which identifies four dimensions of tribes, the dimension “alternative reality”, with tribes “fatherlanders”, “nerds”, “treehuggers” and “spiritualists”, the dimension “ideologies” with tribes “socialism”, “liberalism”, “capitalists” and “complainers”, the dimension “lifestyle” with tribes “fitness”, “vegan”, “sedentary” and “yolo”, and the dimension “recreation” with categories “arts”, “sport”, “fashion” and travel”.

We tested our system by analyzing information content, structure, and dynamics of the Enron e-mail corpus, looking at the number of “journalists”, “politicians”, “risk takers”, and “stock traders” among the 1000 most central people in the Enron network. We find that the convicted criminals are mostly “politicians”, with only two “journalists”. The “politician” communication style is also prevalent among the other employees of Enron included into the dataset. “Journalist” employees are more central than the other categories, while “risk-taker” employees are being answered the fastest by other employees.

We also investigate the other dimensions of our tribe categorization system. We find that the Enron employees are 90% capitalist, they are interested in arts, travel, and sports, they also include seven percent risk-takers, however none of whom has been convicted. In the “alternative reality” dimension, Enron employees are mostly nerds and treehuggers, followed by fifteen percent spiritualists and six percent fatherlanders. This categorization might be misleading, as Enron employees were talking about alternative energy trading, thus using words typically used by treehuggers. Almost half of all Enron employees adhere to a sedentary lifestyle, a third has been (mis)categorized as vegans, ten percent are categorized as “yolo” (you only live once). On the other hand, we also found that the fatherlander Enron employees are more central in the network, while the spiritual Enron employees use more emotional and positive language.

**Measuring market competition with networks of suppliers and buyers: new evidence from procurement data**

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Insider trading of big assets has been a significant issue for many economies of the world. On the one hand, it is a predicament for economic growth, on the other hand, it is a type of corporate and governmental corruption that erodes market institutions and rule of law. However, insider trading is very difficult to spot as well as to deal with. We focus on insider trading in procurement in order to address this issue. We propose a theory that auctions in procurement combat insider trading, and offer empirical analysis to test our theory. Both sociologists and economists recognize the importance of incentives. We argue that auctions facilitate symmetry of information and, thus, incentivize non-insider traders to be more active as well as constraints insider traders from having an upper hand. We analyze unique open data on procurement in Ukraine from 2015 to 2018. We look at two markers of pharma and gas to evaluate the number of suppliers and the degree of competition among them. The analysis shows that the market structure has changed. The number of suppliers increased, and on average they began to supply to more buyers. Furthermore, the density of the markets has decreased. We interpret lower density as more structure on the markets. The number of ties increased, but these ties are established between certain suppliers and contractors. We observe fewer and fewer small stars on the periphery of the graphs. Instead, over time there are more suppliers that connect to certain buyers in a clustering matter. This suggests that certain market niches become more structured. All in all, the procurement data for the gas and pharmacy market show that the number of suppliers increased between 2015 and 2018, that the number of their auction participation increased as well, and that the market overall became more structured. These metrics are indicative of competitive markets. We argue that our measurement of competition as networks of suppliers and buyers provide new evidence of the effect of reforms on fighting against insider trading in the Ukrainian markets.

**Measuring Social and Cognitive Distance in Collaboration Networks Construced from Observational Data**

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The notion that information, knowledge, attitudes, beliefs, values, and behaviours tend to be more homogenous within cohesive subgroups than across them is a foundational premise for network theories of diffusion, structural holes, brokerage, and structural folding. Sample surveys have been especially useful for testing hypotheses from these theories because they enable researchers to collect a broad range of relational, demographic, and attitudinal data with a single questionnaire. Researchers analyzing observational data (e.g. digital trace data), however, often find themselves with an abundance of high-quality relational data but extremely limited attribute data. This poses challenges for testing theories that include hypotheses about homophily on knowledge and beliefs, or for using models that include covariates for node attributes as well as relations (e.g. ERGMs).

In this article, we introduce two new measurement strategies that can be used to test hypotheses about node similarity despite the limitations inherent in observational data. We present computational methods to measure similarity based on the content of what actors say and do. This information is available in many observational datasets -- e.g. email networks, social media networks, scientific collaboration networks -- in the form of unstructured text data. The first measurement strategy we propose combines natural language processing, semantic networks,

and the vector space model to compare the similarity of nodes in some given subset of a network based on the content of what they have said or done. The second measurement strategy, grounded in set theory, determines how similar a set of nodes are given some list of features (e.g. works cited, languages spoken, courses taken, protest events participated in). Both measures can be used at the individual level, or at a group level. After introducing these two measurement strategies, we demonstrate their application by using data on scientific collaboration in the field of remote sensing to test hypotheses from structural holes theory and structural folding theory.

**Measuring Stress and other Emotions with Smartwatches and E-Mail**

Keith April Arano<sup>1</sup>, Peter Gloor<sup>1</sup>, Jannik Roessler<sup>1</sup>

<sup>1</sup>MIT CCI

This paper introduces different use cases for a smartwatch-based system for measuring human emotions based on body sensing of “honest signals”. As it was originally designed to measure happiness, the system is called the “Happimeter”. The Happimeter predicts mood based on the sensor readings of an Android Wear Smartwatch, showing the results on the watch, the associated smartphone app, and on the associated Web site. It has been verified in a longitudinal study with a cohort of 50 students, and has been used at different workshops and in the classroom to measure participant satisfaction, stress, and understanding. The system was calibrated through experience-based sampling, using the smartwatch to poll users at random times to enter a self-assessment of these variables. Using machine learning, the system now predicts these variables with an accuracy of 80 to 90 percent.

For instance, in a classroom lecture setting, the lecturer can now get constant feedback of the variables satisfaction, stress, and understanding, allowing her or him to instantaneously adapt the lecture to the level of the audience to for instance activate participants if the students become tired. In another experiment, we have tracked participant satisfaction and activation at an executive committee strategy workshop of a major telecom company to help them redesign and make better use of valuable executive time at workshops.

In addition, we have also compared longitudinal emotion in e-mail with emotion measured through body sensing. In a preliminary analysis we have compared sentiment, emotionality, and complexity of the text in the mailbox of a wearer of the Happimeter over the duration of a year with the happiness defined as pleasance and activation measured through the Happimeter. We found that happiness is significantly negatively correlated with the amount of messages, i.e. the less messages the wearer of the Happimeter sent and received, the happier he was on a particular day. We also found that sentiment was positively correlated with pleasance, i.e. the more positive the language in the mailbox of the Happimeter wearer, the happier he was measured through the Happimeter. In addition, we found negative correlation between emotionality of language, and activation measured through the Happimeter, as well as negative correlation between complexity of language and happiness. In other words, the simpler the language of the e-mails, the happier the wearer of the Happimeter was, and the less emotional the language of the e-mails on a particular day, the more activated the wearer of the Happimeter was.

**Measuring the Rise of Inequality in Science Globally with Topic Models and Networks**

Charles Gomez<sup>1</sup>, Sebastian Munoz-Najar Galvez<sup>2</sup>

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While science is presumed to be a global and open exchange of ideas, it is also increasingly complex. Collaborations and the mobility of scientists more commonly transcend national borders, and more research is being produced now than at any point in history. Furthermore, many countries typically relegated to the periphery of science are more actively engaged in global

conversations. Nations have a vested interest in science, as national influence in science is often a proxy for economic and military prowess on the international stage. However, growing economic inequality might suggest that science is increasingly less open and influenced mostly by the major powerbrokers on the international stage, which may ultimately inhibit scientific progress. Yet to date, there is no consensus as to how to measure this scientific influence. For instance, citation metrics and their complement, usage-based altmetrics, are unable to capture a country's actual influence on the ideas and concepts of other communities across the globe and across a variety of fields. This is a substantial oversight for science policy and funding, since adequate measurements of scientific influence are necessary to understand the magnitude, speed, and possible explanatory factors driving inequality.

The availability of large-scale publication data and the advent of computationally text analysis techniques, such as topic models, avail us the opportunity to uncover hidden patterns within scientific publications, where scientific knowledge is introduced, debated, and accepted. The language used in these papers encodes a variety of subtle influences from authors spread out across different nations. We argue topic models provide a more precise and granular measure for the scientific influence of countries. It allows us to identify the concepts that are more strongly associated with scientists from a specific country, in a given discipline, and for a specific year. From this, we can then represent the relationship between countries as a longitudinal network that measures how much scientists in one country incorporate concepts associated to scientists from another other country (and vice-versa).

To empirically test this, we apply nation-labeled LDA topic models to over 20 million scientific paper abstracts to generate 2,142 networks of international linguistic exchanges across 126 fields and nearly 20 years of publication data. We find that global scientific influence is increasingly stratified. Specifically, the most influential ideas increasingly emerge from an elite group of countries that includes the United States, China, and those in Western Europe. To isolate a mechanism that may be strongly associated with scientific influence across fields, we apply Double-Semi-Partialing multiple regression quadratic assignment procedure (DSP-MRQAP) model to each of these field-year networks. We find that the percent of GDP allocated to research and development (R&D) is what primarily drives influence across fields, even when controlling for common alternative explanations such as national power, citations, coauthoring, publishing, and proximity.

### Mediators of Structural Balance

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Structural balance is the theory that humans have a disposition to take sides in a signed networks, motivated by the desire to reduce cognitive dissonance. While structural balance is one of the most studied theories of signed ties, empirically the evidence for the theory is mixed. We ask why have researchers found strong evidence for structural balance in some studies, but not in others? We propose that for structural balance to manifest in a network, it requires the presence of one of three mediators: visibility, consequence, and normative orientation. We use various statistical models to analyse a longitudinal dataset of signed ties of 400 university students. We test for the impact of these three mediators on the presence or absence of structural balance.

**Medical Mistrust and HIV Testing: Exploring Correspondence of Belief and Behavior within Dyads**

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In the field of public health, individual attitudes are considered important determinants of behavioral outcomes. Equally important and often overlooked, however, is understanding how normative process operate within *networks* and how attitudes and beliefs are transmitted among network members. Research has consistently demonstrated a relationship between medical mistrust and HIV testing such that those who are mistrustful are less likely to be tested. While these relationships have been explored thoroughly at an individual level, studies have not investigated them from a network perspective. The current study addresses this gap.

This study draws upon data collected from an egocentric network methodology. African American and Latina women were recruited as index participants. They were asked questions about their attitudes and behavior around HIV (e.g., engagement in risky behaviors, perceived risk, testing frequency), as well as questions about their personal networks. Then, using a one-step referral process, index participants were asked to refer members of their network to participate in the study. Referred participants were asked the same questions about their own attitudes, behaviors, and social network. The analytic sample consists of 116 matched pairs of 65 indexes and 116 of their referred alters. With a dyadic analysis approach, the current study explores the extent to which *similarity* in medical mistrust among network members is associated with *similarity* in HIV testing behavior. This study hypothesized that similar levels of medical mistrust (e.g., both low, both high, or different) would be associated with similar intentions to get or *not* get screened for HIV in the future. Specifically, we predicted that mistrusting dyads would be associated with lower levels of screening and trusting dyads be associated with higher levels.

Preliminary results indicate a complex relationship between medical mistrust and HIV testing behavior among network members. First, and counter to the study's hypothesis, dyads in which medical mistrust was low were *less* likely to anticipate future screening as compared to dyads where medical mistrust was high. Second, not all agreement is created equal. The processes that influence agreement to test appear to be different than the processes that impact agreement to *not* test. Third, the amount of correspondence between network members varied depending on the nature of their relationship (i.e., acquaintances, friends, family, partners) and the extent to which dyads were comprised of demographically similar individuals.

These results shed light on an understudied problem, namely, how medical mistrust attitudes and HIV testing behaviors are distributed within networks. Taken together, these results outline a complicated relationship. Nevertheless, beginning to understand how these constructs operate across social networks is an important first step to developing more effective interventions for at-risk populations where barriers to care operate at multiple levels.

**Mistaken enmity: Comparing individuals positive and negative tie perceptions**

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There has been growing interest in the study of negative tie networks, but little systematic analysis has been forthcoming related to the perceptions of negative ties. The majority of research on network perceptions has focused on positive tie networks, leaving unanswered questions about differences in positive and negative tie cognitive social structures. However, as we learn more about how negatively and positively valenced ties differ in their structural properties and influences on individuals and groups, there has yet to be a clear articulation of how perceptions

of these ties diverge. This study uses multiple samples from two organizations to analyze differences in perceptual accuracy (errors of omission and errors of commission) of negative compared to positive ties. Findings show that egos tend to miss the presence of alters' negative ties in field settings and are much more accurate for positive than negative ties as well. In addition, individuals are less likely to see their own and others reciprocated negative ties than positive ties. We theorize that errors of omission are driven by negative asymmetry and the nature of negative relationship expression in organizations. The role of positivity bias and the tendency toward (cognitive) balance as an important aspect of negative tie perception are examined as well. Additional analysis about key drivers of perceptual asymmetry of negative and positive ties is also discussed.

### **Mixing of STI Transmission Networks in Baltimore, MD: A Venue-Based Analysis**

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Baltimore has some of the highest numbers of new HIV and syphilis cases in the country. Nationally, STI prevention strategies often target specific priority populations (i.e., men who have sex with men [MSM], individuals who inject drugs [IDU], commercial sex workers [CSW], youth under 25 years old), yet studies show that transmission frequently occurs between different priority populations. Our objective was to use social network analysis to map the extent to which different physical and online spaces serve as sites of mixing and identify venues to focus limited prevention resources.

We employed data from the Baltimore City Health Department on all new cases of HIV and syphilis reported in Baltimore City from 2009 to 2015. Data included the type of STI, demographic characteristics, priority population classification, self-reported high-risk behaviors, and sex partner meeting venues visited in the last 12 months. We selected individuals that had nominated at least one venue and created a case-venue bipartite network linking cases by shared venue nominations. To the bipartite network, we applied 1) a Jaccard similarity algorithm to calculate the proportion of nominations shared by each pair of venues and 2) a mathematical algorithm to derive the network's irreducible backbone, i.e., a simplified network based on the probabilities of each edge occurring by chance. This method, as applied elsewhere, preserves both global and local network architecture. To this simplified venue-venue network, we added attributes, including the total nominations, the number of unique priority population nominations, and type of venue (e.g., bar/club, app). Using this network of sex partner meeting venues, we drew network diagrams to describe where mixing between priority populations was occurring.

The analytic set consisted of 932 new cases of HIV (31.9%), syphilis (64.8%), and HIV-syphilis coinfection (3.3%). The median age at diagnosis was 27 years, 72.7% were Black, 72.5% were classified as MSM, 12.0% as CSW, and 4.5% as IDU. From a total of 1511 sex partner meeting venue nominations, we identified 425 unique venues, including bars/clubs (13.2%), internet/apps (12.7%), and street addresses (53.6%). The simplified network consisted of 259 venues and 356 links, with a single large interconnected group of 143 venues at its core. Facebook received the greatest number of nominations (17.6% of all nominations) but was completely disconnected from the largest component. Similarly, three other internet venues were highly nominated but absent from central positions that would make them important mediators of transmission across the network. Highly nominated venues were associated with greater mixing of priority populations ( $p < 0.001$ ). Exceptions to this pattern highlight unique qualities of individual venues, e.g., Craigslist was associated with a small cluster unconnected to the large component nominated by multiple priority populations.

Using venue-based social network analysis, we were able to identify a discrete set of venues that facilitate mixing across risk groups, such as priority populations. These venues may be overlooked by traditional strategies that silo risk groups, however, they may warrant attention for any comprehensive prevention strategy.

### **Modeling Association in Multiple Layer Networks using the Conway-Maxwell Binomial Distribution in an Exponential Random Graph Framework**

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Studying social processes unfolding in networks consisting of a common set of actors incident on multiple types of relationships has long been of interest across the social sciences. Various social structures typically involve connections between actors on more than one type of binary relationship that are conceptually “stacked” into layers. The ability to model dependence processes giving rise to such systems within the exponential random graph model (ERGM) framework has been previously introduced for cases where the underlying association between layers is assumed to be independent or ignorable, and only for a few layers in a given model.

One of the outstanding methodological challenges to this line of research has been how to build such models with an arbitrary—or even simply many—number of layers while simultaneously accounting for such association. This problem arises especially in multiple-layer networks where the set of relations are correlated. To address this, we propose an extension of ERGMs to include a Conway-Maxwell Binomial (Kadane, 2016) term that models marginal dependence (and thus association) across dyads and through the layer stack.

Our empirical data are drawn from 31 cascade-sampled family networks consisting of 14 layers each with massive amounts of missing data; seven layers have previously been shown to map onto conflict, and seven onto cohesion, latent construct networks (Koehly & Marcum 2016). These family networks involve members who are at risk for, or have a diagnosis of, Lynch Syndrome (a genetic colorectal cancer susceptibility syndrome). Our case represents a computationally challenging set of multi-layer networks and we employ novel developments in the ERGM framework to fit our model to these data.

### **Modeling Group Boundary Maintenance in ERGMs**

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Stigma has been identified as a key mechanism driving various disparities in society, which can be found in a range of economic, health, and political outcomes. While stigma is commonly seen as a process where members of an in-group exclude members of an out-group who are perceived as displaying some deviant attribute and behavior, a secondary form of stigma can be considered from the exclusion of in-group members who interact with out-group members. This secondary stigmatizing process acts to maintain group boundaries when an in-group member “spoils their identity” by association with an out-group member and has been historically observed in a variety of contexts (i.e. prison hierarchy; HIV status; white racial identity, etc.). Incorporating this stigmatic effect within the exponential random graph modeling (ERGM) framework with a novel sufficient statistic, I showcase the various properties associated with this sufficient statistic in simulation and empirically. I conclude with an exploratory analysis of stigmatic effects on network perturbation.

**Modeling Harm Reduction Knowledge Spread in Opioid User Networks**Glenn Sterner<sup>1</sup>, Ashton Verdery<sup>1</sup>, Shannon Monnat<sup>3</sup>, Khary Rigg<sup>2</sup>, Katherine McLean<sup>1</sup><sup>1</sup>The Pennsylvania State University, <sup>2</sup>University of South Florida, <sup>3</sup>Syracuse University

Fatal opioid overdose deaths in the United States continue to climb. While not a long-term strategy to address opioid use and opioid use disorder, the use of harm reduction techniques (strategies based in the philosophy of reducing harm to those who use substances illicitly) among active users and former users at risk of relapse can help to stem these rates. Knowledge spread of these techniques within the social networks of users, former users, and their support networks can impact the awareness of these techniques and reduce negative outcomes of use. This presentation draws upon results from a mixed-methods study of persons who use opioids in Western Pennsylvania that we collected in 2017 and 2018. This study measured retrospective, contemporaneous, and prospective ego-network data on four domains of social support and interaction (romantic, friendship, advice, and interactions) as well as detailed life and drug use history from each participant. In total, these data include 30 in-depth qualitative interviews and 125 quantitative surveys (including both retrospective and contemporaneous ego-network measurement) from survey participants and additional prospective, longitudinal follow-up in-depth interviews (n=10) and surveys (n=30, including network measurement) with a subset of the first wave respondents. Results from these data indicate the importance of harm reduction techniques, including assisted breathing, naloxone administration, familiarity with sources of illicit substances, among others, in reducing risks associated with opioid use. In addition, results suggest that the presence of this knowledge can disrupt negative consequences of use within an individual's social networks, due to their application among co-users. Utilizing these results, we model the opportunities for knowledge spread within the social networks of users to examine the potential impact on opioid overdose death rates. We discuss opportunities for increasing knowledge spread and flow of these techniques and implications for intervention and policy development.

**Modeling the Impact of Navigated Care on Population-level Breast Cancer Outcomes among African-American Women in Chicago**Abigail Skwara<sup>1</sup>, Ganga Vijayasiri<sup>2</sup>, Garth H. Rauscher<sup>2</sup>, Yamile Molina<sup>2</sup>, Aditya Khanna<sup>1</sup><sup>1</sup>University of Chicago, <sup>2</sup>University of Illinois

**Background:** From 2008 to 2012, African American women were 42% more likely to die from breast cancer than non-Latino white women, in part due to later stage diagnoses. Patient navigation, which provides individualized assistance to patients in order to specifically address barriers to care, is suggested to be a helpful strategy to address this disparity. Additionally, patients who have positive experiences with patient navigation are more likely to engage members of their social network conversations concerning breast cancer screening and treatment, which could lead to behavioral changes in navigated patients' social networks. The aim of this work is to examine the effect of patient navigation for women with breast cancer on population-level health outcomes via diffusion of information through navigated African American women's social networks.

**Methods:** In this NCI-funded study (R21 CA 215252), we develop an agent-based model (ABM) of African-American women in Chicago, aged 50-74 years, to examine the effect of navigation on health outcomes that include the number of breast cancer diagnoses per year and the average stage of breast cancer at diagnosis. The model simulates social network ties of agents, using separable temporal exponential random graph models (ERGMs), developed in the *statnet* suite of packages in R. Agents in the model develop and screen for breast cancer at empirically determined rates. Agents diagnosed with breast cancer are then eligible to undergo patient navigation, which

may influence the health-related behavior of agents within their simulated social network. Given that the effects of these individual-level changes on the broader network are unknown, we will investigate scenarios both with and without patient navigation to quantify the population-level impact of its implementation, including the average stage of breast cancer diagnosis among agents in the model.

Data: The model is parameterized using a number of empirical data sources. The social network data were obtained from the Patient Navigation in Medically Underserved Areas (PNMUA) and Breast Cancer Care in Chicago (BCCC) study. Data on genetic risk factors were obtained from the Survey Epidemiology and End Reports (SEER) Program report for African American women. The effect of genetic and hormonal risk factors were parameterized using published data sources (Braithwaite 2018 and Munsell 2014). The cancer care continuum was parameterized using input from expert breast cancer clinicians and epidemiologists.

Progress to Date: The model is being coded in separate modules. Of the modules that need to be programmed, four have been completed: (1) social network generation breast cancer risk factors and disease progression; (2) modeling impact of risk factors on breast cancer; (3) breast care continuum navigation; (4) vital population dynamics. The code can be found at: <https://github.com/khanna7/bc-navigation>

Expected Results and Conclusions: We will dynamically simulate the code modules above, and present data on the simulated effects of patient navigation on the number of breast cancer diagnoses per year and the average stage of breast cancer at diagnosis.

### **Modified Multiple Generator Approach to Enumerate Personal Support Networks: A Restricted Five Generator Design**

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A number of recent studies suggest that the size and diversity of people's personal networks may be smaller than in the past. Some evidence suggests that this may be a methodological artifact. The most common method for enumerating personal networks, the "important matters" name generator, may no longer enumerate a sufficiently large domain of supportive ties. This measure may not be detecting smaller and less diverse networks, so much as change in how people parcel out discussion and support related to different types of important matters across their network. As such, while reliance on a single-name generator has always been problematic, it may be increasingly problematic, and responsible for findings that personal networks have become smaller and less diverse, when in fact they have only become more specialized.

Surveys that use multiple-name generators tend to produce networks that are larger and more diverse. While using multiple generators can better capture the range of support that network members provide, researchers are reluctant to use multiple generators. Completing multiple generators, and corresponding name interpreters about each elicited alter, extends the length and complexity of personal network surveys. The solution is to revise the multiple-name generator approach in a way that does not significantly increase the demands on participants.

This paper reports the findings of a study that tests the validity of a modified approach to enumerating personal networks. This approach uses a battery of five generators, worded to capture the range of supportive exchange commonly enumerated through a multiple generator design, support related to: family and loved ones, career and work, personal finances, happiness and life goals, and health. Unlike traditional generators that allow participants to name five or more alters, the modified generators record only one name in response to each generator: the most recent person to provide that type of support. Participants are asked to provide additional information about each name, using traditional interpreters.

Using a split-ballot design, 850 adults were administered a personal network survey. This design allowed us to compare a traditional single-name generator approach (important matters), a traditional multiple generator approach (important matters plus others who are “especially significant”), and the new, modified multiple generator design. Findings suggest that the modified design is only modestly more demanding of participants’ time than a single name generator, and does not increase non-response or mental fatigue. The modified design enumerates a larger, more diverse network of similar closeness to traditional one and two-generator designs and has the additional benefit of enumerating the domains of support exchanged. Findings suggest that a modified multiple-name generator approach can be implemented in personal network surveys at the cost of only a slight increase in time, with little additional respondent burden. Moreover, the results of this research suggest that findings of smaller and less diverse personal support networks may be misleading. They may be a methodological artifact, evidence of a continuing trend towards increased network specialization, not evidence of smaller, less diverse support networks.

### **More than Accomplices in Violence?: A Social Network Analysis of Boston Gang Members**

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Street gangs are important subjects of study and targets of policy intervention because of their members’ increased risk of criminal involvement as well as victimization. A fairly recent development in gang research has been the application of social network analysis to an urban area’s street gang setting. Much of the work on the social networks of gangs focuses on the gang as the unit of analysis, relating them to one another based on rivalries and alliances. Individual-level work often examines the risk of victimization based on the experiences of one’s social network. Because of the gap in the literature concerning the individual-level, positive relationships between gang members, I examine the co-offending networks of gang members in the Boston area using official data from the police. I aim to understand how members of different gangs relate to one another with respect to their involvement in joint activity. This study provides much-needed evidence concerning how these positive relationships are structured between gangs. In addition, examining the network in relation to the crimes committed by co-offenders further expands the knowledge of the behavior of urban street gang members.

### **Mostly Dead Is Slightly Alive: Distinguishing Between Inactive and Absent Ties**

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In *The Princess Bride* (Reiner 1987), Billy Crystal memorably taught us that “There’s a big difference between *mostly dead* and *all dead*....Mostly dead is slightly alive.” In this paper we argue that what is true for farm-boys turned pirates is also true for social support ties and we draw on empirical network data to elucidate the nature of that difference.

Ego network analyses of personal support networks commonly focus on ties that are active and supportive, often generating the lists of network members by asking for the names of people who provide different kinds of support. People who are not named – including people with whom the respondent might have had an active relationship in the past or might have a current very weak and non-supportive relationship – are treated as a homogeneous “non-active” group and rarely given any consideration. This paper problematizes those inactive ties, by distinguishing between relationships that are considered inactive and relationships that are deemed non-existent by the respondent.

This distinction is important, because while non-existent ties are of little use to egos, ties that are inactive can, like Westley, spring to life at a crucial moment, providing social support or material

or emotional aid in moments of need. As such, these inactive ties are latent caches of social support filled with the potential for activation as active ties or temporary mobilization.

We collected alter data from 62 respondents interviewed using their wedding albums as a memory aid. Respondents were asked classify their relationships with selected wedding guests as active, inactive, or “no relationship,” at the time of the wedding and the time of the interview. They then provided detailed information on their relationships with each alter at each time period, including their closeness, support exchanged, awareness, relationship capacity, actual exchanges, etc. Using 434 ties labelled by the ego as either “inactive” or “no relationship”, we distinguish between those ties that egos consider to be active versus absent.

We find that inactive and non-existent relationships differ in closeness, ego’s willingness to provide social support, frequency of contact, the physical proximity between the ego and the alter, the importance of the alter, and support exchanged. Surprisingly, however, inactive and non-existent relationships *do not* differ in awareness of alter’s current circumstances and embeddedness of the alter.

We argue that those dimensions suggesting differences in the potential for social support are theoretically significant in that they suggest that inactive and non-existent relationships vary in their potential for future activation. Distinguishing between these kinds of ties is important for researchers interested in a full picture of respondents’ ability to access support through their social networks.

### **Motivations for PrEP-Related Interpersonal Communication within Personal Networks of Women who Inject Drugs**

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**Introduction:** Pre-exposure prophylaxis (PrEP) is an effective HIV prevention strategy that involves the use of daily antiretroviral medications by HIV-negative individuals. However, PrEP awareness and uptake is low among many populations that may benefit from it, including women who inject drugs (WWID). One method of increasing PrEP awareness and uptake, which has been successful with other HIV prevention strategies, is peer influence models wherein interpersonal communication within networks is used to provide information about and support for an innovation. There is a dearth of studies exploring the potential of interpersonal communication between WWID and their network members to facilitate PrEP information exchange and support. This study uses a qualitative ego-centric social network approach to understand the content and context of PrEP-related interpersonal communication among WWID and network members after learning about PrEP.

**Methods:** WWID were recruited from an ongoing prospective study assessing engagement in PrEP care in Philadelphia, Pennsylvania. At baseline, participants received information about PrEP. WWID who reported talking to at least one social network member about PrEP at their next follow-up were invited to complete a semi-structured interview. A name generator was used to identify network members representing different relationship types including: romantic partners, non-romantic sexual partners, persons with whom they inject drugs and persons with whom they discuss important matters. Participants described each network member and the motivations or barriers to discussing PrEP with them. Content analysis of transcribed texts was performed to understand motivations for PrEP-related interpersonal communication, as well as how communication patterns differed by relationship type.

**Results:** Participants (n=20) had a median age of 40 (IQR=36,47) and were predominately White (67%). Participants named on average 3 network members, resulting in them listing 57 pairs of ties (relationships). A PrEP-related conversation occurred within 30/57 relationships. Three

overarching themes emerged related to motivations for PrEP-related communication. WWID shared information about PrEP with other WWID perceived to be at risk for HIV due to their injection drug use and engagement in transactional sex, with the purpose of helping them reduce their HIV risk. WWID also disclosed their PrEP use to main partners and close friends to receive emotional and instrumental support related to PrEP uptake and adherence. Lastly, some WWID felt forced to disclose their PrEP use with a variety of network members. Reasons for not talking to named network members about PrEP (which occurred in 27/57 relationships) included not seeing someone in person since learning about PrEP, interpersonal conflict with close associates, and fear of negative repercussions among non-romantic sexual partners, such as sex clients.

**Conclusion:** PrEP-related interpersonal communication is occurring among WWID and social network members, and motivations for communication vary by relationship type. These preliminary data suggest peer-delivered interventions could play an important role increasing PrEP awareness among WWID. Participants also disclosed their PrEP use to people they are emotionally close with to receive various forms of social support. More information is needed to identify how these relationships can be activated to increase PrEP uptake and adherence in future interventions.

### **Movements and counter-movements: Online network structures and information diffusion among Egyptian pro- and anti-government groups**

Deena Abul-Fottouh<sup>1</sup>

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Online social networking websites such as Facebook and Twitter have become common established mediums for social movements to mobilize. At the same time, governments use social media websites to form counter-movements and disrupt activism. This research studies how anti-government movements and pro-government counter-movements use online social media as venues for activism and counter-activism. The research studies online networks formed by two opposing anti- and pro-government Twitter hashtags at a time they were both among the top trending hashtags in Egypt. The first hashtag called on Egyptian President Sisi to resign while the second praised his regime and called on him to remain in power. The case is a suitable one to study movements and counter-movements, as the Egyptian political environment has recently experienced large turmoil that resulted in a highly polarized society. The rise of both hashtags concurrently indicates that one of them might be a reaction to the other.

This research uncovers the differences and similarities in how the two opposing pro- and anti-government camps use Twitter to catalyze their causes. Previous research has shown that online pro-government and opposition movements differ in the shape of their networks and in the way social media messages spread among them. Moreover, scholarly work and recent political events have shown a reliance on online political bots as a tactic used by governments to curb the opposition. Online social movement theory has established that network properties and topologies help study the influential members of a group and how information spreads among group members. Social network analysis helps also identify online densely connected sub-communities that could represent potential interests within a movement.

Building on online social movement theory and using the tools of social network analysis, this research investigates similarities and differences between online movements and counter-movements through answering the following questions: how do pro- and anti-government movements compare in the shape of their networks and in how they form online communities? Who are the top influencers of both camps? What is the role of political bots in each camp and how does information diffuse within and across the online networks of both pro- and anti-

government movements? The research also highlights whether the two camps exist in separate enclaves on Twitter or whether they interact through reaching out to each other's hashtag.

Preliminary results show that there is a significant difference in the structure of both networks and in the speed by which they grow. In line with previous research, pro-government hashtag has a more centralized network than the opposition hashtag. Also, there are common actors who cross the boundaries of each camp and participate in both hashtags.

Through investigating if there are any observable structural differences in the online social networks of pro- and anti-government movements, this research contributes to our knowledge of the various tactics both camps use to mobilize online. It also offers a new research approach to identify pro- and anti-government movements through only looking at their network properties.

### **Moving beyond individualistic values: The role of sport and physical activity communities in facilitating transplant recipients' personal social networks and self-management capabilities.**

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Organ transplantation is a medical procedure offered as a treatment for end-stage organ failure or chronic disease. Careful negotiation of life after transplantation is crucial for organ survival. This relies heavily on the lifestyle of the transplant recipient and requires careful self-management of medication and aftercare procedures. This focus has been emphasised in the context of increasing long-term survival rates of organ transplant recipients. Within a growing body of literature evidencing the importance of self-management, research has also demonstrated the bio-medical benefits of participating in sport-related physical activity as a valuable way for recipients to maintain a healthy lifestyle post-transplant. Yet, there is very little research exploring the role sport-related physical activity communities can have on the psychosocial outcomes and self-management of transplant recipients. Further, few have explored the impact of these communities on transplant recipients' personal social networks. Moreover, to our knowledge, no study has explored the fluidity of these personal networks implicit to self-management overtime. Utilising social networks may be a powerful way of improving health, lifestyle and wellbeing outcomes. This study employs a longitudinal qualitative social network approach, combining participant-aided network diagram creations (sociograms) with a series of interviews over a 12-month duration. Participants are interviewed at 6-month intervals with the creation of two sociograms at the beginning (0-month) and end of the study (12-month). The sample represented an international cohort of transplant recipients (n=20) who had engaged in the British Transplant Games or World Transplant Games for the first time. The Transplant Games are Olympic style-events that promote active recovery for transplant recipients through sport and social events whilst celebrating the second chance of life and raising public awareness of organ donation. Preliminary analysis highlight the role of participating in sport-related physical activity communities in determining self-management outcomes. Results contribute to an understanding of how participation in sport-related physical activity impacts on the resources within transplant recipients' personal social networks important for self-managing long-term conditions. This study challenges the role of the 'self' in the self-management of transplantation to encourage a shifting viewpoint from individualistic self-management towards a broader social network context. We present initial findings of this longitudinal study to illustrate the use of participant-aided network diagrams with qualitative methods, to demonstrate its adaptability in capturing the fluidity of transplant recipients' personal networks over time.

**Multi-mode Networks Approach to Assessing Community & Economic Development Capacity in Cities**

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How can we understand the discrepancies across cities in their abilities initiate and sustain community and economic development campaigns? How can multimodal and longitudinal networks provide new insights into community capacity to engage in local action? The most robust processes for community development are theorized to be ones that intentionally work to develop more integrated networks that work across sectors and use the expansion of one form of capital to expand other forms of capital. Despite beginning with a network theory of structure and capitals, few community development network studies actually assess how resources (information, financial capital, expertise, etc.) are flowing through networks. Some studies rely on one-mode data to assess the structures of interagency networks while others reduce multimodal data into one-mode networks, thus ignoring important relationships, exchanges, and transformations of capital. In this study, we propose a method for collecting multi-mode data that captures the variety of resources that flow through inter-agency relationships and actions, which allows for the modelling of community capacity over time. Using two urban case studies, one medium sized city, and one large metropolitan city, we explore the differences between the depth of knowledge that can be gained from one-mode networks versus multi-mode networks for revealing community and economic development opportunities and outcomes. The data include agency ties, joint projects, resources exchanged, location, and personal ties. We model one-mode networks and compare them to multi-mode networks, comparing the assumptions and findings for assessing community capacity in time and space. We propose a method for collecting and analyzing robust multi-modal, spatially located, longitudinal models of interagency actions and networks.

**Multilevel ERGMs with overlapping subsets of nodes: models, methods, and mathematical-statistical theory**

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We consider multilevel networks where nodes belong to overlapping subsets of nodes. An example is departments in universities: the departments can overlap, because faculty members can have appointments in more than one department. We propose novel models, methods, and mathematical-statistical theory for multilevel networks with overlapping subsets of nodes. The mathematical-statistical theory underscores a simple and important observation we have made elsewhere: statistical inference for ERGMs with additional structure is possible and supported by mathematical-statistical theory (Schweinberger and Stewart, *Annals of Statistics*, 2019+).

**Multiplex Relationships and Adolescent Alcohol Use: Application using Multiple Membership Multiple Classification Models**

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<sup>1</sup>University of Glasgow, <sup>2</sup>University of Southern California

*Background:* Adolescent social context is multi-dimensional, in that the peer environment is composed of varying forms of relationships, including friendships, popularity, and romantic relationships. Further, adolescent social relationships and behavioural health outcomes (e.g., substance use) are interdependent, such that health behaviours tend to be clustered within peer networks. To date, research on peer context and adolescent health has focused on the role of friendships in explaining health outcomes. The current study is novel in that expands upon a

broader set of relationships surrounding adolescents, and examines the relative share of variation in health attributable to multiple types of relationships. Specially, the current study simultaneously considers three types of social network connections: 1) friendships, 2) perceived popularity, and 3) dating partners, with reference to individual alcohol use.

The following separate, yet interrelated, research questions are addressed:

**Multiscale Integration of Neural, Social, and Network Theory to Understand and Predict Transitions from Illness to Wellness: A Proof of Concept with Mindfulness, Hypnosis, and Alcohol-Use Disorders**

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<sup>1</sup>University of North Carolina at Chapel Hill, <sup>2</sup>Columbia University, <sup>3</sup>University of Pennsylvania  
Understanding processes promoting resilience in humans requires insight into both brain networks that dynamically reconfigure in different situations and social networks that allow behaviors to spread. Here, we consider brain and social networks together in the context of alcohol use and attitudes. Our goal is to explore the relationships between the brain, physiology, cognition, and social networks, identifying key points of influence within a multilayer network model to determine what could most optimally impact the behavior of individuals and the group. We survey undergraduate student groups from two different universities about their health-relevant attitudes and behaviors (with particular focus on alcohol consumption) of themselves and their social ties. A subset of these participants undergo fMRI scanning and complete daily surveys for one month regarding their health-related attitudes and behaviors. We investigate parameter choices involved in processing fMRI scans into network representations of functional brain connectivity. We demonstrate the manner by which comparing subjects by key descriptive statistics related to network community detection can become sensitively dependent on the underlying parameter choices, exploring essential best practices. We then link these brain and social networks to study the processes that govern the kinds of alcohol-related social cues to which individuals are exposed, how they react to them, and how well they can regulate responses to them.

**Nation Branding in the Age of Networked Marketing: A Cross-country Study of China and South Korea**

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<sup>1</sup>Saint Vincent College, <sup>2</sup>John Carroll University

This study introduces an analytical framework for measuring the practices of nation brand building and international relationship management on the web, using the cases of China and South Korea. Citation analysis and social network analysis are employed. We comparatively examine inter-organizational collaboration networks, the impact of the government agencies' websites as well as the sectoral and geographic distribution of information resources offered by the agencies on the web. Social network analysis indicates that the Korean government generates more inter-organizational collaborative network by sharing information sources among the nation branding agencies across sectors than the Chinese government. The findings also suggest that, compared to the Chinese organizations, the Korean organizations have higher global presence based on the number of TLDs (Top level domains) linking to their homepages. The result suggests that .com is the most popular generic TLD followed by .org, .net, and .edu, for both Korean and Chinese organizations. The source sites that sent links to the Korean organizations are mostly originated from East Asian (Korea, Indonesia, and Japan) and European countries (Germany and Russia). Information about Chinese culture is more widely spread across diverse countries,

including East Asian (China and Japan), North American (Canada), European (UK, France) and Oceania (Australia) countries. For both countries, domestic audiences play key roles as information hubs in each network, which illuminates a networked and cooperative form of nation brand building in Korea and China.

### **Navigating Offshore Oil and Nature-based Tourism in Coastal Social-Ecological Systems: A Network Analysis of Extractive and Attractive Development Discourse in the North Atlantic**

Mark CJ Stoddart<sup>1</sup>, John McLevey<sup>2</sup>, Alice Mattoni<sup>3</sup>

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Societies across the North Atlantic region pursue offshore oil and nature-based tourism as parallel development paths. Offshore oil promises economic benefits, but is based on fossil fuel-intensive resource extraction. Nature-based tourism, instead, is based on experiences of natural environments and encounters with wildlife. These modes of development come into contact when there is a disaster or conflict over extending oil development into new regions. In this paper, we use network analysis, computational text analysis, and comparative methods to advance our understanding of how North Atlantic societies deliberate about environmental governance and think collectively about how best to live with coastal environments. Drawing on media and fieldwork data, we use these methods to analyze discourse about offshore oil extraction and nature-based tourism in Denmark, Iceland, Newfoundland and Labrador, Norway, and Scotland. First, we examine discourses about the positive and negative social-environmental impacts of oil development for coastal communities and environments. Second, we examine discourses about the positive and negative social-environmental impacts of tourism development for coastal communities and environments. Third, we connect the two previous analyses by looking at relationships across oil and tourism as different development pathways, with an emphasis on comparing connections and “cultural holes” across the cases. This takes three forms. Co-existence weaves together tourism and oil as parallel and mutually beneficial forms of development. This is most apparent at tourism sites that provide narratives about the social-economic importance of oil. Antagonism results when new oil development comes into conflict with established tourism economies. Finally, black-boxing treats tourism and oil as separate, but parallel, development paths. These connections are less explicit, but include oil sector sponsorship of tourism attractions and events, or geographical spaces that are shared by oil sector and tourism operations.

### **Nearer Kin, More Support? Residential Mobility and Spatial Dispersion of Kin Support Networks: Effects on Social Support**

Kyra Selina Hagge<sup>1</sup>, Diana Schacht<sup>2</sup>

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Over the last decades, social networks of individuals have changed in terms of geographical distance to kin following that more and more people migrated, internally and internationally. Since communication technology and transport possibilities are changing too, the question arises whether access to social support has changed, or whether trends of migration could be compensated by the march of communication technology and thus kin social support remained the same. More specifically we ask: (1) do people now have less access to instrumental and/or emotional support than a decade ago? (2) If such trends in social support can be observed, are these trends related to the spatial dispersion of kin support networks? (3) And do we find systematic variations between people who have moved within Germany or even migrated from another country to Germany?

Arguably, closer proximity to support givers should enhance the ego's possibilities to access social support. At the same time, the spatial dispersion of kin networks is expected to systematically vary between non-movers and mobile populations, thereby influencing migrants' access to social support. Particularly, instrumental support should be strongly related to the geographical distance of support givers, as it requires being physically present as opposed to emotional or informational support, which may also be transferred via phone or internet. Thus, the increase of international and internal migration may promote changes of social support provision/reception from one dimension to another and thereby cause inequalities between migrants and non-migrants in the type of support accessible to them.

We analyze the differences in access to different dimensions of social support between non-movers, internal, and international migrants by using longitudinal data from the German Socio-Economic Panel and applying propensity score matching. Since there are few studies that tackle spatial dispersion to kin as an explanatory factor for social support, our study contributes to closing this gap. Besides, we are able to describe changes within different dimensions of social support for the last 12 years and the consequences of increasing residential mobility. Furthermore, we contribute to the migration and integration literature, where the migration event is considered particularly harmful for the social network, arguably influencing social support. Comparisons to internal migrants are up to our knowledge never drawn, so it remains unanswered whether the social support of international migrants differs from internal migrants' access to social support. Lastly, basing our study on the SOEP, we expand the current literature on social networks for Germany as a country which varies from other countries with regard to the relevance of significant others.

First results show that social support of kin networks slightly increased over all dimensions within Germany over the past 12 years, even though the family size overall declined. However, international migrants lack social support by kin, while internal movers receive social support more often. The difference is most pronounced in the dimension of appraisal support, where people who moved internationally receive, on average, 20% less support than non-movers. Additionally, the proximity to kin seems to be related to individuals' access to social support.

### **Negotiations of knowledge(s) in networks – relationality in learning spaces**

Iris Clemens<sup>1</sup>

<sup>1</sup>University of Bayreuth

From a cultural inclusive perspective, networks are based on meaning. Meaning therefore is crucial for networks, for their emergence as well as for their maintenance. In different networks relational, sometimes divergent meaning forms circulate. But following relational approaches, knowledge is not located *in* actors neither *in* networks, but emerge in networks and relational to the actors involved. Situations, therefore, are the spaces where knowledge emerge and where it is processed, modified, circulated etc. As higher aggregated forms of meaning, knowledge can also circulate across networks – it 'travels' from one network to another.

In consequence of those processes, in situations divergent knowledge forms can encounter, and their relation will be negotiated. Following, in situations not only ties are negotiated but also meaning form. This is particularly interesting if one asks how *new* knowledge emerges. Borrowing the concept of *generative tensions* by Helen Verran I assume that such generative tensions emerge when different knowledge forms or logics come together in a situation. According to Verran these generative tensions are a sign for creativity typically for collective life. Referring to network theory and in line with these thoughts, switching between networks typically create new knowledge. Translated in network theory (White et.al.), one can ask for the modifications of *stories* in such encounters and the fresh action that emerge in consequence. Hence, fresh action

is a product of encounters of knowledge(s) and generative tensions and probably an incubator for creativity. Starting from questions regarding so called *trading zones of knowledge* (Galison, Raina), I want to draw attention to the creative potential of such encounters of knowledge(s) in learning situations while using an example from the Nigerian school context and the example of divergent ways of dividing in math class. I want to show the encounter of divergent logics or knowledge(s) circulating in divergent networks and the dynamic that emerge.

### **Network Analysis Methodology of Policy Actors Identification and Power Evaluation (the case of the Unified State Exam introduction in Russia)**

Grigoriy Khvatskiy<sup>1</sup>, Dmitry Zaytsev<sup>1</sup>, Nikita Talovsky<sup>1</sup>

<sup>1</sup>National Research University Higher School of Economics

In this paper we presented a methodology for identifying policy actors for policy fields and evaluate their power. Presented methodology is based on text parsing and mining, and producing networks with analysis of the text processing results. We used the example of the Russian Unified State Exam, as the real case of policy formulation and implementation, to test the proposed methodology. The methodology was shown to have great potential for verifying the theories of policy studies and for a broader application in the areas where analysis of policy actors and their power, influence, and impact is needed.

### **Network Analysis of Cases with Methicillin-Resistant *Staphylococcus aureus* and Controls in A Large Tertiary Care Facility**

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<sup>1</sup>University of Ottawa, <sup>2</sup>The Ottawa Hospital Research Institute, <sup>3</sup>The Ottawa Hospital

**Background:** Methicillin-resistant *Staphylococcus aureus* an increasingly common cause of hospital associated infection in Canadian healthcare facilities. Despite increased awareness of hand hygiene and transmission-based infection control precautions, MRSA still spreads from colonized or infected patients to other patients, through a contact network of healthcare workers and contaminated surfaces in rooms, bathrooms and wards.

**Objective:** To explore the feasibility and validity of building healthcare networks before and during outbreak periods, and to define the role of room mates, health care providers, and rooms in the transmission of MRSA in a large tertiary care facility.

**Methods:** We conducted a case-control study using secondary data on hospitalizations where cases were infected or colonized, and were matched with controls who tested negative by age, sex and campus at The Ottawa Hospital (TOH) between April 1<sup>st</sup>, 2013 and March 31<sup>st</sup>, 2014. Social networks of all cases and controls were built from links joining patients to rooms, room mates and health care providers over time.

**Results:** Matched controls were similar to cases in comorbidity, numbers of ICU days, deaths within and outside of ICU and in number of linked rooms, health care providers and room mates. Increases in number of nodes and links at all three campuses increased by average of 49% and 86% in the cases before and during outbreaks and 145% and 277% in controls respectively, as did the median numbers of contacts of both cases and controls for two campuses at TOH ( $p=0.001$ ,  $p=0.03$ [cases]  $p<0.001$ ,  $p=0,001$ [controls]). In a timed animation of the network at one campus we identified two potential source patients linked to many room mates and two rooms during the pre outbreak period after which cases connected to those same rooms proliferated.

**Network analytical approaches for analyzing user comments on news websites**

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User comments on news organizations' websites are a specific case of online discussions. Initiated by journalistic content, they are related to current societal debates and can potentially reach large audiences.

If we understand these discussions as networked partial public spheres, each individual comment has to be understood within the logic of the broader community existing on the news website: We argue that users perceive norms and dynamics according to the rules and technical features provided by the news organizations, the journalistic content, other users' actions and their interactions with each other. In this logic, each comment and each user's behavior have to be interpreted in the context of the whole platform. In fact, users act in different ways: Some only post individual statements without relating to other users' statements, others engage in interactive discussions with others. Some prefer talking to like-minded people, others correcting views that are against their own. Some give justifications for their arguments, others limit their comments to simplified claims. Taken together, for example, we expect more answers to be exchanged on platforms that offer answer buttons and display discussions in several levels. Or we would expect people to give justifications if previous comments have also given justifications.

We argue that network analysis can help us identify the conditions for the different types of action or roles that users assume, because it allows us to understand individual behavior in a broader context. In this logic, four levels have to be considered when analyzing the characteristics of these discussions: 1) the level of the news organization – where news organizations have an editorial line and define the rules and technical determinants for the discussion sections; 2) the level of the journalistic article and the discussion thread – where we can differentiate different articles and general measures of the discussions below them; 3) the level of the individual users who post comments in different discussions at the same website; 4) the individual comment a user writes.

Our analysis is based on user comments from 9 news websites. In total, our sample consists of 14,663 user comments below 175 articles about an upper limit of refugees or about a reform of the federal pensions system in Germany. Using a manual relational content analysis of these comments, we are able to relate each answer to its original comment. This way, we can conceptualize each discussion thread as a network in which comments are represented as nodes and the connection between two comments (either using an answer button or directly addressing other users) as ties.

Looking at the platform level, we can find significant differences regarding the tendencies in which users reply to or agree with each other or justify their comments. These can be explained by the above mentioned features on the levels of the news organizations, the articles, the users and the comments. At the conference, we would like to discuss different strategies of conceptualizing these communities as networks and the different dynamics and roles we can detect within these networks.

**Network Citizenship Behavior and Innovative behavior in Public Sector Organizations**

Jing Burgi-Tian<sup>1</sup>

<sup>1</sup>George Washington University

The study will examine the behavioral and environmental factors that influence innovation in public sector inter-organizational collaboration networks. Specifically, the research examines the relationship between Network Citizenship Behaviors (NCB) and Individual Innovative Behaviors (IIB), as well as the moderating effects of Learning Organization (LO) on that relationship. The study will employ a survey method, using regression analysis, at a regional planning organization

on the east coast of US that contains more than 20 independent organizations. Preliminary results is expected to be available for analysis before the conference.

The study aims to make several scholarly contributions:

To begin with, as a newly developed construct, NCB needs more thorough investigation of its values and outcomes. Extending from the well-established construct of Organizational Citizenship Behavior, Provan, Sydow & Podsakoff (2014) defined NCB as “individual behavior exhibited by those who work in organizations that are part of a goal-directed multi-organizational network that supports the social and psychological environment in which the achievement of network-focused goals takes place” (p.9). Such behaviors will put the effectiveness of the multi-organizational network as a priority over individual organizations. It facilitates the transfer of knowledge in between organizations and encourages the generation of innovative ideas.

Secondly, so far, the majority of literature on inter-organizational collaboration network focus on dyadic relationship between two organizations. The context of a “whole network”, or a semi-structured, goal-oriented arrangement that bounds a consortium of autonomous organizations to work together on multiple levels, have not been looked at in depth. This study will further our understanding of innovation among multiple organizations in “whole networks”, instead of between two organizations.

In addition, the study will fill in the gap in social network and innovation research by employing a behavioral approach, instead of the more commonly used structural approach. Defined as new combinations of existing resources, innovation and social network share an intrinsic link because social networks provide channels and mechanism for information and knowledge to freely travel among individuals. The existing research overwhelmingly use a structural approach, examining the relationships between structural properties and innovational outcomes. A behavioral approach in social network and innovation studies is largely missing and has been called for in scholarly dialogues. Network Citizenship Behavior was coined to fill that gap.

Moreover, the study will supplement our existing knowledge about innovation in the public sector. It has long been argued that innovation is more difficult and challenging in the public sector than the private sector because of its roots in representative democracy and its non-competitive, monopoly nature. However, as a result of technological advancements, fiscal pressure and the increasing complexity of the society that it governs, public sector organizations found themselves in need of an innovative mindset to support an innovative economy.

Last but not least, the proposed study will examine the impact of an undervalued environmental factor: learning organization. LO explains a significant amount of innovative output, even much more than creativity climate. However, very few studies had examined the relationship between LO and innovation.

### **Network determinants of conflict in business organizations**

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Researchers in the fields of Organization Studies and Human Resource Management have traditionally looked at such variables of interest as productiveness, employee turnover and team conflict as functions of attributes of employees, management units or organization as a whole. However, in the past 15 years researchers have acknowledged that many of these outcome variables are largely shaped by informal structure of an organization, or, its social network. Organizational Network Analysis can hence be an effective tool to address many HR-related tasks in organizations, such as measurement of employees' performance, creating collaborative environment, increasing team viability through diagnosis and management of conflicts.

In this research I investigate network predictors of personal and group-level conflict in an organization. One such important predictor is employee centrality. There is mixed evidence regarding whether high centrality is desirable. For example, high betweenness centrality of a leader in advice network was shown to be associated with higher conflict and lower team viability. Along with other aspects, my paper addresses such phenomena by an empirical study spanning three countries over four years.

I use longitudinal data on one industrial organization, operating in Belarus, Poland and Russia. The data were collected by the author via online questionnaire, filled by the employees in 3 waves (June, 2015, December, 2017 and December, 2018). Network data are based on employees' nominations in response to questions on different working interactions, including reporting relationships, asking for advice, conflicts and favorable attitudes. A relationship is defined as 'conflict' whenever one employee indicated that he/she "has had to turn to a third party for help or mediation" to resolve difficulty with another employee. The resulting networks are middle size (825 employees in 2015, 754 in 2017, 883 in 2018) multi-relational directed graphs, weighted by intensity of interactions. The data available also include employees' position, department affiliation, seniority, peer evaluated competences, social skills and demographics such as sex and age.

I test the following hypotheses about network factors of organizational conflict on individual (H1 and H2) and department level (H3 and H4):

H1. Asymmetric perception of organizational role in a subordination network increases chances of conflict between the corresponding employees.

H2a. Organizational structures allowing reporting relationships between one employee to multiple managers are associated with increased organizational conflict.

H2b: The associated organizational conflict is moderated by soft skills and managerial competences of involved managers.

H3. Higher managerial skills and competences of leaders are negatively associated with intragroup and intergroup conflict of involved departments.

H4a. Higher indegree centrality of a leader in advice network is associated with lower levels of the intragroup conflict.

H4b. Higher betweenness centrality of a leader in advice network is associated with higher levels of the intragroup conflict.

I test the hypotheses using Exponential Random Graph Model (ERGM) on 'conflict' relationships network. I also undertake an exploratory analysis using Structural Equations Model (SEM) to deeper understand relations between the involved constructs. The data are currently being processed. The results of the tests and exploratory analysis will be proposed for discussion in the conference.

### **Network failure in a matchmaking industrial symbiosis network**

Sarah King<sup>1,2</sup>, Dean Lusher<sup>2</sup>, John Hopkins<sup>2</sup>, Greg Simpson<sup>2</sup>

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Network failure is underexplored in the industrial symbiosis, sustainability and business literatures and yet, we can learn a great deal from failure. By understanding the causes of failure we can support improved resilience in future network structures and improve network success. In a case study of a network where the goal is to build new, inter-organisational collaborations, we ask – what causes network failure?

We focus on the case of ASPIRE (Advisory System for Processing, Innovation and Resource Exchange), a digital matchmaking marketplace for small to medium enterprises. ASPIRE captures

data on business wastes and by-products to facilitate business-to-business waste transfers which reduce waste to landfill. This concept is known as Industrial Symbiosis (IS) which engages traditionally diverse organisations in the physical exchange of waste materials and by-products in order to put them to new uses. In this network, failure arises when businesses do not follow-up on a customised list of potential inter-organisational collaborators, even though the purpose of joining the business network is to gain access to such collaboration suggestions. In other words, failure is the non-creation of ties at the dyadic level, which undermines the goals of the overall network.

We use exponential random graph models (ERGMs) to understand the endogenous and exogenous processes of a failure network at the node, dyadic and whole-network levels. Qualitative research methods such as interviews expand on the network analysis and elucidate the role of regional ASPIRE network facilitators and the influence they have in overcoming dyadic tie failure between businesses.

Through this analysis of network failure, we hope to identify governance interventions that support future growth of ASPIRE. The research contributes to our understanding of industrial symbiosis networks for SMEs and strategic niche management theory by contributing to a best-practice framework for the scale-up of niche, experimental projects with sustainability goals. It also supports our understanding of how to implement circular economy strategies and experimental projects to achieve sustainable development.

#### **Network of scientific collaboration measured as a time-stamped data**

Luka Kronegger<sup>1</sup>, Anuška Ferligoj<sup>1</sup>, Franc Mali<sup>1</sup>

<sup>1</sup>University of Ljubljana

Mechanisms that drive scientific collaboration represent a regular topic in our research agenda. From purely descriptive approaches to analysis of changes in blockmodel structures, over stochastic actor oriented models implemented in Siena, we are moving towards the analysis of co-authorship data measured as time-stamped network using Dynamic Network Actor Models (DyNAM) presented by Stadtfeld et al (2017).

In this presentation we will introduce the study of factors that lead to the establishment and consolidation of ties in co-authorship networks, through repetitive co-authoring. Given the properties of the method that enables us to take into account valued network ties and collaboration inertia, we managed to develop a model that adequately captures the dynamics of collaboration in the academic field.

Analysed co-authorship networks were generated based on the Slovenian national bibliographic database (COBISS).

#### **Network Research: a Means to Evaluating Project Success?**

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KI<sup>2</sup>VA (Kompetenzentwicklung durch Interdisziplinäre und Internationale Vernetzung von Anfang an (Competence Development through Interdisciplinary and International Cooperation from the Start (KI<sup>2</sup>VA)), a university-wide project at the Technical University of Darmstadt (Germany) aims to improve the quality of academic teaching. The project started in 2016 and will end in 2020. It is subdivided in nine different thematic topics, which range from the decision of pupils to start a study at the university, up to the enrollment, the successful start of the study and accompanying study counselling.

As part of the evaluation of the KI<sup>2</sup>VA project a social network analysis will be performed. The fundamental assumption of the evaluation impact model is that cooperation and networking

between stakeholders of the project as well as with other members of the university are necessary requirements for the long-term project success. A mixed method approach has been chosen: with interviews a first insight in the meaning and importance of how to work together should be provided. Subsequently a questionnaire based on the results of the qualitative research gives a deeper understanding of the network structure in projects and its direct and indirect impacts, short and long-term effects as well as the sustainability of the project success.

### **Network Stability and Sexual Risk among Homeless Youth in Los Angeles**

Lindsay Young<sup>1</sup>, Laura Onasch-Vera<sup>2</sup>, Nicole Thompson<sup>2</sup>, Eric Rice<sup>2</sup>

<sup>1</sup>University of Chicago, <sup>2</sup>University of Southern California

Risk of HIV is a significant concern for the nearly 4.2 million youths in the United States who experience homelessness each year. Compared to stably housed youth, homeless youth are more likely to engage in high-risk behaviors that put them at increased HIV risk, including condomless sex, partner concurrency, survival sex, and substance use. Social network factors (e.g., network structure, network composition, social norms) have been positioned as critical mechanisms of HIV risk in this population. Although most of this work has been limited to static network features, there is a growing awareness that network dynamics (e.g., changes in network size and composition) have unique effects. Although most homeless youth experience tremendous turnover in their peer networks, research has also shown a tendency for youth to maintain certain ties that offer reliable sources of support. How tie maintenance (i.e., network stability) impacts HIV risk engagement among homeless youth remains unaddressed.

To this end, our goals are: (1) to examine the stability of confidant ties (i.e., the peers an individual talks to most frequently) over a three month period and identify the types of ties that tend to be maintained and the types of youth who have the most stable networks, and (2) to determine the association between network stability and HIV risk behavior. We use data from the control arm of a peer leader HIV prevention intervention for homeless youth in Los Angeles (N=253). All participants were assessed at baseline and 1- and 3-month follow-ups. Self-administered surveys captured information about demographics, sexual health and risk behaviors, and egocentric confidant networks. Network stability is defined as whether or not each confidant named at baseline was retained (i.e., named again) at follow up. HIV risk outcomes include engagement in condomless sex, sex drug use, and exchange/survival sex, as well as an indicator variable for never having been tested for HIV. Due to the nested nature of the data — i.e., confidants (alters) and confidant ties nested within participants (egos) — we first employ multilevel modeling to examine the effects of both participant and confidant/tie characteristics on the likelihood that a confidant is retained at follow up. Then, using logistic regression, we regress each measure of HIV risk on network stability, measured as the proportion of a participant's baseline confidants retained at follow up, adjusting for participant attributes also associated with HIV risk, including age, sexual identity, time in homelessness, and proportion of confidants who are also homeless.

Understanding how network stability relates to HIV-related behaviors is particularly salient for homeless youth, as they are known to experience considerable turnover in their peer and support networks, which is thought to place them at greater HIV risk. We expect that results of this analysis will yield important insights about the role of network stability in the lives of homeless youth and that if properly exploited could form the basis for innovative, peer-based interventions aimed at encouraging maintenance of confidants over time.

**Network-based HIV prevention among Tajik migrants who inject drugs**

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**Background:** More than a million Tajik men, many of whom inject drugs, migrate annually as temporary workers outside of their home country especially in Russia. The “Migrants’ Approached Self-Learning Intervention in HIV/AIDS for Tajiks (MASLIHAT)” recruits and trains Tajik migrants who inject (or previously injected) drugs as peer educators (PEs). PEs deliver the intervention within their injection drug use (IDU) diaspora social networks while reducing their own risk.

**Methods:** Thirty Tajik men were recruited in Moscow as PEs to attend the 5-session intervention, and each PE recruited two IDU network members with whom they intended to share what they learned. We conducted interviews with PEs and network members at baseline, 6 weeks, 3 months, and 6 months post-intervention. We estimated mixed Poisson regression models with random intercepts for subject and recruiter to test the effects of group and time.

**Results:** HIV knowledge increased significantly from baseline to 6-weeks for both PEs and network members. Average reported IDU network size was 5.4 (SD 2.3), however past month activity was reported with 3.5 (SD 0.9) network members on average. Over time, both PEs and network members reported talking to fewer people concerning buying drugs ( $p=0.0001$ ) and acquiring needles ( $p=0.025$ ). The number of people they talked to about HIV/AIDS or using condoms first increased (from zero at baseline) to 3.2 (SD 0.7) at 6 weeks, declining to 2.6 (SD 0.6) at 6 months ( $p<0.0001$ ). The number of people injected with in the past month decreased from 3.3 (SD 0.8) at baseline to 2.2 (SD 0.5) at 3 months ( $p<0.0001$ ). These changes were accompanied by a steep decline in reported syringe sharing and increased frequency of syringe cleaning. At baseline 52% of all participants reported sharing syringes in the past month, 24% at 6 weeks, 2% at 3 months, and none at 6 months ( $p<0.001$ ). Neither group reported consistently cleaning their syringes at baseline, but all did at least sometimes at 6 weeks, and 87% always at 6 months.

**Conclusion:** The MASLIHAT network-based intervention for Tajik migrants who inject drugs was successful in disseminating HIV prevention information and changing behavior among both PEs and network members. Reported changes in network interactions suggest that one strategy people may use to reduce their risk is to shrink their network.

**Networked Consensus Building in Governance: Comparing German and Japanese Environmental Policymaking**

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Germany and Japan, two developed countries that address climate change responsibly, have been involved in international efforts to promote climate-change awareness and build global dialogue since the early 1970s. However, there are major differences at the country level in terms of their environmental policies. Germany can be considered a forerunner country in initiating and legislating environmental policies, as demonstrated by its accelerated policy of *Energiewende* (energy transition) as a means of removing the nuclear power as a bridging technology in energy transition. In contrast, Japan, long reliant on mainly fossil-fuel energy sources and nuclear energy, has been reluctant to promote renewable energy. Despite the government’s dramatic shift after the Fukushima Dai’ichi nuclear power plant accident in March 2011, forcing a shut-down of all nuclear power plants and announcing plans to phase out nuclear power, in recent years, there have been increases in the consumption of nuclear energy. In this paper, we investigate the

difference in the two countries' policy directions by utilizing an analytical approach to environmental policymaking governance based on consensus building. Consensus building is a process based on conflict mediation which involves diverse stakeholders striving to improve their relationships with other actors and creating occasions to work together to develop acceptable solutions. Such activities are important because many social problems affect various groups with different interests. Successfully navigating this process can overcome problems at the implementation stage to establish a common understanding and framework, leading to opportunities to collaborate in resolving other problems. Failing to incorporate consensus building within governance networks could lead to negative outcomes. This paper investigates consensus building at the governmental level, particularly in terms of environmental policy-making governance, using the two case studies of Germany and Japan. Can we discern evidence of successful consensus building in the two countries in terms of policies and relationships among relevant actors? Have the governments of both countries played a mediator role in environmental policymaking governance? To address our goal and answer our research questions, we compare the governance networks in Germany and Japan by describing the attitudes of relevant actors to each government in terms of renewable energy and greenhouse gas emission policies through the formation of information and resources exchange networks. Our data source is two datasets from the J-GEPON 2 (Global Environmental Policy Network Japan, Round 2) Survey undertaken in Japan in 2012-13 and the G-GEPON 2 (its German counterpart survey) undertaken in Germany in 2016-17. The results show that there are differences between Germany and Japan in the tendency of the attitudes to the government and policies, as well as the network formation among the actors in the governance networks. In addition, we found that attitudes to the government and its policies influenced or demonstrated mutual relationships with the governance network. We contend that these results suggest that the success of the consensus-building process contributes to major differences in the environmental policy-making processes in the two countries.

**Networks against women. Large scale comparison of gender bias in coauthorship networks**

Dominika Czerniawska<sup>1</sup>

<sup>1</sup>University of Manchester

The gender landscape of academia has changed significantly over the last quarter of century. More women than ever obtain scientific degrees and enter scientific job market. In many countries the proportion of men and women in science is equal. Nevertheless, many positions remain unreachable for women, especially those of power and influence. Why[-, despite their growing numbers,] do female scientists occupy lower positions in the hierarchy? Research on success in academia showed that much of career advancement depends on the structure of personal collaboration network. Bellotti (2012) convincingly argued that this structure is more important than individual and institutional resources [-available to scholars] (big pond vs. small pond). It has also been shown that personal networks are shaped by individual characteristics, including gender. Many scholars demonstrated that gender homophily in personal networks ("old boys' club") contributes to unequal distribution of success and power between genders in science. Gender homophilic networks are a source of individual and 'group' success for men. The same does not hold [+true] for women. Women in science benefit more from heterophilic networks, especially early in their careers. The main question of the presentation is whether in fact women have different personal networks than men when controlling for discipline and university size. Does it affect their success as measured by productivity? To address these questions I will use large scale coauthorship data about Polish scholars (110.000). The dataset has been obtained from

Polish Scientific Bibliography, a government platform used for evaluation of scientific achievements.

### **Networks and leadership development: a networks training field experiment**

Theresa Floyd<sup>1</sup>, Kristin Cullen-Lester<sup>2</sup>, Travis Grosser<sup>3</sup>

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Leadership training often focuses on developing individuals' human capital (knowledge, skills, and abilities). Recently, the field has recognized the need for leaders to be effective at developing social capital through building, maintaining and leveraging relationships; accordingly, there has been a call for networking and networks to be incorporated into leadership development. Previous work has shown that networks training can increase the speed and accuracy with which individuals perceive network structure, and consequently can improve performance and promotion outcomes for individuals who receive the training.

Our goal is to build upon this research and explore how training on networks and networking affects not only individual performance, but also individual attitudes towards networks and networking, individual attachment to the organization, individual network structure and composition, and group network structure. In addition, we explore the potentially differential effects of networks training focused on individual vs. group social capital. We hypothesize that a focus on group benefits will reduce the "dirtiness" that people tend to associate with strategic professional networking.

We conduct a field experiment in a regional credit union with 145 employees, using a pre-and post-training survey to assess individual attitudes towards networking, employee attachment to the organization, and the social networks of the organization as a whole, based on work interaction, frequency, affect, advice-seeking, and trust. We conduct networks training sessions in two conditions: one with a focus on the benefits of individual social capital, and one with a focus on the benefits of group social capital. We compare the change in attitudes, individual network properties, and performance of the individuals who participated in the training conditions to those in the control group. Through careful management of our training and control group membership, we are also able to compare group-level network changes of the branches in which all employees participated in the training vs. those in which only a portion participated.

This study provides insight into whether and how networks training changes employees' attitudes about networks and networking, results in advantageous changes in individuals' and groups' networks, and results in advantageous changes in employees' attitudes, organizational attachment, and performance. In addition, by analyzing changes in individuals' position in trust and advice networks, and changes in supervisors' evaluations of employee potential, we are able to infer how network training affects individuals' leadership potential within the organization.

### **Networks and risks: A neo-structural, multilevel approach to the process of institutionalization of public-private partnerships in France Réseaux et risques: Approche multiniveaux du processus d'institutionnalisation des contrats de Partenariat Public-Privé en France**

Peng Wang<sup>2</sup>, Emmanuel Lazega<sup>3</sup>, Chrystelle Richard<sup>1</sup>

<sup>1</sup>ESSEC Business School, France, <sup>2</sup>Swinburne University, Melbourne, <sup>3</sup>Sciences Po, France

This presentation summarizes the neo-structural approach in economic sociology and complexifies this approach by focusing on the process of institutionalization of new norms. This is done by modeling together, using multilevel ERGMs, inter-individual advice networks with inter-organizational contract networks in the business community that promoted public-private partnerships (PPP) in France. In particular, we measure the effect of controversies related to the allocation of risks in such long term contracts (over 30 years) on this multilevel system of

collective agency. These analyses identify actors who punch above their weight in this negotiation process between finance, public authorities, industry, professionals and other players thanks to their position and action at both levels simultaneously.

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Cette présentation résume l'approche néo-structurale en sociologie économique et complexifie cette approche en ce centrant sur le processus d'institutionnalisation de nouvelles normes articulant, à partir de données de type *linked design* et de modèles ERGMs multiniveaux, des réseaux de conseil inter-individuels avec des réseaux inter-organisationnels de contrats observés dans les milieux d'affaires qui ont promu les partenariats public-privé (PPP) en France. Nous mesurons l'effet des controverses liées à l'allocation et au partage des risques associés à ces contrats de long terme (sur 30 ans) sur ce système d'acteurs individuels et organisationnels. Ces analyses permettent, notamment, d'identifier les acteurs publics et privés qui jouent un rôle clé dans ce processus de négociation entre finance, pouvoirs publics, industrie, professions libérales et autres acteurs spécifiques au milieu français (Caisse des Dépôts et Consignations, etc.) grâce à leur position spécifique à deux niveaux à la fois.

### **Networks of attention: participation, knowledge-gathering and status at a business event**

Paola Tubaro<sup>1</sup>

<sup>1</sup>Centre National de la Recherche Scientifique

Business events such as festivals and congresses are temporary clusters where participants seek and exchange knowledge. The literature has compared serendipitous and goal-oriented learning practices, and analyzed cases where actors prevent knowledge transmission to protect themselves from imitation. But more generally, how do participants to an event engage with contents – and with others who carry these contents? The proposed presentation addresses these questions with a multi-level network analysis design. It uses attendance data from two editions (2016 and 2017) of an international “sharing economy” event, the OuiShare Fest. Analysis of the two-mode “networks of attention” relating participants and speakers to contents, reveals underlying social processes that impinge both on individual knowledge-related interests and on status hierarchies emergent within the field. Exponential random graph models reveal a tension between these different motivations, whereby conformism and differential use of reciprocity generate an informal pecking order.

### **Networks of Linguistic Change: Multi-Word Expressions in the History of American English**

John Sundquist<sup>1</sup>

<sup>1</sup>Purdue University

This study focuses on dynamic networks of language change in the history of American English (1820-2010), exploring the ways in which a networks analysis sheds new light on causes of linguistic change. Using a 125-million-word sub-corpus of the Corpus of Historical American English, we examine network properties of a class of so-called Multi-Word Expressions of verb-noun pairings, as in *make money*, *give credit*, or *take responsibility*. These pairings are analyzed as a two-mode network of transitive verbs and their affiliated noun collocates. Analyzing basic network properties within this network from different points in time, we demonstrate the benefits of this approach over traditional historical linguistic analysis.

In the methodological section of the paper, we describe the corpus, queries used to search for relevant examples, and other issues related to the collection of verb-noun pairings and data preparation for network analysis in UCINET. The initial search using ten verbs (*make*, *take*, *give*, *bring*, *hold*, *keep*, *grant*, *bear*, *lose*, *create*) with a collocational window of five words after the verb yielded 33,237 unique noun collocates. These nouns and verbs were analyzed as a two-mode

network in decades from the beginning, middle, and final period under investigation (1820, 1910, and 2000). In addition, we put the data through a filtering process during data collection in which some verb-noun pairings that were deemed "literal" (e.g., *make lasagna* or *give plasma*) were excluded and "non-literal" pairings (e.g., *take charge*, *bear witness*) were retained. This filtering process allowed for more fine-grained analysis of idiomatic and abstract pairings whose network properties for each could be analyzed for comparison across decades.

Results provide us with interesting findings related to so-called light verbs in relation to other verbs that co-occur with a variety of nouns in the network. Light verbs are semantically-low verbs with a general meaning, like *make*, *take*, and *give* in English (Sundquist 2018). Light verbs, in comparison to more lexically-specific verbs like *grant*, *bear*, or *lose*, are most central and pattern together as a closed class when viewed over different periods. In particular, we apply two-mode normalized measures of degree, closeness, betweenness, and eigenvector centrality, as proposed by Borgatti and Everett (1997) as appropriate measurements of two-mode data. Results indicate that the light verbs become more central and pattern alike while the other verbs follow different paths of development over time. These findings are relevant to first language acquisition studies that have examined light verbs as path-breaking verbs so important for development of transitivity in child language, or in historical linguistic research, where questions about the status of light verbs as a closed class in the grammaticalization process have remained unanswered. The implications of these findings for subsequent quantitative analysis of syntactic and lexical changes are addressed.

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### Networks of Misinformation: Incorporating a Socio-technical Perspective in Network Analysis

Ava Lew<sup>1</sup>

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Social network analysis is concerned with the nature and structure of network relations, making it ideal for observing, mapping and analyzing multiple types of interactions that can occur within a network. The technology, function, and widespread use of online platforms, such as social media, enable the formation of online networks by affording and mediating various types of socio-technical interactions. An example of this phenomenon is seen in the current widespread dissemination of misinformation online, which can also produce off-line consequences in sectors of society. In addition to the fact that the interactions these platforms afford are both social and technological, is that the networks they enable may be active across multiple online sites within the larger platform ecosystem, which adds to the complexity of their dynamics. Moreover, in conjunction with human actors, platform features may also work to constrain or provide individuals with opportunities in a network.

In light of the above, the function of platform features and the types of interactions they provide need to be considered in order to effectively evaluate and obtain a comprehensive understanding of the role and impact of online networks. In an effort to fill this gap, this paper demonstrates the use of a combination of digital methods to collect and analyze empirical data on the aggregate dissemination of misinformation. The use of individual platform features and sites in the large-scale dissemination of misinformation are identified, tracked, and visualized as networks. In doing so, specific interactions, patterns and structures are uncovered within and across networks.

Assessing the sample of online misinformation, which are generated by the collective interactions of individuals with each other and with technological features, reveal the formation of socio-technical networks. These networks also reflect attributes located in social network analysis. As a result, by providing a unique perspective of these networks, findings support a theoretical expansion of social network analysis that aims for a more holistic approach when evaluating these socio-technical networks and their impact.

### **Networks of power: Operationalizing Hannah Arendt’s “grammar of action” and “syntax of power” with social network analysis**

Xavier Bériault<sup>1</sup>

<sup>1</sup>McGill University

I propose to present the theoretical framework and methodological approach drawing from Hannah Arendt’s political thought and social network analysis I developed in the course of my PhD to study the creation and organization of power by Métis leaders and the Hudson’s Bay Company officers in the historic Northwest. This interdisciplinary intellectual combination – Canadian history, Arendt’s thought, and network analysis – constitutes a novel approach that can be applied to the study of a wide variety of political phenomena.

The main concepts defined in this theoretical framework – the “grammar of action” and the “syntax of power” – are developed in such a way as to formulate a conceptual vocabulary capable of describing and evaluating the creation and organization of power. These two interrelated concepts acquire a fundamental importance in light of the fact that, in Arendt’s words, the rules by which actors practice “the elementary grammar of political action and its more complicated syntax [...] determine the rise and fall of human power”.

In light of this theoretical framework, social network analysis presents itself as an original and innovative approach to operationalize the grammar of action and the syntax of power. This analytical framework can be combined with social network analysis because both Arendt and network analysts share a fundamental theoretical premise: the simple fact that humans form networks by interacting with each other. The tools provided by network analysis software – its centrality measures (degree, density and betweenness) as well its capacity to visually represent the networks – enables researchers to augment Arendt’s concepts with a technical vocabulary that goes beyond a metaphorical description of the political networks analysed. These tools allow researchers to shed more light on certain aspects of the creation and organization of power than traditional methods of political science and history. Throughout the presentation, the grammar of action and syntax of power concepts, as well as the social network analysis tools, will be illustrated with the help of networks mapping the mobilization of the Métis Resistance of 1869.

### **Networks Studies in Environmental and Occupational Health in Quebec / Résultats d’études des réseaux en santé environnementale et en santé au travail au Québec**

Johanne Saint-Charles<sup>1</sup>, Mélanie Lefrançois<sup>1</sup>, Marie Eve Rioux-Pelletier<sup>1</sup>

<sup>1</sup>Université du Québec à Montréal

Addressing occupational and environmental health issues from a communication and network perspective means trying to understand how interactions, relationships and their structuring contribute to these issues or their persistence. It also means looking at how relationships networks become resources or constraints for individuals, groups or communities through processes such as power, diffusion or social support.

This offers a relational and collective perspective on health. Interventions based on such analyses aim to shed light on relational dynamics, often marked by global social relations, in order to

positively and sustainably transform collective practices rather than to make individual responsible for changing their ways of acting or being.

In this paper, we will illustrate the contribution of social network analysis to occupational and environmental health through three studies: workers' interactions surrounding the choice of atypical work schedule impacting work-life balance; discussions between community members in a participatory research project on mercury and health; neighbourly relations in green alley projects.

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S'intéresser aux enjeux de santé au travail et de santé environnementale sous l'angle de la communication et des réseaux, c'est chercher à comprendre comment les interactions, les relations et leur structuration contribuent à ces enjeux ou à leur persistance. C'est aussi se pencher sur des processus, notamment le pouvoir, la diffusion ou le soutien, qui font en sorte que les réseaux de relations peuvent être des ressources ou des contraintes pour les individus, les groupes, et les communautés.

Une telle approche permet de s'intéresser à la santé d'un point de vue relationnel et collectif. Les interventions se basant sur ces analyses visent à rendre visibles les dynamiques relationnelles, souvent marquées par des rapports sociaux, afin d'influencer positivement et durablement des pratiques collectives plutôt que de rendre les personnes individuellement responsables de changer leurs manières d'agir et d'être.

Trois exemples issus de nos travaux de recherche nous permettront d'illustrer comment l'analyse de réseaux sociaux a soutenu l'étude de différents phénomènes en lien avec la santé environnementale ou au travail. Nous aborderons les interactions entourant le choix d'horaires atypiques contraignants pour la conciliation travail-famille, la diffusion dans le cadre d'une recherche participative en santé environnementale et les relations de voisinage dans le cadre de projets collectifs de ruelles vertes.

### **Ego-networks and STEM identity formation**

Hannah Renée Chestnutt<sup>1</sup>, Allison Gonsalves<sup>1</sup>, Abby Spilkevitz<sup>1</sup>

<sup>1</sup>McGill University

**Background:** The development of a science, technology, engineering or math (STEM) identity is known to influence the success and persistence of under-represented minorities in STEM post-secondary education. In addition, existing research suggests participation in STEM clubs/organizations/initiatives improves under-represented students' persistence through degree programs in these subject areas. However, what is less understood, is the influence of social interactions through STEM initiatives on the development of STEM-identity. An examination of how students access resources to develop STEM identities is needed to understand the structures and processes that support students. We argue that the spaces created by STEM initiatives allow for the flow of a unique set of resources needed for identity work. We have used an ego-network approach to capture social interactions that facilitate the flow of resources through these spaces allowing students to position themselves as 'insiders' within their disciplines.

**Objectives:** This paper presents preliminary findings of a study examining the networks that students access through a women in physics committee at an Eastern Canadian University. We assessed the following spaces that supported identity-forming episodes of recognition: structural holes, intermediary spaces and outreach networks.

**Methods and analysis:** 13 members of a 14-person committee responded to the survey and were invited to attend semi-structured interviews. During interviews participants used paper and pencil to place alters on a target sociogram consisting of a suite of concentric circles. Participants placed alters at the perceived relational proximity from the centre of the sociogram. This exercise

offered rich data regarding the interactions and interdependencies which shape identity construction. The interviews were voice-recorded, transcribed, coded, and thematically analyzed. Survey results were analyzed using descriptive statistics. UCINET was used to analyze network structures.

**Results:** Merging qualitative data with SNA data regarding the positioning work students' do within these networks allowed for the illumination of spaces where identity-forming episodes of recognition were supported. Preliminary analysis suggests the presence of the following key spaces: a) structural holes; b) intermediary spaces; c) outreach networks. **Structural holes:** Key individuals were positioned to broker across structural holes. These brokers were well-positioned to promote diversity and innovation and thus support STEM identity development among students who lacked access to these resources. **Intermediary spaces:** Brokers who introduced information 'from the outside' disrupted existing hierarchical divisions between faculty and students. The initiative appeared to provide a non-bureaucratic *counterspace* and protection for individuals who were brokering relationships in a place of new power structures and new knowledge construction. This disrupted space appeared to facilitate knowledge exchanges related to identity formation. **Outreach networks:** Participants described "feeling like a physicist" and importantly described episodes of recognition when engaged in equity-focussed outreach workshops to local schools. Episodes that positioned participants as altruistic and knowledgeable in relation to less experienced students were seen as identity-forming.

**Conclusions:** This paper demonstrates the significance of using an SNA approach to illuminate the necessary conditions to create and sustain spaces for identity development for the purpose of improving the success and persistence of under-represented students.

#### **Minsk II Agreement between Russia and Ukraine and Polarization of the Ukrainian Parliament.**

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<sup>1</sup>University of Pittsburg, <sup>2</sup>Kyiv School of Economics

Do new people bring change or are they absorbed by the system? This is a broad question of a very practical matter for any organization and social movement. In politics, people care whether new individuals or new groups of elites can change ways of how things are done (does the new blood move the old blood?). We study a unique dataset of legislators in Ukraine that entered the Parliament in 2014 after the Euromaidan revolution. These legislators are divided into parties, yet they also represent new and old elites (that are present in all parties). We employ the ideal point estimation models to analyze whether new legislators differ from the new ones; is there any convergence; and who follows whom. We assume that each legislator votes for the outcome that is closest to her ideal point. Our analysis generates distance proximity between legislators based on their actual voting behavior. By looking into the dynamics of co-movement of ideal points we identify whether new and old legislators end up in the same cluster of points with time. Our preliminary analysis shows that there is indeed convergence over time. New legislators behave similarly to the old ones in the course of time. We analyze whether this convergence can be explained by homophily effects in terms of economic status (connections to industries and wealth).

#### **New sites of financial production: Introducing the networked product**

Daniel Tischer<sup>1</sup>, Adam Leaver<sup>2</sup>

<sup>1</sup>University of Bristol, <sup>2</sup>University of Sheffield

The paper introduces the concept of the networked product. Using the example of the Collateralised Debt Obligation (CDOs), we depart from the notion of financial products as created by one firm. Instead, we conceive of financial products as assemblages, containing human

and non-human actors with multiple, geographically dispersed experts. These networked products assemblages emphasise both temporality and spatiality and in doing so shift our attention to alternative processes of organisation and innovation as form of bricolage and jurisdictional arbitrage (Engelen et al. 2012). Each networked product assemblage presents a purposeful, temporary entanglement of siloed expertise – legal, accounting, mathematical and financocratic – drawn together by the specific requirements of the financial technology – the CDO. Whilst in and of itself temporary, repeated interactions between (sets of) actors also lead to the formation of enduring relationships, in particular where few experts are involved, for the purposes of jurisdictional arbitrage, in the structuring of many CDOs. The concept specifies two orders of interaction: One, at the product level to describe how the product shapes the network and *vice versa*; and, two, the assemblage manifests itself in form of a global set of relations between experts across jurisdictions, one that is adaptive and capable of countering legislative impasses, and one that opens up new market opportunities for the product. Places of production at firm level are effectively replaced with a common space, a network of relations enacted by the component parts, human and non-human, and the drawing in new actors albeit only temporarily.

### **News media and Twitter: The construction of narratives in the refugee crisis**

Adina Nerghes<sup>1</sup>, Ju-Sung Lee<sup>2</sup>

<sup>1</sup>DHLab, KNAW Humanities Cluster, <sup>2</sup>Erasmus University Rotterdam

The European refugee crisis received heightened attention at the beginning of September 2015, when images of the drowned child, Aylan Kurdi, surfaced across mainstream and social media. While the flows of displaced persons, especially from the Middle East into Europe, had been ongoing until that date, this event and its coverage sparked a media firestorm. Mainstream media content plays a major role in framing the discourse about events such as the refugee crisis, while social media's participatory affordances allow for the narratives to be perpetuated, challenged, and injected with new perspectives. In this study, the perspectives and frames of the refugee crisis from the mainstream news and Twitter---in the days following Aylan Kurdi's death---are compared and contrasted.

Using a combination of theme identification and network portrayals, we uncover the socio-semantic dimensions of narrative building by investigating the association between mainstream-media outlets or Twitter users and the themes and frames they contributed to. Specifically, we analyze thematic affiliation networks to examine thematic communities as well as how individual actors (news outlets or Twitter users) participate in the creation or perpetuation of themes.

Based on our analysis, we draw several conclusions regarding similarities and differences in the themes and frames across the two media environments. Firstly, we found mainstream-media to be more diverse and broader than social media in the themes addressed. While some of the themes on Twitter correspond to those in the news, Twitter users introduce new themes into the discussion, which should not be surprising since social media afford users with near unlimited opportunities to push debates into new directions. Secondly, we find that news outlets cluster into fewer communities bounded by distinct subsets of themes, often geo-politically defined, while Twitter users separate into more, focused communities, where categories of users--such as celebrities and news outlets---exhibit aligned perspectives. Lastly, we find that those themes constructed in social media to be more sympathetic, positive, and welcoming tone than those created by mainstream-media. By relating to refugees, focusing on the tragedy of Aylan, and promoting migrant success stories, Twitter users created frames and themes that call upon feelings of shared humanity. With this study, we demonstrate how mainstream and social media form a new media space, where the latter both echoes and augments the narratives of mainstream-media. Showing how the refugee crisis narrative - created by mainstream-media and

social media - converged and diverged has enabled us to expose emergent perspectives and how they are perpetuated and challenged.

### **NGOs' Agenda Building on Twitter in the Refugee Crisis: An Inter-organizational Network Approach**

Jingyi Sun<sup>1</sup>

<sup>1</sup>University of Southern California

As a form of strategic communication, agenda building has attracted much research attention to understand organizations' influence on media agenda (Guo & Vargo, 2015; Kiousis, Mitrook, Wu, & Seltzer, 2006). Previous studies on agenda building mainly select representative information sources to compare the salience of objects, attributes and semantic network connections within text, but rarely identify the structural mechanisms of network ties between organizations and media and examine their consequences. This study seeks to extend agenda building literature by inspecting how the ties between organizations and media could lead to more object salience in the whole network and bring about significant increase in salience transfer of semantic associations.

An event-based Twitter dataset of 1,365,932 tweets about the refugee crisis from 2013 to 2015 was retrieved. There were 6474 tweets from verified accounts in the retweet network and 6941 tweets in the mention network. The users of tweets from 2013 were manually coded, which yielded a list of 130 NGO accounts and 193 media accounts. This list was used to identify the NGOs and media in the whole network. Two hypotheses were proposed: mention ties between NGO and media positively correlates with higher chance of being mentioned in the entire network; the semantic network of frames is more likely to transfer between NGOs and media that have mention ties compared to those without mention ties.

The first hypothesis was tested with a social influence model specifying the network constraints on actors' attributes. As a member of the Exponential Random Graph Model (ERGM) family, the Autologistic Actor Attribute Model (ALAAM) has the advantage of not only taking network endogeneity into account but simultaneously testing the network-attribute-dependent assumption and the covariate-dependent assumption (Daraganova & Robins, 2013). Since there were too few ties between NGOs and media in the retweet network, the mention network of 153 NGO and media organizations were used for the ALAAM model specification. After accounting for network dependency, the ALAAM results showed that sending ties to the mismatched group, namely cross-group ties between NGO and media, would make organizations more likely to be mentioned in the whole network.

The second hypothesis seeks to compare the semantic similarity between two sets of NGOs and media, those with mentioning relations and those without. Following the method of network agenda setting (NAS), this study also used predetermined frames from previous studies on the refugee issue to avoid bias (Kiousis et al., 2015; Vu, Guo and McCombs, 2014). The entire text from both verified and unverified accounts were cleaned and stemmed, and the most frequently appearing words were coded into five frames as indicative words. Since two frames rarely co-occurred in one tweet, the co-occurrence of frames was defined as appearing on the same day. QAP tests were conducted to measure the similarity between matrices, and the results showed that the QAP correlations between the agendas of NGOs and media that had mention ties were significant at .05 level throughout the three years, but non-significant for NGOs and media that didn't have mention ties.

### **Non-Campaign Networks: Investigating Hyperlink and Twitter Networks Among Japanese Politicians**

Leslie Tkach-Kawasaki<sup>1</sup>, Junku Lee<sup>2</sup>

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### **Non-Campaign Networks: Investigating Hyperlink and Twitter Networks Among Japanese Politicians**

The political use of the Internet in developed democracies throughout the world has witnessed many transformations in the past two decades. The Internet is no longer a novel feature of political campaigns but is now an indispensable and commonplace media format. As the political use of the Internet has continued to develop, websites have evolved into static platforms for information provision, and social media channels (such as Twitter, Facebook, YouTube, and Instagram) are used for instantaneous communications and for providing up-to-date information. Similar to their counterparts in other countries, Japanese politicians have used Internet-based platforms such as websites and, more recently, social media, as communications and information-provision platforms to create and maintain relationships with the public for close to two decades. To date, most of the public attention and interest involving the use of such platforms in Japan has focused on election-campaign periods. While this emphasis is certainly warranted, given the importance of information provision, communications, and mobilization during election campaign periods, such focus comes at the expense of investigating politicians' networked relationships in general and comparing their use across platforms.

This paper addresses that gap by examining the hyperlinking patterns on Japanese politician websites and comparing such patterns with the corresponding Twitter networks, as well as the Twitter network pattern in general. What patterns can be discerned in the hyperlink and Twitter networks among Diet politicians in Japan? Do politicians of certain political parties tend to demonstrate similar network patterns? Are the similarities and differences in the hyperlink and Twitter networks of male and female politicians?

In this paper, we use the hyperlinks found on Diet politicians' individual websites (as at early 2019) to create the network diagrams illustrating their relationships. For those politicians who utilize Twitter, we draw similar diagrams of their relationship networks. We aim to identify similarities and differences in their networked relationships through their websites and Twitter, and also distinguish whether there are differences or similarities in terms of political party affiliation, incumbency, sex, and age.

With almost every politician in the Lower and Upper Houses of the Japanese Diet having a website and close to half of the politicians utilize social media channels such as Twitter, such network comparisons during non-election periods can be valuable in assessing non-campaign Internet utilization.

### **Occuper une position sociale périphérique au sein d'une clique non-populaire : un facteur de risque pour l'estime de soi des jeunes adolescents / Holding a Peripheral Position within an Unpopular Clique: A Risk Factor for Early Adolescents' Self-Esteem**

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Au début de l'adolescence, une diminution de l'estime de soi est notée. En parallèle, les adolescents accordent une importance grandissante à leur popularité et à l'affiliation à un groupe de pairs, appelé une clique. La littérature démontre qu'être membre d'un groupe de pairs non-populaire est relié à une faible estime de soi. Par ailleurs, les jeunes occupent une position dans la hiérarchie sociale construite au sein de leur clique. Cette position peut être estimée par un score de centralité. Nous émettons l'hypothèse que les jeunes en périphérie de la clique sont plus

susceptibles que les jeunes centraux de subir une baisse d'estime de soi. De plus, nous supposons que la relation négative entre la position périphérique et l'estime de soi serait accentuée si les jeunes font partie d'une clique non-populaire versus d'une clique populaire.

Cette étude mesure l'effet modérateur de la popularité de la clique sur le lien entre la centralité et l'estime de soi des jeunes sur un an. L'âge, le sexe ainsi que la popularité et l'estime de soi individuelles sont des variables de contrôle.

**MÉTHODE :** 470 adolescents (54% filles,  $m = 13$  ans) en 1<sup>re</sup> et 2<sup>e</sup> année du secondaire d'une école belge ont été sondés deux fois, à un an d'intervalle. Une version française du *Rosenberg Self-Esteem Scale* mesure l'estime de soi (10 items,  $\alpha = .81$ ). Les amitiés entre participants sont identifiées via les nominations réciproques à la question « Qui aimes-tu le plus parmi les jeunes de ton année scolaire? ». Les cliques sont identifiées en utilisant l'algorithme Girvan-Newman de UCINET 6 et ce logiciel permet aussi de calculer un score de centralité intra-clique pour chaque membre d'une clique. Les nominations « plus-populaire » et « moins populaire » à la question « Qui sont les jeunes les plus et les moins populaires dans ton année scolaire » sont combinées pour mesurer la popularité individuelle. La popularité de la clique est mesurée par la moyenne des scores individuels de popularité des membres de la clique, en excluant le participant ciblé. Les scores de centralité et de popularité de la clique sont dichotomisés à moins un écart type, pour isoler les membres en périphérie et les cliques non-populaires.

**RÉSULTATS :** Des analyses de modération sur Mplus 7.0 montrent que la centralité prédit positivement l'estime de soi dans le temps ( $\beta = .35, p < .01$ ) et que la popularité de la clique modère négativement ce lien ( $\beta = -.47, p < .01$ ). Des analyses post-hoc démontrent qu'uniquement les jeunes en périphérie d'une clique non-populaire sont à risque de subir une baisse d'estime de soi en un an.

**CONCLUSION:** Ces résultats démontrent que les membres en périphérie d'une clique non-populaire sont les plus à risque d'avoir une faible estime de soi dans le temps. Cela suggère le développement d'interventions préventives qui ciblent cette catégorie de jeunes afin de pallier pour l'influence négative que leur situation sociale à risque peut avoir sur leur estime de soi.

### **Organic Health Discussion Network Activation: The Influence of Health Discussion Partners on Smoking Behaviors**

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Traditionally, health communication campaigns were theorized to operate according to a 'hypodermic needle' model where ads directly affected behavior change among individuals. Health communicators are increasingly recognizing the critical role that social influence processes like interpersonal communication play in the efficacy of health communication campaigns (Brennan et al., 2015; Hornik, 2002). In fact, recent studies suggest that national tobacco education campaigns can prompt interpersonal conversations about smoking cessation (McAfee et al. 2013) and positively influence attitudes and behaviors toward cessation (Durkin, Brennan, Wakefield, 2012).

Studies in this area have considered how social interactions and interpersonal communication indirectly prompted by national campaigns and health warning labels influence individuals' reactions (Brennan et al., 2015; Durkin et al., 2012; Hall et al., 2015; Thrasher et al, 2015). For example, one recent study found that discussions about graphic health warning labels among smokers were associated with more quit attempts.

While these studies demonstrate that individuals are influenced by conversations, the studies begin with the assumption that individuals are influenced by conversations prompted by a health

communication campaign or warning label. Studying the ties activated in response to a stimulus does not account for the influences that may stem from one's health discussion network absent a specific exogenous stimulus. It is possible that the characteristics of individuals' organic health discussion networks—the ties activated naturally and not in response to any stimuli—may influence health behaviors above and beyond the effect of specific stimuli.

As Perry and Pescosolido (2010) explain, “health discussion networks work through social regulation, or the normative influence applied by social networks in order to shape a member's decisions, behaviors, or attitudes toward health” (p. 236). That is, health discussion networks represent the ties individuals activate when discussing health matters. These ties can be categorized as “discussants” (i.e. those who one turns to discuss her physical or emotional problems), “regulators” (i.e. those who try to get one to do things about her health), or “burdens” (i.e. those who are burdens because of their own health problems). However, we know little about the extent to which these categories of ties have on individuals' health behaviors.

The purpose of this study is to explore whether organic health discussion networks are associated with smoking behaviors. We do this by first exploring whether and to what extent smokers' and nonsmokers' health discussion networks vary. Then we examine whether the network characteristics are associated with smokers' quit intentions and nonsmokers' smoking susceptibility.

We recruited 1,107 young adults between the ages of 18 and 29 to participate in an online survey. Participants completed the “health matters” name generator (Perry & Pescosolido, 2010). The name interpreter questions included each alter's relational role, age, gender, race/ethnicity, closeness, frequency of communication, social support, and alter-alter ties. Respondents then indicated their own tobacco use, smoking status, susceptibility to smoke if they were not a current smoker, and their quit intentions if they were a smoker. At present, we are analyzing the data and will have a completed manuscript, if accepted.

### **Organizational change and its effect on the formation of new and diverse ties: An examination of networks among physicians before and after the change**

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Empirical research on how restructuring interventions affect personal networks of organizational members is still scant. Notable exceptions include recent works on the dynamics of ties creation and decay, and on the role of informal networks in supplementing the inefficiency of newly adopted formal structures, or in supporting the emergence of new behaviors and schemata. This paper contributes to -and extends - this line of research by investigating how qualitative, other than structural characteristics, of personal networks are more likely to differentially affect micro-level changes in personal networks in response to macro-level changes in organizational structures. We formulate hypotheses on how the cohesiveness and diversity of personal networks play a role in predicting the creation of new and diverse ties after an organizational change. We also formulate hypotheses on how network diversity and cohesiveness interact with network size and homogeneity to explain the creation of new and diverse ties in the context of organizational change. We tested our research hypotheses on a sample of 174 physicians working in a large Italian teaching hospital, which underwent a major restructuring intervention aimed at fostering inter-unit collaboration and a multidisciplinary approach in knowledge sharing. Our main dependent variables are the number of *new ties* and number of *diverse ties* created in physicians' advice networks after the organizational change. The independent variables are measured by considering structural and compositional characteristics of the advice networks such as *size*, *density*, *diversity* and *homogeneity*. We also control for a number of characteristics of physicians,

including their degree of exposure to change. We use negative binomial regression models to test our theoretical conjectures. Results show a positive effect of network diversity on the formation of new ties, while network size has a negative effect. Moderation effects were also tested, revealing a positive relationship between network diversity before the change and the formation of new ties after the change. Instead, network density is negatively related to the propensity of physicians to form new and diverse ties, while homophilous ties has a positive effect. Finally, the results show that the formation of new and diverse is mitigated for networks with a larger number of homophilous ties. Overall our findings provide evidence of the role of qualitative characteristics of personal networks in predicting changes at the personal network level as a result of changes at the organizational level. We discuss the implications of our findings in terms of how micro-level endogenous social processes within organizations react to, and are shaped by, macro-level exogenous processes of organizational design and change.

### **Organizational networks revisited: Predictors of headquarters-subsidary relationship perception**

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The problem of effective management of company subsidiaries has been on the forefront of strategic management research since the early mid-1980s. Recently, special attention is being paid to the effect of headquarters-subsidary conflicts on the company performance, especially in relation to the subsidiaries' resistance, both active and passive, to following the directives of the headquarters. A large number of theoretical approaches have been used to explain the existence of intraorganizational conflicts. For example, Strutzenberger and Ambos (2013) examined a variety of ways to conceptualize a subsidiary, from an individual up to a network level. The network conceptualization, at present, is the only approach that could allow explaining the dissimilarity of the subsidiaries' responses to headquarters' directives, given the same or very similar distribution of financial and other resources, administrative support from the head office to subsidiaries, and levels of subsidiary integration. This is because social relationships between different actors inside the organization, the strength of ties and the size of networks, as well as other characteristics, could be the explanatory variables that researchers have been looking for in their quest to resolve varying degrees of responsiveness of subsidiaries, and – in fact – headquarters' approaches – to working with subsidiaries.

The purpose of this study was to evaluate the variety of characteristics of networks formed between actors in headquarters and subsidiaries, and their effects on a variety of performance indicators of subsidiaries, as well as subsidiary-headquarters conflicts and their perception. Data were collected in two waves at a major Russian company with over 200,000 employees and several subsidiaries throughout the country. To test the hypotheses, we used TERMG and structural equation modeling, and the results of the study provide a number of theoretical insights for further study and practical recommendations for large companies.

### **Organizing for Complex Product Innovation: How the Case of Smart Materials Inspires towards an explicit Network Conceptualization of Innovation Ecologies**

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Reviews of the concept of innovation ecologies rather unanimously bemoan its lacking conceptual rigor, theoretical foundations, and its varied, often metaphorical use. As a form of organizing for solving complex problems, such as complex product innovations, the concept is not only intuitively appealing, but potentially fills a crucial gap that prominent related concepts, most

notably innovation systems, innovation networks, and business ecosystems, are not equally well equipped to fill. Rather than discarding and replacing the concept for its weaknesses, the present paper aims to advance its conceptual development.

With the aim of finely specifying and thus enhancing the analytical power of the concept, we present a network analytical anchoring of innovation ecologies. Our thinking is solidly grounded in and will be illustrated by the empirical case of a complex product innovation task, namely the search for promising product applications of smart piezoceramic materials. Over a period of so far more than five years, rich case material (e.g., participatory observations, interviews, and documentary material) has been gathered as part of three successive and still ongoing projects of engaged scholarship in the field of smart materials.

In line with recent advances in complex network modeling, we propose to model the innovation ecology in the case at hand as a two-layered network. The first layer is conceptualized as a supply network with material artefacts as nodes and directed flow relations as edges; the second layer is conceived as a network of actors with multiple actor attributes and corresponding multiple types of ties. Furthermore, we identify a number of network metrics that are specifically relevant for complex innovations, such as structural holes and optimal walks and paths. As an anchor, this modelling allows a fine-grained specification of the complex innovation task that innovation ecologies are thought or specifically designed to help fulfill. Most notably, we elaborate on iterations of intra- and cross-layer (re-)coupling as core catalytic process tasks. We conclude by outlining a distinct network conceptualization of innovation ecologies as a multilayered form of organization enabling and entwining the emergence and steering of processes of innovation together with innovative outputs.

The paper is valuable in three regards: first, it clearly and distinctly defines and substantiates a network grounded concept of innovation ecologies along with its core constitutive elements and dynamics. Second, it stringently grounds the conceptualization in an in-depth analysis of the task to be organized, namely complex product innovation. It thus clearly spells out the boundary conditions of the concept. Third, it weaves organization, network, systems, and complexity theory into the conceptualization and thus harnesses this work for the challenge of organizing for complex innovations.

### **Over-Connected Bridges: Cognitive Bias in Respondent Estimation of Alter Embeddedness**

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<sup>1</sup>University of Toronto

Research into cognitive biases in the memory of network structures has focused primarily on whole networks and on the ways in which the perceived overall structure varies from structure measured in other ways. We draw on whole network research to consider how cognitive biases in remembering network structure shape respondents' abilities to report structural characteristics of their ego networks.

Remembering connections between people is a cognitively difficult task because even in relatively small networks there are many relationships. In a network of ten people there are 45 connections to be recalled. Research shows that people simplify this task by using schema – organizing rules about what networks typically look like. One important schema is triadic closure, in which people who know the same others are remembered as knowing each other, as well.

We hypothesize that when estimating the embeddedness of alters, triadic closure schemas will result in inflated reports of embeddedness for alters who are bridges. For example, if an alter, X, is connected to Y who is an alter within a cluster, then triadic closure schema could result in X being thought of as connected to the entire cluster to which Y belongs, rather than just to Y.

In this study we examine whether and how egos' ability to estimate the embeddedness of their alters is shaped by cognitive biases. In a name generator survey of 568 respondents who named 5202 alters, respondents were asked for each alter "please estimate how many of the other people listed that person knows" and chose from the following options, "none or a few," "less than half," "about half," "more than half," or "all or almost all." Following this, a full dyad census was completed, in which respondents indicated for all pairs of alters whether those alters know one another.

Using multi-level models to account for the alters nested within egos, we then regress egos' reports of alters' embeddedness on their bridging status and controlling for the number of ties the alter is reported to have and the respondent's ego network size. We show that alters who are more bridging within the network are reported to be more embedded than similarly embedded alters who do not act as bridges. Further, the bias is greater for respondents who completed name generators that primed them to think of their alters in terms of clusters.

Results suggest that cognitive biases matter for ego network data collection not only because they influence which alters are named as part of the network, but also because they shape respondent reports of network structure. We discuss how this may influence data collected using existing data collection methods, how this shapes our own development of new data collection methods, as well as limitations of our study.

### **Pando: Participatory SNA & Feedback for Social Change**

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<sup>1</sup>Root Change

Pando (<https://www.mypando.org>) is an innovative online platform that combines SNA and feedback to help organizations visualize, learn from, and engage with the systems where they work. Pando was developed by Root Change, a nonprofit based in Washington D.C. working globally in over 15 countries. We design products, technologies and interactive experiences that help organizations, groups, and networks identify ways to make systems more equitable, effective and impactful.

We have been using SNA for a decade to support our work and research. In our experience, we have found traditional SNA tools challenging to apply in practice. They can be costly, time intensive, and involve training enumerations with data becoming obsolete in a matter of months. All this can make it hard for organizations to sustain SNA approaches in their work. We created Pando to be an easy-to-use tool for organizations to regularly apply SNA and feedback practices to inform a common understanding of collective work and opportunities to strengthen systems over time.

Pando enables real-time participatory network mapping and sharing of data across organizations, creating a process where data is regularly updated based on the changing landscape. Map administrators start by customizing a network map and invite in by email other organizations, institutions or stakeholders. Once registered, invited users fill out short relationship surveys and nominate others they go to for information, ideas and support across a range of areas. Users put in email contacts to invite their partners to join Pando and undergo the same process. Relationship data is instantly visualized in a network map made available to all map members to analyze using user-friendly filters and centrality measures to identify key actors. Organizations create a profile to share more about their work with map members. The more actors invited in, the more the map grows. Map members can come back at any time and update their relationships and see how relationships change over time.

Pando is integrated with Keystone Accountability's Feedback Commons (<https://www.feedbackcommons.org>), an online tool that allows users to collect and analyze

anonymous feedback about relationship quality among map members. The combined power of network maps and feedback surveys helps create a holistic understanding of the system and changing levels of trust, social capital and influence.

As an accessible tool open to all map participants, Pando can be used to facilitate inclusive dialogues about network structure, power dynamics, relationship quality, and potential opportunities for increased collaboration. All of the data generated is cloud based and made readily available to users. Import features allow users to upload SNA data from other sources. Pando was officially launched in September 2018, and has since been used by USAID Bosnia and Herzegovina to understand relationships among more than 1,000 civil society organizations. More recently, the Aga Khan Foundation has used Pando to learn about the relationships among hundreds of youth and service providers in coastal Kenya. We are excited to use this session to share the Pando tool suite and use cases for participatory SNA with a wider audience.

### **Panel data and relational event data for the study of network dynamics**

Christoph Stadtfeld<sup>1</sup>

<sup>1</sup>Chair of Social Networks, ETH Zürich

Dynamic social network data typically take one of two forms. First, network panel data consist of sequences of static network snapshots. They are useful to investigate change in not directly observable social networks, such as friendship perception networks. Second, relational event data are time-stamped traces of dyadic data that can be collected to investigate change in social networks of transactions, communication, or coordination.

In the past years, new sources of event data have emerged (as described in the session call), promising the opportunities to study social processes at a finer granularity and on larger scales. However, a number of sociological theories are not only considering interactions, exchange, or communication opportunities (that can potentially be collected as relational event data), but are at their core concerned with individuals' perceptions of social networks (that are best collected as network panel data).

The talk compares the two approaches in terms of data sources, sociological theories, and methods of statistical analysis, and argues that a lot can be gained by simultaneously considering both approaches to dynamic network analysis.

### **Partitioning Networks by Social Influence**

Ulrik Brandes<sup>1</sup>

<sup>1</sup>ETH Zurich

We present a family of computationally efficient community-detection methods for which processes of social influence in the tradition of French, DeGroot, and Friedkin serve as a theoretical justification. In these models, actors repeatedly update their positions or beliefs according to those in their social environment. Variants allow for weighted aggregations, externalities, Bayesian belief revision, and other generalizations. Given a set of influencers such as stubborn actors or external sources, the network is partitioned by assigning each actor to its source of maximum influence. Examples demonstrate that the method leads to interpretable results. It scales to large networks and suggests means for empirical validation.

### **'Pass it on?' Social contacts and social capital between younger and older generations**

Beate Volker<sup>1</sup>

<sup>1</sup>University of Amsterdam

There is much attention paid to the social divides according to gender, ethnicity and education, but much less to the divide in terms of age. However, meeting places, like clubs, cafés or voluntary

associations, and social life in general, are heavily segregated according to age. People of different ages and in particular of different generations hardly meet, except they are family of each other. From a resource theoretical view, this gap between generation is a missed chance to share social capital with each other.

This paper firstly describes how intergenerational contacts look like and who actually has network members, who are much older or younger. It then examines what kind of resources are exchanged and how these relations look like, how close they are, how frequently one meets etc. Finally, we discuss some projects currently done in the Netherlands aimed to enhance intergenerational contacts. Our data come from the Survey of the Social Networks of the Dutch (SSND) a panel study on networks and social capital (n=967) and from a project on the age divide in modern societies, where in depth interview data have been gathered.

### **Pass the Condom: Friendship Ties and Contraceptive Choice**

Lauren Newmyer<sup>1</sup>

<sup>1</sup>Pennsylvania State University

This paper aims to build on the ideas of social learning and social influence by investigating types of contraceptive methods and what role a friendship network plays in an individual's likelihood of using them. Individuals may learn about the effectiveness of certain contraceptive methods only through their friends, such as withdrawal versus condoms. Their peers might encourage them to use a more effective method of contraception not only to protect the individual from an unplanned pregnancy, but to also protect the network from the spread of sexually transmitted diseases.

Data used are from the National Longitudinal Study of Adolescent Health (Add Health). Specifically, this study focuses on the saturated sample of "Jefferson High School." The friendship network contains 832 students. The Wave 1 data set includes the question: "What method of birth control did you or your partner use [most recently]?" There are multiple answer choices for this question. The top four answer choices are condoms, birth control pills, the Depo-Provera shot, and withdrawal. In Jefferson, there are 224 students who identified using condoms, 33 students who identified using birth control pills, three who identified using the Depo-Provera shot, and 16 who used withdrawal. Other methods are not included because the sample size was very small ( $\leq 3$ ). The inclusion of a partner in the question allows for a respondent to identify using a contraceptive method even if they were not personally responsible for it such as a male birth control pill user or a female who used withdrawal.

Analyses of these data include centrality measures, subgroup analyses, and exponential random graph models. There are several prominent actors, determined by measures of centrality and subgroup analysis, who use a specific type of contraceptive method. Condoms are the most used method in this network. This is also the method that the most central actor uses, who is a female condom user. It is possible that knowledge about condoms is spread through a friendship network by central actors, and that people are encouraged to use this method in order to protect the network from the spread of sexually transmitted disease and/or unwanted pregnancies. The subgroup analysis reveals the opposite effect might happen as well. A student may learn about an ineffective method through their peers such as withdrawal. They may be encouraged to use a method like withdrawal by their peers' lack of concern of catching sexually transmitted diseases. The ERGMs build on these findings by revealing that actors are more likely to form friendship ties with others who use condoms, and, possibly, with others who use withdrawal. Networks might have greater influence on the use of these methods due to their accessibility. Condoms or withdrawal do not require a trip to the doctor, nor do they require parental involvement to access. Birth control pills and the Depo-Provera shot might be harder methods for a high school student

to obtain, even if they learn about them through their social networks and/or feel influenced to use them by their friends.

### **Patterns of biases in adolescents' perception of peer social structure: Implications for network positions and mobility**

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Peer groups constitute an important relational environment for adolescents. Expanding upon the theoretical developments on perceptions of network structure, this study tests how being able to accurately perceive peer social structure and being in visible peer groups provide adolescents with advantages pertaining to their positions in friendship networks and peer groups. First, this study presents a detailed analysis of patterns of perception biases. It is possible to distinguish between accuracy in perceiving the self as embedded within a structure and in perceiving the global picture of peer social structure. When examining one's self-understanding regarding the peer group(s) one belongs to, there can be overestimation or underestimation of whether one belongs to a group as well as ignorance of groups that are identified by a general consensus. In terms of perceptions of others' groups, we examine overall perception accuracy as well as perception range reflected in the number of groups recalled. In addition, peer groups one belongs to vary in the extent to which they are frequently and accurately recalled by outside people. Second, while existing literature has examined biases in network perceptions, there is limited understanding of the implications of these for network positions and mobility. Theoretical arguments suggest that those who are able to accurately perceive the social structure can better navigate through resources and constraints, take advantage of social capital, and better manage relationships. This study examines how adolescents' perceptions form an important ground for their social action by testing how accuracy in perceiving social structure, and belonging to visible peer groups, are linked with adolescents' network positions and their likelihood of changing peer groups. The first wave of data was collected from 7th and 10th grade students from schools in Lanzhou, China, followed by two subsequent waves at one-year intervals. A Social Cognitive Mapping questionnaire was used to measure students' recall of peer groups, while a traditional sociometric questionnaire was used to measure dyadic friendship ties. Perception bias measures were calculated based on multiple ways in which a respondent's recall of peer groups and their members matched the groups derived from peer consensus. Initial results suggest a link between inaccurate perceptions and a higher likelihood of changing peer groups, and a link between belonging to visible peer groups and popularity. Further, growth curve models will test the impacts of perception biases over time. The findings will facilitate extending theories of network perception which have primarily been developed in dyadic tie settings to the context of groups.

### **Patterns of countries' interactions in multinational clinical trials networks**

Robson Rocha de Oliveira<sup>1</sup>

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Clinical trials have progressively achieved a significant global scope. Scientific, regulatory and economic factors have combined to expand clinical trials across national borders. The analysis of the patterns of countries' participation in multinational clinical trials networks is an opportunity for the study of the interaction of national innovation systems at a global level, particularly from the point of view of Science, Technology, and Innovation (ST & I) activities in the health sector. The overall objective of this research was to study the global expansion of clinical trials in order to map the patterns of interaction among participating countries. It was envisaged that innovation is an interactive process increasingly related to a selective internationalization of ST & I activities.

Multinational clinical trials (conducted in three or more countries) registered at Clinicaltrials.gov in the period from 2000 to 2014 ( $n = 10,451$ ) were considered. The analysis of the evolution of structural properties of social networks of these multinational clinical trials was carried out in two steps: a) initially, from the evolution of global structural properties (year by year); b) secondly, the registries of these clinical trials were grouped in three periods of five years and the evolution of both global structural and positional properties of participating countries were analyzed. The results suggest the existence of consolidated structural patterns of interaction between countries. As clinical trials expanded geographically, the average number of countries per study increased until reaching a threshold representing a point of saturation. Presumably, the global expansion of clinical trials is the result of an even broader phenomenon: the growing interdependence of national innovation systems. Both countries from traditional and emerging economies have increasingly accessed the diverse competencies of foreign research centers, forming these international ST & I networks. Countries would have occupied positions within these networks that would be related to their own local capacity for innovation. If on the one hand international interactions could improve national capacity for innovation, on the other, reflexively, national capacity would shape the possibilities of better insertion in these global networks of ST & I. It should be remembered that to be located in a strategic point of a network is, in a certain way, more important than to be located in some superior hierarchical level. In conclusion, the understanding of patterns of interaction would guide policymakers to recognize the most strategic positions within these global ST & I networks.

### **Patterns of Social Integration: How Combinations of Close Friendship Networks and Voluntary Association Membership Influence Individual Wellbeing**

Sela Harcey<sup>1</sup>

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This paper explores the relationship between depression and two dimensions of social integration—interpersonal connections and membership in voluntary organizations. On one hand, social relationships have been widely associated with health outcomes through measures of social support, perceived social isolation, and social network size. Having higher levels of social support and close friendships is associated with better health. Whereas those that lack close social connections report higher levels of loneliness, depression, and morbidity. On the other hand, voluntary association membership (VAM) and volunteering have an influence on health outcomes from a broader context of social engagement. Volunteering and VAM has shown to improve subjective wellbeing, decrease loneliness, and prolong cognitive decline in older adults. Despite the continued exploration of both social relationships and social engagement on wellbeing, little research has considered how these forms of integration function jointly.

In this paper I argue that social integration is a multidimensional construct. Close friendship networks and VAM are two dimensions that operate as separate processes that compose social integration. This paper explores the role of two forms of social integration jointly, both close friendship networks and social engagement on wellbeing. I specifically ask—how do different *combinations* of social network size and VAM influence wellbeing? For example, does participation in many voluntary associations mitigate the isolation from having few close friendships? Or, does having many close friends and high participation in organizations lead to detrimental health outcomes? Overall, how do these two dimensions combine to influence social integration and how, in various combinations, do these dimensions of social integration influence mental health? In order to answer these questions, I develop a typology of profiles of social integration.

The paper captures a simple typology of social integration that combines social network size and VAM in a 2x2 table. Possible combinations of social integration are conceptualized as low network size-low membership, low network size-high membership, high network size-low membership, and high network size-high membership. Conceptualizing the joint effect of two forms of social stimuli across different high and low dimensions allows for identification of influence of different combinations of social integration.

To assess the role of social integration on mental health, I use data from the National Voluntary Association Study (NVAS). Collected in 2006, NVAS was collected to better understand the role of voluntary association in individuals' lives. The NVAS builds on the 2004 topical module of the General Social Survey (GSS) about voluntary associations and networks. These data provide both ego network and VAM information allowing for the exploration of the joint association of social relationship and social engagement on wellbeing.

Findings suggest that combinations of social relationships and engagement influence mental health differently. Preliminary findings suggest that being socially isolated or highly integrated (strain) is associated with higher levels of poor mental health. Being involved in voluntary associations acts as a buffer for being socially isolated with little/no close friendships. Overall, multiple dimensions influence social integration jointly. Exploring combinations of multiple dimensions social integration provides insight into how social relations influence mental health.

#### **Peer effects and inter-organizational performance similarity: A longitudinal study**

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There is growing evidence that peer effects modify individual behaviors and affect performance, in particular, it is argued that they make behaviors of interconnected actors similar. However, how peer effects actually operate and spread between organizations remains unclear. At which level do peer effects operate? One way to address this question is to examine the patterns of connectivity and positional similarity explain peer effects in interorganizational networks. In this study, example of patterns of connectivity include dyadic relations, network subgroups (co-membership in cliques) and positions within the network as whole (structural equivalence). The objective of this study is to analyze and clarify which level is more appropriate for understanding similarities between organizations in behavior, e.g., performance among organizations.

I use data collected on a regional community of hospital organizations over four years, capturing network ties through patient transfers relations, which can be interpreted as forms of collaboration among partner organizations. Similarity in organizational behavior is computed by using Comparative Performance Index (CPI), an indicator that is frequently used as a measure of organizational performance. I also use information on a number of organizational and institutional characteristics to assess their role in affecting peer effects among hospitals in the sample. Analytically, I employ a dyadic panel model by using the Generalized Method of Moments (GMM). The results provide evidence on how peer effects operating through system of collaborative relations explain similarities and differences within organizational field and communities.

#### **Peer Effects on Academic Performance by Friends and Extracurricular Activity Members**

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Peer influences on educational outcomes have been widely discussed, and scholars often found positive relationships between them (Betts and Morell, 1999; Coleman et al., 1966; Harris, 1998; Sacerdote, 2001). Although there are quite a few studies, they have something in common; only

one type of tie (the friendship tie) is discussed. However, students have a variety of ties in their school life. Especially, participations in extracurricular activities play an important role (Eccles and Barber, 1999; Im et al., 2016; Mahoney et al., 2003). To our knowledge, there is no study examining the effects of these two ties simultaneously.

Communications among friends and those among peers in extracurricular activities have qualitative differences; those among friends are based on enjoyment. Their communication is more intimate, and various types of information is usually shared. There is a social pressure for conformity to their norms, whether they refer to academic performance or fun activities. On the other hand, extracurricular activities are structured for practicing specific skills, contributing to one's community, and dealing with challenges. Students gather for similar purposes and goals regarding their extracurricular activity. Therefore, if needed, students can decide to keep a certain distance from other members in extracurricular activities to avoid harmful effects in their private life. Under this situation, students can observe others' behaviors and learn only beneficial aspects from them.

The difference above brings about interesting hypotheses regarding peer influences. In communications among friends, we expect both beneficial and harmful peer influences, while in communications in extracurricular activities, we expect only beneficial peer influence. The aim of this study is to examine this difference between the peer effects from friends and from extracurricular activity members on academic outcome.

Our respondents are 7th to 12th grade students from Waves 1 and 2 of the National Longitudinal Study of Adolescent Health (Add Health), conducted by the Carolina Population Center at the University of North Carolina.

Our results show that there is a symmetric peer effect from friends. If average Grade Point Average (GPA) of the respondent's friends is higher (or lower) by 1.0, his/her GPA increases (or decreases) by .11. On the other hand, peer effects from members in extracurricular activities are asymmetric. The effect from students of GPAs higher than a respondent is .22 (for each 1.0 increment) while this effect is not significant for students with GPAs lower than the respondent.

In the argument of social capital, sharing information and getting new information are important. In strong ties and bonding social network, sharing information can be used for enforcing their norm. This may be applied to activities among friends regardless of whether their norm is beneficial or not for the respondent's academic performance. In extracurricular activities, on the other hand, new information is selected for its benefit. While communications in extracurricular activities are not weak, their characteristics are more similar to weak ties and bridging social capital in terms of utilizing new information.

### **Perceived social support and access to LGBT community resources as influential proxies of social capital on pre-exposure prophylaxis (PrEP) use for HIV prevention**

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**Introduction:** Social capital definitions are almost as complex as the underlying constructs they try to define. However, most definitions highlight potential *benefits* of social connections to

network members. Here, we operationalize social capital as proximal (perceived social support, PSS) and distal (LGBT community resources, LGBT-CR) connections that influence LGBT+ health. In this study, we investigated social resources of men, transmen, and transwomen who have sex with men, and the relations between these connections and pre-exposure prophylaxis (PrEP) use and intended use for HIV prevention.

**Methods:** We used baseline questionnaire data collected as part of the new US-national, internet-based *Together 5000* (T5K) cohort ( $n = 6,283$ ) on the use of LGBT-CR, a validated PSS scale, and PrEP use. Participants who were not currently on PrEP were recruited from geospatial sex-seeking apps from 10/2017 to 6/2018. We assessed demographic factors associated with categories of PSS—recommended average scale scores of low  $\leq 2.5$ , moderate  $> 2.5 - \leq 4.3$ , high (ref)  $> 4.3$ —and LGBT-CR usage, as well as the impacts of these two social capital measures on former (vs. no use) or intended use (vs. no intentions) of PrEP using bivariate and multivariable linear and multivariate regression models.

**Results:** The average PSS score was 4.2 (SD = 1.2; range = 1–6) and mean LGBT-RS score was 3.7 (SD = 3.7, range = 0–28). A small proportion of participants reported low overall PSS (8.3%). However, a sub-scale analysis indicated that more participants had lower perceived family support (19.1%) compared to social support from significant others (13.4%) or friends (7.8%). One-fifth of the sample reported never visiting any LGBT resources (e.g., community centers, health care providers, clubs/bars, etc.). The most frequently visited resource was a LGBT-friendly club or bar (68.1%). Several demographic factors were independently associated with PSS and LGBT-CR scores—e.g., gender and race/ethnicity were positively associated with LGBT-CR scores, while higher ages and engaging in sex work in the past 3 months were associated with low and moderate PSS ( $p$ -values all  $< 0.05$ ). Further, accessing LGBT-CR more often appeared to be protective against reporting low PSS (aOR = 0.90, 95% CI: 0.88–0.93) and moderate PSS (aOR = 0.96, 95% CI: 0.95–0.98) compared to high PSS. In terms of HIV-related health outcomes, visiting LGBT resources more often was positively associated with having a history of PrEP use (aOR = 1.06, 95% CI: 1.04–1.09) and with intentions to use PrEP in the future (aOR = 1.03, 95% CI: 1.01–1.04). Low nor moderate PSS were not significantly associated with former PrEP use, and participants with moderate PSS (aOR = 0.79, 95% CI: 0.70–0.89) were less likely to intend to use PrEP compared to participants with high PSS.

**Conclusions:** Only 8% of T5K participants reported low PSS, and 20% reported use of LGBT community resources. Having access to LGBT community resources was found to be associated with former PrEP use and intentions to start PrEP. These results suggest that improving connectedness to LGBT community resources may reduce barriers to PrEP use or intended use.

### **Personal Networks, Social Support and Upward Mobility Among Roma Immigrants in France**

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Social support has long been studied as an important determinant of individual health and well-being. Five main dimensions of social support have been considered in existing literature: emotional support, instrumental aid, companionship, financial help, and informational support. The support individuals receive in all these dimensions strongly depends on the compositional and structural characteristics of the personal networks in which they are embedded. In particular, much research has explored the role of kin and friends as support providers in general, non-immigrant populations. On the other hand, research on personal networks and social support in immigrant minorities, particularly among immigrants experiencing upward social mobility, has been limited. Social support patterns and determinants may be different between immigrants and

non-immigrants: migration may be a source of strain and conflict in social ties, lead to more social isolation, or encourage immigrants to strengthen relationships with close and extended family and friends in sending and receiving countries. This paper analyzes a unique personal network dataset to examine the factors and contexts shaping the provision of social support among Romanian Roma immigrants in trajectories of upward mobility in France. Using hierarchical logistic and negative binomial models, we investigate the characteristics of immigrants (i.e., the potential support recipients), their social contacts (i.e., the potential support providers), and personal networks (i.e., social contexts) that are associated with the provision, variety and intensity of social support. Findings suggests that Roma migrants who experience upward mobility in France are more likely to receive support from alters who are female, geographically close, older, non-coethnic, and part of their family. We discuss the policy implications of these results and their significance for the study of social support, immigrant integration, and transnational practices in immigrant minorities.

### **Personality change and social relationships in older adulthood**

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Older adulthood is a time of considerable change in individuals' social roles, and in their social relationships. Both types of changes may impact older adults at the level of their psychological traits – that is, characteristic individual differences in thought and behavior. Using longitudinal data from a national probability sample of older adults (N=2210), this paper draws upon perspectives from social investment theories, and disengagement theory, to investigate how changes in Big Five personality traits are related to changes in social roles (e.g. marriage, retirement), and social-interactive factors (e.g. network size, social support, social strain). We employ variance components models to estimate associations between changes in traits and changes in social factors. We find that changes in marital status and changes in social support are positively associated with changes in Conscientiousness, changes in number of close relatives were positively associated with changes in Extraversion, and changes in strain were positively associated with changes in Neuroticism. In some cases, associations between trait change and changes in social factors were larger among the oldest respondents. Although personality traits are highly stable in older adulthood, changes in marriage, connections to family, and social strain with contacts may all precipitate personality change, with consequences for older adults' wellbeing.

### **Physician patient-sharing networks and care coordination through the lens of the patient experience**

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There is significant promise in analyzing physician patient-sharing networks to construct indirect measures of care coordination by defining relationships between physicians based on shared patients. This approach has the potential to uncover how otherwise latent organizational aspects of health care systems impact patient outcomes. A key challenge to this approach is how the various measures used to describe these networks infer the complex realities of health care delivery. The extent of patient-sharing relationships within physician networks has been associated with care utilization, cost of care, and some measures of care quality. While this approach has been validated to signal true professional relationships between physicians from

the physician's perspective, it is unknown whether these measures reflect patients' perceptions of their own care coordination. The objective of this study is to evaluate the associations between network-based measures of care coordination and patient-reported experience measures. We linked three publicly available data sources released by Centers for Medicare and Medicaid Services (CMS) that include national data on physician patient sharing in 2015, physician participation in a group practice, and patient-reported quality performance for group practices based on responses to the Consumer Assessment of Healthcare Providers and Systems (CAHPS) Survey in 2016. The outcomes of interest were patient-reported experience measures reflecting "Between visit communication", "Clinicians working together for your care", and "Getting timely care, appointments, and information" (CAHPS). The predictor variables of interests were physician group practice density (the number of physician pairs who share patients adjusting for total number of physician pairs) and clustering (the extent to which sets of three physicians all share patients). There were 476 groups that had patient-reported measures available. Patients' perception of "Clinicians working together for your care" was significantly positively associated with both physician group practice density ( $p=0.02$ ) and clustering ( $p=0.006$ ). Physician group practice clustering was also significantly positively associated with "Getting timely care, appointments, and information" ( $p=0.005$ ). This work suggests that network-based measures of care coordination are associated with some patient-reported experience measures. Evaluating and intervening on patient-sharing networks may provide novel strategies for initiatives aimed at improving quality of care and the patient experience.

### **Probabilistic Reference Networks and Information-Theoretic Measure of Impact and Novelty in Creative Works**

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Amid the surging interest in scientific understanding of human behavior and intelligence, advanced methods and high-quality data of intellectual and creative achievements are enabling deep investigations into how creativity, an essential human faculty, crystallizes into novel knowledge and culture. To understand how they form and evolve, we characterize the interconnected nature of creativity using the concepts of novelty and influence that differentiate and connect creative achievements. Our general framework starts from the *probabilistic reference network* that compares the content of two creative works to estimate the likelihood that one referenced the other. This overcomes the following problems of classical citation networks: First, with the exception of research publications, references are not seldom explicitly given, especially in cultural creations. Second, since citations are self-reported, it is subject to incompleteness due to human bias or misinformation. Our content-based reference/influence network between creative works considers all known data of older works and also accounts for the possibility that each element of a work could have been invented or originated from unknown sources by introducing a general prior. We define information-theoretic measures of impact and novelty based on the probabilities. Applying to various data of creative works such as music (which provides precise time-ordered symbolic representation very useful for network construction and analysis), we find that a continual innovation against oneself as well as the entire field helps become an impactful and influential figure, and show that the developmental history of a creative enterprise can be visualized as a series of paradigmatic shifts in creative styles featuring novelty against the old conventions.

**Program Exposure, Centralization, Bridging, and Community Success – A Network-based Comparison Group Evaluation**Manoj Shrestha<sup>1</sup><sup>1</sup>University of Idaho

If and how networks can be manipulated to effect change has been a question of great interest to both scholars and practitioners in recent years. This paper addresses this question by applying a network-based comparison group evaluation to determine whether rural communities (villages) with program exposure seek more expansive and bridging networks with organizations compared to rural communities without the program.

To investigate the proposition, this research uses the case of rural communities in Nepal, who participated in the process of applying funds for their drinking water project (intervention) from the World Bank supported Rural Water Supply and Sanitation Program (the Program). While the immediate goal was to improve access to clean drinking water, the program also hoped that the communities will learn through this intervention and will pursue self-help development on their own. The program, by design, encouraged communities to build contacts with various organizations to secure resources or help necessary to put together a competent project proposal, and to implement the project. Those resources included finding water source, meeting regulatory compliance, securing matching fund, resolving conflicts, and getting political support. The program provided technical assistance, which included engineering support and trainings relating to project organization and social mobilization as demanded by the communities.

This research is based on a set of 125 communities from five sample districts in the Central Development Region of Nepal that took part in the application process. Out of 125 communities that applied, 62 communities were funded to implement the water project. Thus, 62 funded ones served as communities with program exposure, and the unfunded ones served as communities without the program. The data on the communities' networks with organizations used in this research was collected from the field survey of both groups of communities after two years from the time of funding. Each community, represented by the elected Water User Committee, was asked to name who they contacted and how often for different resources needed to pursue self-help development activities own their own, such as village roads, irrigation channels, school building, and community centers.

Bipartite exponential random graph models will be estimated using XPNET program available at <http://www.melnet.org.au/pnet/>. The model will include theory-driven network structures and a binary attribute, coded 1 for funded communities and 0 for unfunded communities. The attribute effect's interaction with the network structures will provide a test of the proposition whether the network structures of funded communities was different from the unfunded ones. Community size, time saving from water projects, and geographic distance will also be included to account for the priority given to the communities that were small, located far away, and had more time savings when making funding decisions on the community proposals. The preliminary results indicate that the funded communities tend to seek more expansive and bridging networks compared to the unfunded communities. This research shows how programs can be used to manipulate networks to effect or manage change. It also contributes to the development of network-based evaluation methods.

**Programmable Corpora: Towards a Combined Words/Networks Analysis of Literary Texts**Frank Fischer<sup>1</sup>, Eugenia Ustinova<sup>1</sup><sup>1</sup>Higher School of Economics, Moscow

Network analysis of literary texts has been conducted since the early 2000s. While the focus in the first decade was on Shakespeare, the past years have seen analyses of larger and more diverse

literary corpora. In our talk, we want to introduce DraCor, a new platform for the research on European drama of different times and languages that combines the extraction of rich character-based network data with underlying full texts of plays (<https://dracor.org/>). DraCor builds on freely accessible full-text corpora encoded in XML-TEI, the standard format for annotated historical sources. Yet the decisive factor of the platform is the well-documented and extensible API which makes it possible to access exactly the slice of data needed for a specific analysis (<https://dracor.org/documentation/api/>). The DraCor API offers plain CSV network data, but also richer data in GEXF format, automatically extracted from the TEI-encoded corpora. While the website previews some of the data (e.g., for Goethe's storm-and-stress play "Götz von Berlichingen", see <https://dracor.org/ger/goethe-goetz-von-berlichingen-mit-der-eisernen-hand>), the bespoke data slices obtainable via the API are much richer (e.g., combined network and quantitative data in GEXF for the same play: <https://dracor.org/api/corpora/ger/play/goethe-goetz-von-berlichingen-mit-der-eisernen-hand/networkdata/gexf>). Network data can be combined with subsets of the full text, e.g., of the spoken text per character, or even stage directions connected to the actions of characters appearing on stage. At the moment, self-maintained corpora for German and Russian are available, comprising hundreds of texts enabling a "Distant Reading" of two centuries of literary history. In addition, the freely available Folger Shakespeare Corpus with all of Shakespeare's 37 plays has been attached to the platform to showcase the feasibility. The API automatically provides all types of extracted data for any connected corpus. The addition of large corpora of dramatic texts in French, Italian, Swedish and Danish are projected for the next months. Our own research conducted on the basis of DraCor comprises studies on the automatic detection of protagonists combining network data and spoken text of characters, showing that protagonism is a rich concept calling for a rich feature vector (we introduce a formula combining 5 network-analytical and 3 quantitative measures), resulting in a data-driven typology of protagonism. Another case study was conducted on the basis of stage directions in Russian drama, which showed that within 200 years of literary history, all parts of speech within stage directions doubled, while verbs tripled, showing that characters slowly but consistently became more active on stage from the 18th century onward. Due to the size and diversity of our corpora, we could also widen the "small world" experiments applied to Shakespeare in the early 2000s. Our study on small worlds within dramatic texts shows inherent structural changes as regards character constellation throughout two centuries and added an angle of large-scale analysis that was hitherto infeasible in literary studies. Apart from our own case studies, DraCor as a host for "Programmable Corpora" provides reproducible network and text data to the community. It seeks to help pave the way forward to foster interdisciplinary research on literary texts.

**Programme de sensibilisation à la santé cardiovasculaire : portrait et mobilisation des réseaux sociaux des résidents pour soutenir la mise en œuvre d'un programme dans les logements subventionnés**

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L'étude présentée porte sur les influences des relations de voisinage sur la participation à un programme de prévention et de gestion des maladies cardiovasculaires actuellement mis en œuvre dans des logements sociaux subventionnés pour aîné-e-s. L'objectif principal du Programme de Sensibilisation à la Santé Cardiovasculaire (PSSC) est de réduire l'impact des maladies cardiovasculaires sur la santé des aînés. Il a été démontré que le PSSC a réduit les hospitalisations liées aux MCV sans coûts supplémentaires pour le système de soins de santé.

Le PSSC est actuellement offert chaque semaine dans les salles communautaires de logements sociaux subventionnés pour personnes âgées au Québec, et jusqu'à présent, les taux de participation entre les immeubles varient de 18,3 % à 43,6 %. L'une des hypothèses partagées par les chercheurs et les responsables des logements subventionnés pour expliquer cette variation réside dans le fait que les dynamiques relationnelles entre les locataires peuvent avoir une influence sur une participation faible ou élevée au programme.

L'analyse de réseaux sociaux a fait ses preuves dans l'exploration, le maintien et l'amélioration de la mise en œuvre de nombreux programmes de santé, en améliorant notamment les interventions en réseaux. Cependant, en raison de ses difficultés de réalisation (contraintes de temps et nombre de personnes à interviewer), l'analyse de réseau complet des participants aux programmes est souvent mise de côté.

L'objectif de l'étude proposée est de dresser un portrait de la dynamique relationnelle de deux bâtiments, qui représentent les cas extrêmes en termes de participation, afin de voir si ces dynamiques peuvent expliquer les différences de participation au programme. La présentation décrira la méthode d'analyse de réseau basée sur des questionnaires sociométriques (réseau complet), complétée par une analyse qualitative. Les résultats seront présentés en deux étapes : 1) les résultats quantitatifs, tels que le nombre et la force des liens (densité, centralité, intermédialité) ainsi que les types de soutien, et 2) les résultats qualitatifs illustreront comment des relations conflictuelles au sein des immeubles, mais aussi des stratégies de proximité et de distance mises en place entre voisins, peuvent expliquer les différences de participation. Discussion : analyser les relations interpersonnelles pourrait compléter la compréhension des influences des interactions sur l'adoption de nouveaux comportements ou, plus spécifiquement, sur la participation des personnes au PSSC. Identifier les conditions optimales pour que le PSSC devienne une initiative durable, et adaptée à différents contextes, implique de prendre en compte les dynamiques relationnelles de voisinage lors de sa mise en œuvre.

### **Promoting Adolescents Physical Activity through Social Network Interventions**

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Keywords: physical activity, adolescents, media interventions

#### Background

Adolescents are not sufficiently physically active. Previous attempt to promote physical activity via media interventions have been shown to have little effect. Potentially, interventions can be more effective when utilizing the impact that adolescents have on each other's physical activity. Social network interventions are an emerging and promising approach to counteract the decline in physical activity, by capitalizing on the influence peers have on youth's behaviors. In social network interventions, a small group of influential individuals (influence agents) is selected to promote health behaviors within their social network. However, no previous social network intervention study has investigated whether a social network intervention is more effective than a mass media campaign or no intervention.

#### Method

Adolescents (N = 446; Mage = 11.35, SDage = 1.34; 47.31% male) were randomly allocated by classroom (N = 26) to one of three conditions: social network intervention, mass media intervention or control condition. In the social network intervention, 15% of the participants was selected to be an influence based on peer nominations (on closeness centrality) and were asked to create several vlogs about physical activity. During the intervention period, participants in the social network condition were able to view the vlogs on a research smartphone. In the mass media intervention, participants were exposed to vlogs made by unfamiliar peers (i.e., the vlogs

of the social network intervention). All participants received a research smartphone to complete questionnaires and a wrist-worn accelerometer to measure physical activity.

#### Results

Mixed effect models were used to account for the clustering of data per participant, per day, and per classroom. The analyses showed that there was an overall increase in physical activity during the intervention. However, no differences were observed between the social network intervention and the control condition in the short-term, and an unexpected increase in the control condition compared to the social network intervention in the long-term. Also no differences between the social network intervention and mass media intervention were observed.

In addition, exploratory analyses suggest that descriptive norms involving physical activity increased in the social network intervention and decreased in the mass media intervention. Also, participants in the social network intervention watched the vlogs more often and for a longer period, than participants in the mass media intervention that.

#### Conclusion

The current study was the first study to test the additional benefit of implementing a social network approach to promote physical activity in adolescents by comparing a social network intervention to a mass media intervention and no intervention. The results do not provide evidence that the social network intervention was more effective in increasing physical activity in adolescents. Compared to other social network interventions, the current study did not train the influence agents on how they could promote physical activity in the class, but merely showed them how they could create vlogs. Perhaps, a key factor to the effectiveness of social network interventions is a training of the influence agents.

### **Promoting Social Networks to Reduce Sedentary Behavior in Low-Income Parents with Pre-school-aged Children**

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This study tests whether social ties were associated with differences in parents' daily physical activity and sedentary behavior over time as a result of a health promotion intervention. We hypothesized that parents who formed at least one social tie with an intervention participant would engage in more daily physical activity and less sedentary behavior compared to parents who did not form a tie, after controlling for participant covariates, including randomization status and relevant demographics. With a 3-year follow-up duration, Growing Right Onto Wellness (GROW) was the longest obesity prevention randomized controlled trial in underserved preschool-aged children. The GROW intervention strove to build new social connections among study participants by using social network diagnostics to guide the intervention implementation and to intentionally create peer-to-peer interaction to spread new behaviors within small groups of parents. The intervention promoted healthy lifestyle behaviors including increasing physical activity and decreasing sedentary behavior through three intervention phases: (1) the intensive phase delivered in a group format where small, consistent groups of parents met weekly for 12 90-minute sessions over 3 months (ended at 3 mo timepoint); (2) the maintenance phase that

included monthly phone-call coaching (ended at 12 mo timepoint); and (3) the sustainability phase that included cues to action to use the surrounding built environment for health (ended at 36 mo timepoint). Social network and health behavior data were collected at baseline, 12, and 36 months from 610 low-income parents participating in the trial. A network survey was used to identify the social ties among adult study participants at each timepoint (“Please provide the names of up to 7 people you know and talk to from GROW”). ActiGraph GT3X+ accelerometers were used to measure physical activity and sedentary time. Matthews’ validated cut points were used to define moderate-to-vigorous physical activity (MVPA) (>2100 counts/1 min), light physical activity (>100 to ≤2100), and sedentary behavior (≤100) for adults. Longitudinal regression analyses tested effects of social ties on parents’ physical activity and sedentary behavior. Compared to participants who did not have a social tie, having a tie to an intervention group participant was associated with a statistically marginal and clinically meaningful 11.04 min/day (or approximately 77.28 min/week) decrease in adult sedentary behavior (95% CI [-22.71, 0.63],  $p=0.06$ ) during an observation period of 3 years. Although not statistically significant, parents with a tie to an intervention participant may have shifted 7.86 sedentary minutes to light-intensity physical activity (95% CI [-2.10, 17.82],  $p=0.12$ ) and 3.26 sedentary minutes to MVPA (95% CI [-1.77, 8.28],  $p=0.20$ ). Forming a social tie to an adult participating in a pediatric obesity prevention intervention may reduce sedentary behavior. Future behavior change interventions should leverage social ties to elicit and sustain reduction in sedentary behavior.

### **Protest Repertoires and Digital Interactions in Dynamic Semantic Networks: A Case Study of the Candlelight Protests of 2008 in South Korea**

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This study examines digital interactions through the configuration of semantic networks that occurred during the first month of the 2008 Candlelight Protests in South Korea. There have been few works investigating the dynamics of digital interactions after their aimed street gatherings are launched. The lack of such research has left unexplained how digital interactions incorporate contingencies arising from events in the streets unexplained. To bridge this gap, this study focuses on the transformation of the protest repertoire of the Candlelight Protests that emphasized the observance of the Assembly and Demonstration Act (ADA). Dividing the studied first month of the Candlelight Protests into three periods based on government reactions to street gatherings, the author carries out dynamic semantic network analysis to trace forward paths from the focus term of illegality, which was often discerned to identify potential violations of the law. Defining digital interaction as the thread created by an initial post and the subsequent replies accrued over time, terms that appear together within and across digital posts are extracted as nodes that are linked to each other. To reflect the fact that digital interactions on similar topics can take place simultaneously through different threads on a digital platform, the posts are timestamped in chronological order. The goal of this semantic analysis is to specify link terms that connect other terms back to the focus term of illegality.

The findings are as follows. Firstly, the legality discourse remained cogent throughout the entire month as a yardstick used in participants’ recounts to verify whether the Candlelight Protests were developing without violating the ADA. Secondly, the consistent presence of the focus term of illegality was rearranged with link terms that stressed the experiences of a specific age cohort, which shares the collective memory or firsthand experience of high-risk democratization movements in the 1980s. These newly-inserted recounts provoked discussions over digital media users’ vulnerability to illegal behavior, both as crowds in the streets and as individuals on digital platforms. Thirdly, changes identified in semantic networks were not always triggered by the

reactions of the state. Rather, digital interactions resurfaced experiences of past protests and led the discussion to what collective actions should look like and how such expectations should be met in digital interactions and institutional settings that are already in place. Lastly, this study highlights that semantic structures are highly sensitive to communicative contingencies.

### **Proximity Exposure in a Social Network and Adolescent Smoking**

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**Background:** Adolescent peer influence for tobacco smoking is a dynamic process affected by both close friends and other network peers. In addition to close friendships, various network positions can be highly influential on risky behaviors such as smoking. The aim of the current study was to introduce proximity exposure (Ep) as a novel concept of exposure to peer influence.

**Methods:** Through a retrospective analysis of the Teenage Friends and Lifestyle Study dataset, 160 adolescents (mean age 13 years) from Glasgow (Scotland) were followed with friendship ties and health behavior assessments at 3 waves (1 year intervals). The current study analyzed data for Waves 1 and 3. Within the framework of network exposure model (Valente, 1995), Ep was operationalized as a peer influence and measured with a closeness adjacency matrix that is multiplied by an alter's smoking status (represented by a vector) and divided by row-normalized Ep. Following simple logistic regression models, generalized structural equation modeling (GSEM) with Bernoulli logistic regression was conducted for a cross-lagged model in order to test the effect of proximity exposure level on smoking behavior over time, considering peer selection and controlling for the effects of popularity (in-degree centrality) and exposure based on cohesion (i.e., one's direct exposure to smokers). In GSEM, we computed unstandardized regression coefficients with continuous outcomes and odds ratios dichotomous outcomes (i.e., smoking behavior). GSEM also controlled for age, gender, having smokers at home, and amount of pocket money that adolescents receive from parents for school.

**Results:** Among nonsmokers who lack any cohesion exposure (n=79), proximity exposure at Wave 1 was significantly associated with smoking initiation by Wave 3 (OR=1.76, p=0.002). With GSEM (n=160), controlling for the socio-demographic factors, the measures of interest at Wave 1, and covariance between exposure measures, our results showed a significant relationship between proximity exposure at Wave 1 and smoking by Wave 3 (OR=1.31, p=0.012). There was no significant relationship between smoking at Wave 1 and proximity exposure by Wave 3 (B=0.88, p=0.118). On the other hand, it is smoking at Wave 1 that predicted more cohesion exposure (B=18.19, p=0.037), and less popularity (B=-0.38, p=0.024), by Wave 3. Cohesion exposure at Wave 1 (OR=1.00, p=0.807) and popularity at Wave 1 (OR=1.59, p=0.281) did not predict smoking by Wave 3.

**Discussion:** This study longitudinally examined peer influence in terms of network proximity, by applying the proximity exposure measure Ep. Nonsmokers with initial lack of cohesion exposure still initiated smoking as a result of proximity exposure. Supportive of peer selection, early adolescent smoking predicted more direct exposure to other smokers through cohesion and less popularity by Wave 3. On the other hand, supportive of peer influence, proximity exposure predicted future smoking behavior. These results can be further examined with exponential random graph modeling, in order to account for other changes in certain structural properties in the network. In practice, with the current results in mind, researchers may consider developing interventions that aim to lower proximity exposure among adolescent nonsmokers with high proximity exposure in order to prevent smoking initiation.

**Quantifying layer similarity in multiplex networks: a systematic study**Piotr Bródka<sup>1</sup>, Anna Chmiel<sup>2</sup>, Matteo Magnani<sup>3</sup>, Giancarlo Ragozini<sup>4</sup>

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Computing layer similarities is an important way of characterizing multiplex networks because various static properties and dynamic processes depend on the relationships between layers. In our work we provide a taxonomy and experimental evaluation of approaches to compare layers in multiplex networks. Our taxonomy includes, systematizes and extends existing approaches, and is complemented by a set of practical guidelines on how to apply them.

First, we propose the new notation for multiplex networks called property matrix which allows us in a simple and unified manner to calculate all known measures for multiplex networks. Next, we enumerate various approaches to calculate layer similarity grouped into three categories: (i) comparing global/aggregated layer properties like network diameter, (ii) comparing measures distributions between layers like degree distribution, and (iii) comparing properties of individual structures like nodes or edges. Finally, we experimentally evaluate fifty different measures using twenty-three real world multiplex networks.

From our literature study, theoretical framing and experiments it appears how layer comparison measures can be very valuable and often succeed in practice to characterize the structure of multiplex networks, but they are not always straightforward to use. Therefore, we list a set of guidelines motivated by our experience acquired while testing these measures. Some of them are mentioned below.

The number of available measures is very large, considering that the fifty options used in our experiments are only some of the measures we can obtain using different combinations of property matrices and observation functions. While the choice of the measures to be used for a specific empirical network is of course influenced by what the analyst is interested in, e.g., degree-based similarity, betweenness-based, or specific motifs that are motivated by the application context, our experiments show that different measures highlight different types of similarities.

When comparing layers by comparing a single value, particular attention should be paid to the so called discriminative power or uniqueness of the measure, i.e., the capability of a measure of taking different values on non-isomorphic networks. For example, while mean is not a representative measure for non-regular distributions, it can still be used to compare two distributions, such as degree distributions. But not alone, because the same degree does not imply the same topology.

While aggregation like MIN can be useful in general to characterize a distribution if used together with other statistical summaries, it does not appear to be very useful to compare layers where there is typically at least one node having value 0. For example, min degree is 0 for all layers for most networks. On the contrary, max can be useful, e.g., to include the size of the layers in the comparison.

What is more our framework captures several measures appeared in the literature: node activity overlapping, global overlapping of edges and absolute binary multiplexity are just applications of the Russel-Rao function to node and edge existence property vectors, while, average edge overlap can be the Jaccard or coverage functions applied to edge existence.

### **Race or Status? The Role of Racial Homophily and Status Hierarchies in Shaping Negative Relationships in a Racially Diverse School**

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<sup>1</sup>Northeastern University, <sup>2</sup>Fachhochschule Potsdam, <sup>3</sup>Duke University

Race is arguably the most salient social divide in the US and many other ethnically diverse societies. Individuals attach meanings to racial characteristics and establish racially homophilous social relationships that tend to reinforce those meanings. Classic theory and recent advances in the research on negative ties suggest that status struggles play a crucial role in the formation of enmities. Individuals generally strive for positive attention from peers, and these relational processes frequently lead to rejection by and conflict with peers. What is less clear is how racial homophily and status hierarchies influence the flow of negative emotions in a population? To address this question, we use a unique longitudinal sample of a magnet school located in the southern US that consists of near equal numbers of white and black students. These data offer a quasi-experimental setup where race and class are less correlated, allowing us to better isolate the effects of racial homophily on the emerging social structure from the effects of class. Also, the nearly equal proportions of black and white students allow us to look at how categorical homophily affects status struggles and the formation of negative relationships in a diverse social setting, a setting that differs in important ways from more frequently studied single-race and white-majority schools.

We model both status hierarchies and dislike relationships, finding that: (1) Students tend to build parallel status elite structures within their own racial subgroups, rather than between them. (2) Cross-racial overtures are more likely to be punished, and the people who make them are more likely to occupy lower status positions in both racial groups. (3) Further, there is a positive association between cross-race friendship overtures and receiving dislikes, although this association is only significant for whites. (4) In terms of the relative importance of race compared to peer standing, struggles around social rank within cohesive racial subgroups better explain the overall pattern of dislike relationships. Our findings support Gould's (2002) model that hypothesizes that the rejection of friendship overtures by similarly ranked or -slightly-higher ranked alters leads to the devaluing of the social attachment.

We conclude with theoretical extensions from our findings, particularly focusing on the integration of studies on race relations and status theory in social networks.

### **Reducing acquired seizure disorders in Northern Peru: The influence of social networks on parasite prevention behavior**

Angela G. Spencer<sup>1</sup>, Lynne C. Messer<sup>1</sup>, Michelle Beam<sup>2</sup>, Ruth Atto<sup>3</sup>, Lauralee J. Fernandez<sup>1</sup>, Percy Vilchez<sup>3</sup>, Ricardo Gamboa<sup>3</sup>, Claudio Muro<sup>3</sup>, Hector H. Garcia<sup>4</sup>, Seth E. O'Neal<sup>1,3</sup>, for the Cysticercosis Working Group<sup>3</sup>

<sup>1</sup>School of Public Health, Oregon Health & Science University – Portland State University, Portland, OR, United States, <sup>2</sup>School of Medicine, Oregon Health & Science University, Portland, OR, United States, <sup>3</sup>Center for Global Health Tumbes, Universidad Peruana Cayetano Heredia, Lima, Peru, <sup>4</sup>Department of Microbiology, Universidad Peruana Cayetano Heredia, Lima, Peru Background.

In Northern Peru and other regions worldwide, the combination of free-roaming pigs, outdoor defecation, and presence of pork tapeworm (*Taenia solium*) creates the conditions for endemic levels of debilitating neurological infections. Brain infection with this zoonotic parasite (neurocysticercosis [NCC]) causes an estimated 30% of acquired epilepsy in low- and middle-income countries, a disease burden which is entirely preventable. Infection risk can be reduced by behaviors including latrine use, handwashing, and careful pig raising and pork consumption

practices. Social networks are key to initiation and maintenance of protective behaviors, and influence social norms related to pork consumption, hygiene, sanitation, and stigma associated with infection. Especially in low-resource environments, where public health systems face lack of funding and infrastructure, social networks play a critical role in health promotion. However, the role of social networks in promoting behaviors to prevent NCC is unknown. The objective of the work reported here is to determine how social networks and norms of Northern Peruvian villages are associated with risk-reducing behaviors for human and pig infection, and how these norms and behaviors change over time.

#### Methods.

We collected longitudinal egocentric network data from adult heads-of-households in seven rural villages at baseline, 4 months, and 8 months, which we used to construct the personal network environment for participants (egos). There were 419 participants at baseline. Egos responded to a name-generating prompt, modified from the General Social Survey, to establish network alters and their relationship to egos. Egos were also asked about frequency of ego-alter interaction, informational exchanges related to NCC prevention, ego's knowledge of tapeworm transmission, and ego's recent prevention behaviors. In multilevel logistic regression models, knowledge of the parasite transmission cycle and prevention behaviors are predicted as a function of social network characteristics, adjusted for covariates gender and education level, and clustered at the village-level.

#### Results.

At time 1, mean age of respondents was 48.4 (range 18-95), and 66% of were female. At least one alter was reported by 97% of egos; 50% identified at least three alters; and 11% identified at least five alters. Only 3% reported 6 or more alters. Time 2 and 3 data have been collected and data entry recently completed, therefore are not included in this abstract. There were 360 egos who participated in all three data collection points. The relationship between baseline, time 2, and time 3 social network characteristics and knowledge and health behaviors will be presented at this conference session. We will also describe the stability of participants' social networks over time.

#### Discussion.

The long-term goal of this research is to investigate the social drivers of individual and collective behavior change for prevention and control of NCC in a rural low-resource region of Peru. This research will provide new information about the usefulness of social networks as predictors and influencers of infectious disease knowledge and prevention behaviors. Understanding how the social environment affects peoples' knowledge and behaviors will inform the development of future community-based NCC interventions that leverage network influences.

### **Regional Differences in Board Network Structures**

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<sup>1</sup>Mälardalen University

This paper looks at board networks in Sweden and compares the network structure in the northern parts of the country with the network structure in southern parts. The different conditions of these regions could affect the way networks of interlocking directorates form, which in turn could affect the opportunities and resources reachable for the companies. Potential implications include conditions for entrepreneurship, growth and innovation.

The northern part of Sweden, with the two counties Norrbotten and Västerbotten, accounts for widespread and varied geography. Distances are generally large; both between cities and in the large areas sparsely populated. Northern Norrbotten to southern Västerbotten extends 800 km,

roughly  $\frac{1}{2}$  the length of Sweden. They account for  $\frac{1}{3}$  of the area, and  $\frac{1}{20}$  of the population. The region is considered to have strong traditional industries, based on natural resources.

As a contrast, the Mälardalen (Mälaren Valley) region, surrounding the lake Mälaren is considered a central, concentrated and vibrant region; extending west from the capital Stockholm. Five counties (Stockholm, Uppsala, Örebro, Södermanland and Västmanland) together account for  $\frac{1}{3}$  of Sweden's population, but only 7.5% of its area. Here distances are small, with the longest distances being around 350 km, and many cities being within commuting distance. The business in Mälardalen is considered dynamic, innovative and high-tech, with companies in IT, automation and robotics.

The embeddedness of a company in a network of others is a factor influencing its access to competence, information, resources and opportunities. Marketing and innovation are two fields that have shown the importance of networks. Board networks are substantial and formal types of networks, formed by interlocking directorates: a person that is a member of two companies' board of directors links the two companies and enables the flow of information, influence and practices.

The study uses a unique dataset capturing the complete board network structures in Sweden for a 10-year period. Using Social Network Analysis, structural characteristics at a network level and positional variables at a company level are calculated. This enables analysis and comparison of the board network in the two regions, but also their development over the last ten years.

Among the aspects included in the analysis are: clustering, density, coherence, small-world characteristics, authorities and centrality distribution.

The regional dimension of board network structures have previously not been studied, and this exploratory study is thus the first attempt to investigate the existence of differences and in which aspects the differences appear. A tentative discussion of potential effects of differences is also included in the paper.

### **Rehab-Recovery-Relapse: Exploring Multiplex Network Models to Explore Addiction**

Benjamin Ortiz Ulloa<sup>1</sup>, Andreia Sofia Teixeira<sup>2</sup>, Iulia Martina Bulai<sup>3</sup>

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Network models have been successfully used to understand concepts in epidemiology and game theory. This is due to the fact that if we can understand relationships in a system, then we can reasonably predict how the state-change of one actor affects the others within a system. A historical example of this phenomenon can be seen in SI(R) models in which an infected actor can pass on an infection to connected actors. Another example can be found in the literature of social consensus - ideas and opinions spread within a network dynamically.

Many of these network models primarily focus on the state of the agents and only consider relationships as a vehicle to pass on infection or information. However, relationships can also contain their own states. In real world systems, the relationships two actors can have with one another can take on many different forms. For example, two actors connected within a social system can have a friendly, antagonistic, or even neutral relationship. The context provided by the state of a relationship can be featured in many network models and can have strong effects on how information or emotions spread throughout a system.

Another example of the importance of relationships and their context is the utility of defining the type of connection two actors have with one another. In social networks, actors can be connected by a shared work place, a shared social club, or even a shared online platform. Once we understand that agents can have different types of relationships we can quickly see that a single agent can belong to multiple different communities.

In this paper we will explore the concept of relationship states and types to create a network model we call the “Rehab-Recovery-Relapse” cycle. This model explores a system where actors have an opinion on drugs, change these opinions according to the positive/negative relationships of their neighborhood, and can be placed into a new system if their opinions of drugs drives them to actually use drugs. The goal of this paper is to understand how a dynamic temporal multi-graphs can be used to model real world systems.

#### **Relational Event Models for Diary Data.**

Mark Tranmer<sup>1</sup>

<sup>1</sup>University of Glasgow

In this talk, I outline some ideas for the quantitative analysis of networked diary data. I will focus on the potential of the Relational Event Model (REM) for identifying patterns in the frequency and nature of appointments between major political figures, and their contacts - within and between their respective organisations. The data are from the UK, and are historical, from the 1960s to the 1980s. I will discuss various aspects of data preparation, given the nature of the original data, and the need to transform it into a suitable format for analysis with the REM. I will describe some initial thoughts on the REM specification given the substantive research question and the nature of the available data. I will discuss some preliminary results.

#### **Representativeness and Generalisability of Inference for Exponential-Family Random Graph Models from Samples of Networks**

Pavel N. Krivitsky<sup>1</sup>, Pietro Colletti<sup>2</sup>, Niel Hens<sup>2</sup>

<sup>1</sup>University of Wollongong, <sup>2</sup>University of Hasselt

Joint modelling of large samples of networks collected from similar settings—classrooms, households, etc.—has a long history, with a variety of methods available to pool information in model estimation and inference. In the exponential-family random graph modelling framework, these methods range from post-hoc two-stage meta-analyses to sophisticated multilevel approaches. However, relatively little attention has been devoted to the generalisability of this inference, especially when the sample of networks is effectively a convenience sample, and when the population of networks is heterogeneous in size and composition.

We consider two samples of within-household contact networks in Flanders, Belgium, which used very similar survey instruments but very different sampling designs: 1) a sample of 318 households, selected based on having children 12 years of age and under, for which the dyad census has been observed, and 2) a generally representative sample of 1265 households from the region for which only contacts incident on one respondent were observed. By applying the principles of model-based survey sampling inference, we propose to combine the strengths of the two datasets, while making explicit the assumptions previously left implicit in this type of analysis. Our approach allows us to borrow concepts and diagnostic tools from generalised linear modelling to produce parameter estimates that are meaningful and generalisable to the entire population of networks, while allowing complex within-network dependence to be represented.

#### **Resilience and social structure in mexican agricultural research institutions**

Juan-Felipe Nuñez<sup>1</sup>

<sup>1</sup>Colegio de Postgraduados

Social resilience is a multi-organizational and communitarie process that involves innovation, support, protection and recovery capacities, of different actors: individuals, communities and institutions when facing crisis. The resilient capacities of the mexican agriculture research institutions are susceptible of being analyzed by the social network analysis. Here we present the

case of Colegio de Postgraduados (an historical institution at México), as an experience of academic linkage capable of expressing its resilient capacity degree. This analysis was made involving 86% of the academic staff of this institution. The data analyzed corresponded to the collaborative and academic activities, each of one were indicated by each researcher. This information was analyzed with social networks approach obtaining valuable information about the real capacities of this institution to be resilient and capable (or not) to face the new challenges that are coming with the climate change. An experience that perhaps could share important lessons to others institutions at Latinoamerica.

**Revisiting the inner circle arguments from a multilevel perspective on the corporate elites: The case of France**

Catherine Comet<sup>1</sup>

<sup>1</sup>Université de Lille

To identify members of the inner circle, scholars usually select the interlockers who have at least two or three directorships. Indeed, interlockers are shown to be the most likely to stand at the leading edge of business political activity in the US and the UK (Useem 1984). But there are other indirect signs associated with inner-circle identity. Useem indicates two of them. The first sign is to have taken an active part in programs designed to introduce business-oriented curricula into the schools. The second sign, related to the inner-circle core, is to have been consulted by seniormost government officials about candidates for appointment to the major advisory bodies or top administrative positions. Drawing on these observations, I focus on the trajectories of corporate leaders who become state experts. These actors are considered as boundary spanners who succeed in getting high status at several distinct levels. Their multilevel status enables them to appear as legitimate to participate in policy making. The analysis of various major advisory bodies in France is used to illustrate these arguments. This abstract is related to Corporate Networks.

**ScamCoins, S\*\*\* Posters, and the Search for the Next Bitcoin™: Collective Sensemaking in Cryptocurrency Discussions**

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In the last year, cryptocurrencies have attracted massive attention from investors, institutions, and the general audience. The public notoriety of Bitcoin, with its sizable price increase, led to an explosion of attempts to create the next Bitcoin. Thus, a number of cryptocurrencies, often referred to as altcoins, and a vibrant set of exchanges have emerged due to the low cost required to create or mutate a new coin, with some being minimal changes to parameters and branding of a pre-existing codebase. While many of these altcoins did not offer any new technological advancement, there have been some successful attempts in creating new cryptocurrencies that offered either significant technical innovation over the existing technology or introduced a wholly new idea (e.g. Peercoin or Ethereum). Given the abundance of new coins, it is natural to ask how well do traders detect cryptocurrencies that offer genuine technological innovation and are likely to succeed? A related question is whether the cryptocurrency community is attempting to collectively analyze and make sense of this large array of altcoins or is it simply engaged in hype-based speculation?

We use an empirical approach to assess whether and when the discussions of cryptocurrencies are truth-seeking or hype-based. We rely on a novel data set that combines measures of the main online forum discussion around cryptocurrencies with their price and volume history in exchange

markets. Leveraging the literature on finance, we assume treat price volatility as an indicator of information uncertainty around the technological innovation of the cryptocurrency. Similarly, drawing upon collective intelligence literature and using three measures of experience, information diversity and (equal) community participation, we quantify the extent to which the community discussion exhibits characteristics of collective sensemaking.

Our results indicate a negative correlation between the quality of discussion measured in terms of collective sensemaking and price volatility of the coin suggesting that for more serious coins, discussion is more likely to serve a truth-seeking role. Coins with more information available have equal participation by experienced contributors to the discussion and more diverse opinions measured in terms of access to other information sources. In contrast, coins with high information uncertainty tend to be discussed by less experienced and more narrowly focused users. We replicate the same results using an objective measure of technicality as a second operationalization of information uncertainty around the crypto coin. The content analysis of the forum also reveals that the discussion of more innovative coins is more focused on the design and technical aspects. These results suggest that there are people in the cryptocurrency community who are mainly driven by market hype and view cryptocurrency as an investment, while others are dedicated to the technological advancement of the cryptocurrency ecosystem and view Bitcoin and its variants as a legitimate currency.

Finally, we hypothesize that the same discussion patterns may also be present in other forms of social media. To filter out hype, fake news, and similar noise, one can simply look for characteristics of collective intelligence in the discussion surrounding the news item.

#### **School-based friendships and sexual health: analysis of data from STASH, a social network based intervention trial**

Chiara Broccatelli<sup>1</sup>, Mark McCann<sup>1</sup>, Ross Forsyth<sup>1</sup>, Lisa McDaid<sup>1</sup>, Sharon Simpson<sup>1</sup>, Kirstin Mitchell<sup>1</sup>, Laurence Moore<sup>1</sup>

<sup>1</sup>MRC/CSO Social and Public Health Sciences Unit, University of Glasgow

School year groups are a stable ecosystem in which adolescents' interactions occur and attitudes are shaped. These connections vary in number, strength, trust, and reciprocal expectations. Friendship ties can also influence the acceptance of social norms, i.e., unwritten rules on how to think and behave that are approved by their peer group. Exploring the importance of peer influence and peer selection effects in shaping perceived social norms and behaviours is particularly relevant for sexual risk reduction interventions in public health that attempt to promote positive mental and physical health. The present peer-led intervention study "STIs And Sexual Health' (STASH)", built on approaches used in a previous anti-smoking intervention (ASSIST). STASH aimed to reduce risk of sexually transmitted infections by identifying influential peer supporters, nominated by their year group (aged 14 – 16) and training them to promote positive sexual health and relationship messages to their peers face-to-face and through Facebook-mediated messages. We used a Stochastic Actor-Oriented Model to analyse network data and sexual behaviours of adolescents (n = 618); 82 percent sample response rate, from six schools in Scotland (UK). Data on friendship ties and behaviours were collected at baseline and after the intervention was concluded. Network school sizes varied from 53 to 189 alumni. First, we were interested in understanding how adolescences' friendships influence each other sexual behaviours and attitudes and the extent to which there is a similarity-attraction effect among them. Second, we sought to assess whether the recruited peer supporters (n = 91, 12 percent of the year group) influenced the diffusion of sexual-risk knowledge and the adherence to positive sexual attitudes among their friends. The presentation will focus on the expected outcomes of the intervention, including assessing the contribution of peer-leaders in spreading positive messages

to their friends and understanding the general tendency of adolescences to conform to the behavioural norms of their peer group.

### **Schools-based peer-led social support intervention on STIs and Sexual Health (STASH):**

#### **Intervention Feasibility Trial Results**

Laurence Moore<sup>1</sup>, Kirstin Mitchell<sup>1</sup>, Carrie Purcell<sup>1</sup>, Ross Forsyth<sup>1</sup>, Julia Bailey<sup>3</sup>, Sarah Barry<sup>5</sup>, Chiara Broccatelli<sup>1</sup>, Lawrie Elliott<sup>2</sup>, Rachael Hunter<sup>3</sup>, Mark McCann<sup>1</sup>, Lisa McDaid<sup>1</sup>, Sharon Simpson<sup>1</sup>, Kirsty Wetherall<sup>4</sup>

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#### **Background –**

Young people in the UK are at highest risk of STIs and report higher levels of unsafe sex than any other age group. Schools are well placed to reach young people at risk, and peer-led approaches within school offer potential to shift norms and attitudes. However, the evidence for peer-led versus teacher-led approaches is equivocal. To date, the potential of school-based peer supporters utilising social media to improve sexual health, has yet to be explored.

#### **Description of the intervention –**

The school based ‘STASH’ (STIs and Sexual Health) intervention makes use of social media and face-to-face interactions between nominated ‘Peer Supporters’ and their wider year group to diffuse information, norm change and provide social support for healthy sexual behaviour among their peers.

The intervention is delivered for and by 14-16 year old pupils over a 5 or 10 week period. Influential ‘Peer Supporters’ are recruited using a questionnaire administered to the whole year group. Those selected as influential and agreeing to the role (circa 15%), receive two days training on key sexual health messages and communication skills. ‘Peer Supporters’ register on the STASH website (a resource with memes, links, infographics etc) and are encouraged to link the website to their Facebook page, sharing content with their friends via a ‘Secret STASH group’.

Diffusion of innovation suggests that over time novel ideas and behaviours spread through members of a social system via communication channels. In STASH, peer supporters serve as ‘early adopters’ or innovators’. The theory suggests that because they are selected by members of their social system as trustworthy and credible, they have potential to: act as models of change; ‘sell’ the relative advantages of healthy sexual behaviour; and help create an enabling social environment to support behaviour change and adoption of positive sexual norms (norm change). STASH is a feasibility study, which seeks to test whether this theory is borne out in practice, and examines the feasibility of the intervention, its acceptability to target group and key stakeholders, and the feasibility of a subsequent larger scale evaluation.

#### **Scope of the proposed presentation –**

We will present results of the feasibility study which included (i) a process evaluation to assess implementation, reach, mechanisms of impact and context and (ii) baseline and follow-up measurement of sexual health knowledge, attitudes and behaviour. This will be the first public presentation of results. Early findings indicate that the intervention was acceptable, with the peer supporters being active in their role both on line and in personal conversations. The data indicate that STASH satisfies the pre-set criteria for the research to move onto the next stage, a full scale evaluation study.

**Semantic network analysis of the satanic milieu in the Russian social network “Vkontakte”**Oxana Mikhaylova<sup>1</sup><sup>1</sup>National Research University Higher School of Economics

In the Russian social networks now there are many communities, which could be characterized as belonging to the satanic milieu. These communities have more than thousands of subscribers. Danish sociologist of religion A. Petersen argued that satanism should be understood as a field which consists of different discourses: rationalistic, esoteric and reactive. Among these three ideal types only reactive satanism represents the explicit intentional sometimes aggressive rebellion against Christianity. In the spring of 2018 the representative of the Russian Security Council argued that Russian Internet was flooded by satanic destructive cults and that we had to save Russian youth from the influence of the dangerous ideologies. The protection of Russian youth from the satanism presumes the blockage of communities that seem suspicious. In the European history there was satanic moral panic, so that we supposed that probably not all communities which call themselves satanic are – reactive. However, to understand which communities represent what type of satanism we need the indicators which could help us to distinguish between satanic groups which are aggressive and which are not. For that purpose, we conducted semantic network analysis of the groups which represent three types of satanism suggested by Petersen. The results of the study could be used for the automatic analysis of big volumes of satanic discourse.

**Senders and Sinks: Modeling the transmission of job attitudes in an organization's email network**Jesse Fagan<sup>1</sup>, Giuseppe Labianca<sup>2</sup><sup>1</sup>University of Exeter, <sup>2</sup>University of Kentucky

We study how job attitudes, such as job satisfaction, job insecurity, and organizational commitment, are transmitted among between individuals through email communication. We combine longitudinal psychometric surveys with the content of millions of email messages exchanged between organizational members to train machine learning models to identify different linguistic signatures that can predict job attitudes. Initially expecting that messages personally written by each subject (i.e., sent messages) would be most predictive of the employees' responses on the surveys, we instead find that for many subjects the messages they receive (i.e., received messages) provided a better model of job attitudes. We use our models to then impute the net effect of each dyad in the network and classify individuals as either net senders ("influencers) of job attitudes to others or net sinks ("absorbers") of job attitudes in the network. We then analyze other sources of available data to develop a theory of individual differences to which explains why individuals are either attitudinal senders or sinks.

**Sexual network structure affects direction of HIV virulence evolution with increasing treatment coverage**Sarah E Stansfield<sup>1</sup>, Joshua T Herbeck<sup>1</sup>, Geoffrey S Gottlieb<sup>1</sup>, Neil F Abernethy<sup>1</sup>, James T Murphy<sup>1</sup>, John E Mittler<sup>1</sup>, Steven M Goodreau<sup>1</sup><sup>1</sup>University of Washington**Background:**

HIV-1 set point viral load (SPVL) is the viral load (VL) established shortly after initial infection. SPVL is a proxy for HIV virulence; higher SPVLs are more likely to be transmitted and lead to faster progression to AIDS-defining illnesses. Multiple models of heterosexual populations found that increasing the proportion of people receiving treatment in test-and-treat scenarios (where treatment begins immediately after diagnosis) selects for viruses with higher SPVLs, i.e. higher

virulence. Here we focus on a population of men who have sex with men (MSM), both because this population has the largest HIV burden in the United States and other high and middle income countries, and to evaluate the potential impacts of different sexual network structures on virulence evolution. Our goal was to examine the patterns of virulence evolution that occur in an MSM population with increasing proportions of test-and-treat coverage.

**Methods:**

We extend a stochastic, dynamic network model (EvoNetHIV), which is based in temporal ERGMs and uses the statnet suite of R packages and the EpiModel package API. Key agent attributes include SPVL and current VL; SPVL was partially heritable so virulence could evolve over time. Our main input was treatment coverage and main output was mean SPVL in the population. Treatment began one day after diagnosis. Sexual network structure parameters were varied, with an MSM pattern based on two studies of US-based MSM where relationship duration averaged 100 days and 0.2 sex acts/day and a heterosexual pattern based on previous models where relationship duration averaged 2.45 years and 1 sex act/day. We also varied HIV transmission models (increasing vs. plateauing probability of transmission at very high VLs). These factors were examined in isolation and in combination to determine those most integral to observed outcomes.

**Results:**

In the scenario with relationship patterns designed to reflect an MSM population and the increasing transmission function, increasing the proportion of individuals treated selected for viruses with lower mean SPVLs (0.10  $\log_{10}$  decrease in mean SPVL in the population between 40% and 100% treatment coverage). However, with parameters most similar to those in previously published models of heterosexual populations, increasing the proportion of individuals treated led to *increased* mean SPVLs (0.11  $\log_{10}$  increase in mean SPVL in the population between 40% and 100% treatment coverage), replicating trends previously found.

**Implications:**

Relationship duration, coital frequency, and HIV transmission function all impact virulence evolution and set up very different evolutionary environments in the MSM and heterosexual scenarios. Under a set of realistic, data-derived modeling assumptions centered in an MSM population, we found that virulence decreases with higher treatment coverage. In contrast, virulence increases with higher treatment coverage in heterosexual scenarios. These findings emphasize the impact of sexual network conditions on predicted evolutionary outcomes. Our results suggest that, under some realistic conditions, effective test-and-treat strategies may *not* face the previously-reported tradeoff in which increasing coverage fuels evolution of greater virulence and instead suggest that a virtuous cycle of increasing treatment coverage and diminishing virulence, both leading to fewer HIV transmissions, is possible.

**Shared Cognition on Informal Social Roles and its Implications for Future Manned Space Exploration: evidence from campaign 3 and 4 of the human exploration research analog (HERA)**

Michael Zurek<sup>1</sup>, Jeffrey Johnson<sup>1</sup>, Leslie DeChurch<sup>2</sup>, Noshir Contractor<sup>2</sup>

<sup>1</sup>University of Florida, <sup>2</sup>Northwestern University

With the advent of long-distance space exploration (LDSE) nearly a decade away, now more than ever, research focused on team-related dynamics, as well as the social and physical conditions that shape them, is paramount. An increasing reliance on analog environments offers numerous opportunities for researchers to comprehensively understand such processes. These environments are often characterized as isolated, confined, and extreme (ICE) and are comprised of both short (<60 days) and long-duration (>60) missions. Previous work among winter-over

crews in Antarctica demonstrates the importance of shared cognition regarding informal social roles and leadership isomorphism on network stability, crew cohesion, and overall mission viability (Johnson, Palinkas, and Boster 2003).

This paper presents the preliminary results of research on NASA's Human Exploration Research Analog (HERA) involving campaigns 3 and 4, which spanned from the beginning of 2016 until mid-2018. The former oversaw four 30-day missions and the latter contained five 45-day missions, apart from one crew which was evacuated halfway through their mission due to a hurricane. Every mission was composed of four crewmembers and contained a formal Commander, Flight Engineer, and two Mission Specialists.

Mission participants filled out several questionnaires and exercises throughout the course of the simulation. This study examines information specifically related to informal social roles, socio-metric variables, and assessments of viability contained within a "team dynamic survey." First, at each mission and time-point, network density was calculated for the informal social role nominations (i.e. storyteller), group reciprocity was calculated for the socio-metric viability measurements (i.e. "With whom would you want to go on a 3-year space mission?"), and leadership isomorphism was measured using the commander's indegree for leadership nominations. Correlations between these measurements and the viability indicators were calculated to assess the most influential processes for determining mission success or predicting failure. Additionally, separate correspondence analyses were used to examine the patterning among each of these network metrics across the various time-points in relation to the crewmembers within each mission. Finally, the missions were collectively compared across time as well and partitioned by each campaign. This stage in our analyses provided crucial insight into the similarity and agreement shared among the crewmembers of each of the missions and allowed our team to assess the nuanced attributes, and relative degree, of shared cognition throughout, and across, each of the nine total missions.

Our preliminary results indicate how agreement related to several informal social roles, as well as leadership isomorphism, significantly correlate with higher group reciprocity of 3-year space mission. Results like these help to reveal the social factors that influence mission viability while simultaneously highlighting the distinctive findings of team processes in ICE environments. Furthermore, this presentation will detail the continued analyses that will unfold with HERA campaign 5 later this year.

### **Situations, Small Networks and Network Research as Cultural Analysis**

Christian Stegbauer<sup>1</sup>

<sup>1</sup>Goethe-University of Frankfurt

Network analysis mainly focuses on the investigation of the structure of relations between people or other elements. Within the structure, which network analysis measures, culture is developed. It can be said that culture emerges within the network - especially where strong contact exists.

Relationships develop from transient contact to strong ties. In order to become a strong tie, numerous repeating "meetings" are necessary. We can speak of a chain of shared situations. In these situations, the appropriate cultural elements are developed together (negotiated or simply aligned). How influential the individuals are dependent on their position.

Although changes are also possible, there is a temporary stabilization of the culture negotiated in a particular network area. Stabilization means certainty and behavioral safety. At the same time, the people involved adopt the negotiated cultural elements and incorporate them into their cultural toolbox (Swidler).

Once developed, cultural elements can be transferred to other contexts. In the other context, the cultural elements are also negotiated and confirmed. This, however, allows for the transfer of

cultural elements. A transfer is a relatively simple task as long as it is a similar network domain. If the domain is changed, however, the transfer possibilities are limited.

Sometimes cultural elements are also passed on without the need for direct contact between all participants, for example at events such as private parties, academic celebrations or major events such as festivals.

With regard to the possibilities of empirical analysis, we can therefore define situation or event as equal. The instrument for the analysis of attendance at events and thus the potential inclusion of cultural elements in the cultural toolbox is two mode-network analyses. Normally, you only look at people who attended an event. A refinement of the analysis would be to analyze which cultural tools were used in an event. Then network research would also be research on the development and transmission of culture.

### **Social choices: The spread of attitudes towards media and politics in online and offline social networks**

Katherine Ognyanova<sup>1</sup>

<sup>1</sup>Rutgers University

The political attitudes of young Americans are shaped in a fast-paced new information environment against a backdrop of partisan polarization and ever-declining public trust in national institutions. In periods of higher uncertainty and low institutional confidence we tend to rely more heavily on our social ties to form opinions and make decisions about politics. This study examines longitudinal full-network data from thirteen residential student communities to illuminate patterns of social influence on media and political attitudes. The results show that both online and offline social ties help shape individual attitudes. The largest effects, however, come from face-to-face interactions with politically like-minded alters.

### **Social class and inequality in social capital in Chile**

Gabriel Otero<sup>1</sup>, Beate Volker<sup>1</sup>, Jesper Rözer<sup>1</sup>

<sup>1</sup>University of Amsterdam

Although the massive income inequality and its consequences have been studied in Latin America, it is less known how other resources are distributed among social groups. In this paper, we study the distribution of social capital in Chile.

Up until now, only a few studies inquired into the distribution of social capital in a country like Chile. They mostly focused on Western developed countries, and usually looked at separate indicators of social stratification such as education and occupational prestige. However, we argue that thinking along class lines should be considered as well, in particular in Latin America. We do this by employing a “class” indicator that combines measures of education, income, and job status. In addition, we consider a respondent’s socioeconomic background. We study the consequences of class and socioeconomic background for common indicators of social capital, such as network extensity and diversity. In addition, we inquire into the degree of homogeneity of networks, that is the extent in which lower, middle and upper class respondents mainly know people with a similar job status. This provides a further indication of the social boundaries between social classes.

Our analyses on a representative Chilean survey (ELSOC, n=2,479) shows that the upper middle class has access to more, richer and more varied social contacts in terms of the job status of their social contacts. However, parents' education only produces differences in terms of contacts' occupational prestige. Furthermore, we observe a clear and prevailing pattern of homogeneity. This pattern is surprisingly similar between the upper middle classes and the poorer classes. These findings show how unequally social networks and social resources are divided across (objective

measures of) “social class”, and how strong social networks are segregated across class lines in one of Latin Americans most unequal countries.

### **Social comparison effects on academic self-concepts – Which peers matter most?**

Malte Jansen<sup>1</sup>, Zsófia Boda<sup>2</sup>, Georg Lorenz<sup>1</sup>

<sup>1</sup>Institute for Educational Quality Improvement, Humboldt University Berlin, <sup>2</sup>ETH Zurich

Academic self-concept (ASC), the self-evaluation of a student’s ability, is one of the most important motivational factors in educational psychology. Exploring the different comparison processes that students use to inform their self-evaluations has been a major focus of ASC research. The Big-Fish-Little-Pond Effect (BFLPE, Marsh, 1987) predicts a higher ASC for a student with a certain ability level in a lower achieving class or school, compared to a student with the same ability level in a higher achieving class or school, as a result of social comparisons with peers. Commonly the BFLPE is modelled by regressing ASC on the aggregated achievement of a peer group (e.g., school or class achievement) while controlling for individual achievement. However, this approach assumes that students compare themselves with a “generalized other” that is best estimated by the peer average to estimate their “ranking” in a given group. Following this idea, all peers are implicitly assumed to be equally important social comparison targets (as they contribute equally to the group average). These assumptions can be questioned. For example, Mussweiler (2003) argued that easiness of availability of social comparison information plays an important role for its usage. In the school context, students might know more about the achievement (e.g., the grades) of their friends, of students they frequently study with, or of students that participate a lot in class than about the achievement of other classmates. Similarly, we know from social identity theory (Tajfel & Turner, 1979) how important group membership is for identity and thus self-concept. Therefore, students might make social comparisons within the smaller “pond” of their (salient) social groups. However, such assumptions have not been extensively tested in BFLPE research

The aim of this study was to disentangle and juxtapose the effects of specific peers’ and the class average achievement on students’ ASC based on sociometric data from the longitudinal CILS4EU study (N = 1,381 students from 67 school classes). We used Random Effects Stochastic Actor Oriented Models which are implemented using a Bayesian estimate procedure in RSienaTest (SienaBayes). In a series of models, we estimated/simulated social influence effects on academic self-concept with the (a) average ability of friends, the (b) average ability of all classmates and (c) both as predictors.

When friends’ average achievement and class-average achievement were included in separate multilevel social influence models, the two indicators showed negative effects on ASC (after controlling for individual achievement as in classic BFLPE research). Thus, the BFLPE could be replicated using SAOMs. When both averages were included in the same model, only the class-average achievement showed a substantial negative effect whereas the effect of friends’ average achievement diminished. A similar result pattern was found for homework peers and popular peers.

Our analyses show that, at least within the domain of school achievement, adolescents seem to compare themselves mostly with a *generalized other* based on the level of their learning group rather than specific peers such as friends or popular students providing further evidence for the assumptions of the BFLPE.

**Social Differentiation in Policy-Networks: Governing Climate Change in Germany**Volker Schneider<sup>1</sup><sup>1</sup>University of Konstanz

The network approach in policy analysis has undergone an interesting development in recent decades. While the policy-network perspective in the late 1980s was seen as a stand-alone approach or even as a specific theory itself, it is becoming increasingly clear today that the logic of relational thinking underlying the network approach is not a self-contained holistic paradigm but can be productively linked to a variety of theories. However, most of these theories and approaches are located at the micro or meso levels of society. Relational structures are determined at this level on the one hand by material interests and resource dependencies of individual actors or organizations, on the other hand, also ideas and beliefs can be the basis of coalition and cooperation behaviour among such action units. On the other hand, some theories are related to the macro level and focus not on relations between individuals or organizations, but on relationships between functional societal subsystems such as economy, science and politics, or institutionally differentiated organizational aggregates such as the State, private market economy, and civil society. Such macro perspectives are particularly useful for cross-national comparisons which aim to show how differences in the construction of complex societies, i. e. the specific patterns of functional and institutional differentiation and integration of the various countries, is influencing the differential perception and processing of social problems by means of public policies.

Focusing on such a macro perspective, this paper aims at a theoretical and empirical contribution to the analysis of public policy in a network perspective. It pursues an innovative thrust in that various sociological theories of societal differentiation and theories of organizational ecologies are combined and linked to policy-analytic approaches and social network analysis methods. The aim is to describe processes of networked policy-making by relational macro-configurations that are shaped by specific differentiation and integration patterns of modern societies. Social network analysis in this perspective is not only suitable for the (descriptive and explanatory) analysis of communication and resource flows between such large societal subunits, but also works as a fruitful empirical approach to the systematic identification of policy actors linked to various functional and institutional subsystems based on mutual relevance in policy-making process.

The outlined approach will be applied to German climate policy. Data for this case had been collected during 2011 and 2012 within the research network COMPON. These years are commonly referred to as the period of the German energy transition following the Fukushima disaster. The paper shows that the agenda setting and policy formulation process of tackling the global warming problem in Germany had involved a wide range of actors from different functional and institutional sectors. In addition, this policy network shows that patterns of cooperation do not simply follow individual actor preferences, but are strongly determined by macro-structural positions in the specific German matrix of social differentiation. For instance, the political and the science systems in Germany exhibit specific patterns of functional and institutional differentiation implying various degrees of autonomy.

### **Social inequalities in the personal network and development of « relational skills » / Inégalités sociales dans le réseau personnel et développement de « savoir-faire relationnels »**

Jeremy Alfonsi<sup>1</sup>

<sup>1</sup>Laboratoire d'Economie et de Sociologie du Travail

The analysis of social networks does not replace the traditional categories of sociology. On the contrary, it shows that the socio-demographic characteristics of individuals have effects even in the size and shape of their personal network.

In a survey conducted in the south of France in Montpellier, the social origin of the young participants thus proved to be a decisive variable for capturing the different types of personal networks observed. Young people from poor and wealthy backgrounds have relational structures with distinct forms and effects, reinforcing their position in their own social environment.

But how are such different relational structures shaped during the lifecourse ? The survey showed that these gaps are partly supported by specific sociability practices. Ways of building and maintaining relationships transform the personal network. Here too, these habits of sociability are socially situated. A detailed analysis of these practices and their combinations shows, however, that the primary effect of the social background can be tempered, or even transformed, by other factors in the course of the biographies. In the end, it is true « relational skills » that can be developed, contributing to a virtuous dynamic between modes of sociability, form of personal network and available resources.

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L'analyse des réseaux sociaux ne se substitue pas aux catégories traditionnelles de la sociologie. Elle montre au contraire que les caractéristiques sociodémographiques des individus ont des effets jusque dans la taille et la forme de leur réseau personnel.

Dans une enquête menée dans le sud de la France à Montpellier, l'origine sociale des jeunes participants s'est ainsi révélée être une variable déterminante pour saisir les différents types de réseaux personnels observés. Les jeunes issus des milieux populaires et aisés présentent des structures relationnelles aux formes et aux effets distincts, contribuant à situer chacun dans son milieu d'origine.

Mais comment se façonnent, au cours de la trajectoire des personnes, des structures relationnelles si différentes ? L'enquête a montré que ces écarts sont notamment soutenus par des pratiques de sociabilité spécifiques. Les façons de nouer et d'entretenir des relations transforment le réseau personnel. Là aussi, ces habitudes de sociabilités se révèlent situées socialement. Une analyse fine de ces pratiques et de leurs combinaisons montre toutefois que l'effet primaire du milieu social d'origine peut être tempéré, voir transformé, par d'autres facteurs dans le cours des biographies. A termes, ce sont de véritables « savoir-faire relationnels » qui peuvent être développés, contribuant à une dynamique vertueuse entre modes de sociabilité, forme du réseau personnel et ressources disponibles.

### **Social Influence and Punitivity in the Commons**

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The literature on cooperation in commons examines very little how social control is exercised to manage common pool resources in communities. In the political science literature, CPRI theory relies on formal institutions to account for social control. Sociological neo-structural theory, however, argues that sanctions can be less impersonal than expected by CPRI theory, more personalized and based on relational infrastructures found in the community. We use this theory of social control in the commons to argue that respondents exercise social control through a combination of two mechanisms. The first mechanism allows the members of a community to

lower the costs of exercising control by using their personal ties and low punitivity for that purpose, especially for targets of social control that are personally close to them. The second mechanism consists in using an executive committee ('the board'), i.e. a more formal process, for more impersonal and more punitive sanctioning, either for targets very close to the respondent or for targets socially distant from the respondent. Combining both mechanisms is meant to avoid oppositional solidarity between respondent, sanctioners and targets. Finally, this mechanism raises the issue of who guards the guardians. Based on the same theory, we hypothesize that the guardians guard themselves, raising the prospect of possible institutional capture

### **Social integration and well-being of immigrant students in Europe**

Zsofia Boda<sup>1</sup>, Timon Elmer<sup>1</sup>, Georg Lorenz<sup>2</sup>, Malte Jansen<sup>2</sup>

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Well-being is an important indicator of psychological adaption of ethnic minority students in school. In general, social relationships are found to be closely associated with individuals' well-being. However, quantitative studies investigating the role of social networks in the well-being of immigrants in particular, especially in the European context, are scarce. Most importantly, support networks seem to be related to well-being: especially having a host support network seems to be important. However, immigrant students often experience less access to social support than their native peers. Friendship is an important source of support in school. Our presentation thus focuses on the role integration of students with immigrant backgrounds in their friendship networks plays in their well-being. For this, we use large-scale data sets from Germany, the Netherlands, the UK and Sweden (from the Children of Immigrants in Four European Countries study). First, we look at the relationship between well-being and friendships in a cross-sectional analysis: the existence and the number of native friends, immigrant friends, and same-ethnic-group friends. Afterwards, we model the co-evolution of friendship and well-being using the Swedish subset of the data, where longitudinal information on both measures is available. Using random-coefficient multilevel stochastic actor-oriented models, we can distinguish between various social processes, separating the effect of well-being on forms of social integration (such as integration in native or immigrant social networks) from the effect of such forms of integration on well-being. We also test whether these processes are different for native students and for those with different types of immigrant background (such as country of origin and immigrant generation). We also take social influence into account: we test whether students adapt their friends' well-being regardless of the ethnic group they and their friends belong to.

### **Social Network Analysis of Quebec's Corporate Elite: A case study of Quebecor and Power Corporation**

Laurent Alarie<sup>1</sup>

<sup>1</sup>University of Ottawa

My communication aims to present the implementation of Social Network Analysis (SNA) to the study of corporate elite in Quebec. More specifically, the analysis maps the networks formed by the directors sitting on the respective boards of Power Corporation and Quebecor. Since this analysis comes from a Ph.D. project in progress, I will have the opportunity to divulge the partial results.

Power Corporation and Quebecor were selected as case studies because they are controlled by two central families in the media and political landscape of Quebec, which are presumably opposed politically. The first, controlled by the Desmarais, proclaims to be federalist and liberal, while the second, controlled by Pierre Karl Péladeau, is defined more as nationalist and even

sovereignist (the main shareholder was the leader of the Parti Québécois between 2015 and 2016). The editorial slant of the newspapers respectively owned by the two companies testifies to this political division.

My analysis first seeks to verify whether this cleavage corresponds to differences in the respective social networks of the two companies. To do this, I conduct a SNA of the members belonging to the respective board of directors (BoD) of Power Corporation and Quebecor as well as their main subsidiaries. The links between individuals and organizations are examined in terms of interlocking directorates. Interlocking directorates occur when a person affiliated with an organization simultaneously sits on the BoD of another organization. Drawing primarily from the BoardEx database, I analyze the extent of the networks of the respective administrators of both companies. I then compare these two networks by retaining the links between the administrators and the organizations that are important or considered as such in Quebec (e.g. banks, large private and Crown corporations, universities, think tanks, private foundations). In order to compare the two networks and the positions their respective agents occupy within them, I also included various attributes of the actors (gender, age, nationality, occupation, level of education, achievements). Then, using several centrality measures (i.e. betweenness, closeness, degree), I evaluate the structural positions occupied by these various actors. The analysis of these networks and the relative centrality of these agents allow us to examine the respective place occupied by the two corporate networks in Quebec society.

The analysis should provide empirical evidence to identify the specificity of the two companies' networks. At the conclusion of the analysis, it should be possible to specify whether there are two, or more, divergent trends in this corporate elite or a more integrated one. Furthermore, I should be able to determine the preponderance of this elite in the spheres of economic, politics and other sectors of activity of Quebec society.

### **Social Network Analysis, company networks and their informed management in participatory planning processes for Climate Change mitigation efforts in urban industrial areas**

David Heimann<sup>1</sup>

<sup>1</sup>Osnabrueck University

When it comes to Climate Change mitigation action and climate change policy interventions there is a huge debate about how to formulate interventions, how stakeholders can be activated and how measures can be implemented and multiplied locally in a way that sustainability goals can be achieved on a broader level. The federally funded project "Grey goes Green – Transformation of Industrial Areas" aims at answering these questions based on case-studies in three industrial areas in Germany. Older industrial areas encounter a considerable amount of sustainability issues which reduce their competitiveness, e. g. land sealing, heat islands or a waste of energy. In order to reverse these trends, the question arises how a shift towards sustainable development can take place and how such a process is analysed best.

As sustainable urban and regional planning is increasingly making use of different forms of networks to develop solutions in cooperative participatory planning processes it seems obvious to take a deeper look at the structures of the actors that are involved. This contribution aims to explore and describe the potentials of using the knowledge about relational structures in existing cooperation structures among companies to facilitate the formation of a sustainability oriented network and to accelerate the diffusion and multiplication of measures. To do so, a thorough understanding of the contextuality and the structure of the network including the potential and realized interactions between companies is needed. By looking deeper into actor networks the author is also addressing criticism towards the multi-level perspective on Sustainability Transitions regarding the lack of a thorough understanding of actors' and networks' role in

shaping niches and their diffusion to the regime level. According to Bodin and Crona, social networks can have a greater impact for the implementation of sustainability standards than formal institutions and have the power to foster collaborative governance processes. Therefore, this contribution is gathering information about private, business, and communication-related relations among stakeholders. In a mixed-methods approach, this quantitative network survey is complemented by qualitative interviews among companies to characterize them in terms of awareness about, attitudes towards and motivations for climate protection and adaptation measures. Above that, the local public administration's experience in and forms of cooperation for promoting sustainable policies with local businesses was investigated. The project was able to create insights in terms of identifying key brokers for creating pathways to speed up transitions and with respect to the creation of a common understanding between private and public actors for common action. Characteristics within the network structures, such as Centrality or Betweenness, made it possible to identify relevant actors. These actors are the key for transferring knowledge to network periphery or subgroups. In addition to these findings, the author was able to confirm a lack of vertical exchange between different levels of politics, policy making, and businesses to effectively implement measures that are needed to achieve goals that are formulated at the (supra-) national level.

**Social network and social normative characteristics of married adolescents participating in a family planning intervention in rural Niger: associations with family planning use**

Holly B. Shakya<sup>1</sup>, Sneha Challa<sup>1</sup>, Nicole Carter<sup>1</sup>, Ricardo Vera-Monroy<sup>1</sup>, Jay Silverman<sup>1</sup>

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This study was conducted among married adolescent girls and their husbands in 16 villages in the Dosso district of the Dosso region of Niger as a supplement to the Reaching Married Adolescents (RMA) study (a study to assess the effectiveness of a family planning (FP) intervention among married adolescent girls and their husbands in Niger). Data for this analysis were taken from the Social Networks Module of the main RMA study Time 2 survey plus a separate module administered to one alter per RMA participant. The social networks module of the main RMA study Time 2 survey was administered to respondents enrolled in the RMA intervention and controls. Girls were asked to name individuals important in their lives (using three different name generating questions as part of a larger survey including questions about reproductive health, social norms, and FP). Each girl was asked specific questions about their alters. One alter per girl was then separately interviewed (N=250), with a subset of the questions asked of the primary girl respondent.

Consistent with the two sources of data, analysis was divided into two primary components. In the first component we analyzed the primary respondents' answers to questions about their alters, and looked at them in conjunction with their answers regarding their own behaviors. A total of 322 female respondents were administered the social networks survey. Of those 283 provided information regarding at least one alter (1.39 per girl or 439 unique dyads). The remaining 39 female respondents (12%) noted no one that they could name in response to the network questions. The second component of the analysis used data from the Alter survey (N=250), with alters' own responses to questions regarding their own attitudes and behaviors. Alter surveys were matched with the nominating primary respondent so that associations between the respondents and their alters could be assessed. Of the 283 participants who named alters, we were able to interview alters for 250 of them (87%).

We found that girls with no alters were more likely to be nulliparous, and that those with the most alters had participated in the intervention. Intervention participants were also more likely to have nominated friends versus only nominating family members. Intervention participants were more

likely to report that their alter approves of FP and healthy birth spacing, and these beliefs were associated with respondents reported use of FP. There was some evidence of diffusion, as alters of treatment participants were more likely to have heard of the intervention, reported discussing the intervention with other people, and more likely to have used FP. There was an association with respondents use of FP and that of their ego although it was relationship specific. Respondents were more likely to have used FP when their sisters or in-laws had, but there was no correlation with friends.

The data we collected from girls, including the network module, and the alter survey, we also collected from their husbands, and will analyze and report on this data as part of this study.

### **Social network predictors of sexual behaviour among young adults in an area of high HIV incidence**

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**Background:** HIV incidence remains almost 5% per annum among 15-30 year olds in rural KwaZulu-Natal (KZN), despite the existence of many prevention interventions, several targeted at young people. Evidence elsewhere has shown that individuals' sexual health decisions can be affected their familial and social contacts. We have previously shown that young KZN adults discuss sexual matters with both family and friends, but there is little evidence on how these discussions are associated with health attitudes and behaviours.

**Methods:** We interviewed 119 18–34 year-old men and women in one rural and one peri-town location. We asked them to describe who provided them with emotional, informational, financial, physical or social support and generated weighted egocentric networks (egonets). We evaluated how frequently respondents were in contact with support providers in general, and those providing sexual health advice in particular, stratifying our data by family, sexual partners and friends/others; we calculated egonet density. We also asked about sexual health attitudes and behaviours: are abstaining, using condoms or only having one partner realistic ways of preventing HIV; are you able to refuse sex if a partner refused to use a condom; and current, 12-month and lifetime numbers of sexual partners. We used multivariable Poisson regression with robust errors (adjusted for respondent age and gender) to assess how egonet structure and composition was associated with sexual health outcomes using incidence rate ratios (IRR) and 95% confidence intervals (95%CI).

**Results:** Respondents named between zero (n=1) and eight supportive contacts (median three) of whom 61% were family, 14% were sexual partners and 26% other friends. Seeking advice from same-generation relatives (siblings and cousins) was associated with greater ability to refuse condomless sex (IRR for one more daily interaction: 1.26, 95%CI: 1.08-1.47) and fewer lifetime partners (0.83, 95%CI: 0.60-1.13). Abstinence was seen as less effective by those getting more advice from friends (IRR: 0.83, 95%CI: 0.65-1.04) and sexual partners (IRR: 0.76, 95%CI: 0.55-1.05), and both were associated with more lifetime partners (IRR for friends: 1.37, 95%CI: 1.00-1.87; IRR for sexual partners: 1.32, 95%CI: 0.94-1.85). Those with greater sexual partner advice were also less likely to be able to refuse condomless sex (IRR: 0.75, 95%CI: 0.57-0.99). Respondents with denser egonets were more likely to report faithfulness as effective (IRR per standard deviation of

density: 1.06, 95%CI: 1.00-1.12) and being able to refuse condomless sex (IRR: 1.06, 95%CI: 0.98-1.14), and reported fewer sexual partners over all time periods. Results were similar for networks defined by general sexual or HIV conversations.

**Discussion:** Despite the small sample, our data found patterns of sexual attitudes and behaviours varying by social network composition and structure in a population at risk for HIV. Respondents who discussed sexual matters with family tended to have more protective attitudes and past behaviours than those more connected to friends and sexual partners. Denser networks were associated with lower risk attitudes/behaviours. Longitudinal analysis is needed to determine the causal direction of these associations; however, our work highlights that social ties may be worth incorporating into future sexual health interventions.

### **Social Networks and Climate Change Policy Preferences in Canada.**

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We set out to assess whether there is a relationship between position in a network structure, and an actor's position on a particular climate change policy issue: curtailing oil sands development. Based on blockmodelling and regression analysis, we find substantial statistical support for the existence of such relationships (for the business organization dominated block, and the environmental organization dominated block).

### **Social Networks and HIV Stigma in African Immigrant Communities**

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HIV/AIDS continues to be a worldwide health problem: approximately 36.9 million people were living with HIV in 2017. Although advances in antiretroviral treatment have slowed the progression of HIV to AIDS, infections are on the rise annually, with about two million being infected in 2017. A number of socio-behavioral factors account for the rising incidence of HIV. Stigma in particular has been identified as a key barrier to effective prevention and care, resulting in delays in testing, care seeking and poor adherence to treatment regimes, among other outcomes. Despite advances in stigma research, there are gaps in the conceptualization and measurement of HIV stigma. Drawing on insights from social network analysis, this presentation operationalizes stigma within the context of social networks, showing that the experiences of stigma vary depending on the structure and composition of the social networks of the stigmatizer and the stigmatized. The paper uses data from the "Social Networks and Stigma Study" to demonstrate the links between stigma, social networks and HIV testing / adherence to treatment within African immigrant communities.

### **Social Networks and Mental Illness Stigma: Preliminary Findings from the College Toolbox Project**

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The College Toolbox Project (CTP) is a program focused on reducing the stigma associated with mental illness among college students. In association with this project, egocentric social network and other survey data have been collected from a cohort of incoming students during their freshman year, with follow-up data collection one year later. In this research, we first describe the egocentric networks of CTP participants. After providing a basic description of participants' networks, we examine how changes in these networks are related to stigmatizing attitudes about mental illness, as well as perceptions of the campus culture around mental illness stigma.

Preliminary findings indicate that as students gain ties to people with mental illness and as they discuss mental illness and stigma with a greater number and diversity of network members, their attitudes become more tolerant. Similarly, additional connections to ties with mental illness and having mental illness discussion partners are both positively associated with perceptions of a tolerant campus culture around mental illness. The implications of these findings will also be discussed.

**Social Networks as a "Relation Tool" and Electronic Social Media as a "Communication Tool" in an Educational Context / Les réseaux sociaux comme « outil relationnel » et les médias sociaux électroniques comme « outil communicationnel » en contexte éducatif.** Marjolaine St-Pierre

Université du Québec à Montréal (UQAM)

Electronic social media is generally considered in terms of technology tool and online social media communication tool. But what about the impact of comments made via social media on the users and the people concerned by these same remarks. In fact, are there inherent dimensions to all these communicational interventions in education?

Ever-expanding social networks are introduced to the functioning of our society which, inter alia, schools, training centers, universities, as a means of communication. The social networking phenomenon in schools at primary and secondary levels is mainly related to their peers, their reading and intellectual curiosity. This reality is now perceived and experienced as an essential dimension in schools because of electronic social media (e-SM) are a new form of collective and individual communication.

In this context, the present communication aims to highlight the construction of a "professional" social network made up of school' principals through which a scientific study dealing with the professional representations of school principal could be conducted from 2010-2013 (St-Pierre, 2013). Based on an inductive and qualitative methodology, this study explored and analyzed the data provided by this professional network in order to identify and grasp the contribution and influence of information technologies conveyed by social media in the school setting.

Thus, nine axes of analysis emerged following the analysis of representations made by these school' actors regarding the presence of electronic social media (e-MS) and the use of information technologies in Quebec schools. In this specific framework, made up of the "Understanding Wheel of Social Media", we explore these nine axes from the analysis of the data collected. Then we try to show some links between professional social networks as a "relational tool" and electronic social media as "communication tool" in an educational context.

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Les médias sociaux électroniques sont généralement considérés en termes d'outil technologique et d'outil de communication des réseaux sociaux en ligne. Mais qu'en est-il de l'impact des propos tenus via les médias sociaux par les utilisateurs sur les personnes concernées par ces mêmes propos? En fait, existe-t-il des dimensions inhérentes à toutes ces interventions communicationnelles en éducation? Les réseaux sociaux, en expansion constante, sont introduits dans le fonctionnement de notre société, notamment les écoles, les centres de formation, les universités, en tant que moyen de communication. Le phénomène de réseautage social dans les écoles primaires et secondaires est relativement nouveau au Québec et plusieurs directeurs d'école découvrent les problèmes qui se posent par leurs contacts avec leurs pairs, leur lecture et leur curiosité intellectuelle. Cette réalité est maintenant perçue et vécue comme une dimension essentielle dans les écoles. En effet, les médias sociaux électroniques (e-SM) constituent désormais une nouvelle forme de communication collective et individuelle. Dans ce contexte, la présente communication vise à mettre en évidence la construction d'un réseau social

"professionnel" constitué de directions d'établissements grâce auquel une étude scientifique traitant des représentations professionnelles des directions d'établissement a pu être menée de 2010- 2013 (St-Pierre, 2013). Selon une méthodologie inductive et qualitative, cette étude a exploré et analysé les données fournies par ce réseau professionnelle afin d'identifier et de saisir la contribution et l'influence des technologies de l'information véhiculée par les médias sociaux dans le cadre scolaire. Ainsi neuf axes d'analyse ont émergé suite à l'analyse des représentations entretenues par ces acteurs scolaires quant à la présence des médias sociaux électroniques (e-MS) et à l'utilisation des technologies informationnelles dans les écoles québécoises. Dans ce cadre spécifique, constitué de la "Roue de compréhension des médias sociaux", nous explorons ces neuf axes issus de l'analyse des données recueillies. Nous tentons ainsi de faire apparaître certains liens entre des réseaux sociaux professionnels à titre "d'outil relationnel" et les médias sociaux électroniques à titre "d'outil communicationnel" en contexte éducatif.

### **Social networks in the experience of housing of tenants: unequal social relations and the importance of social movements**

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Housing is a public health issue. For many years now, institutions recognize its importance for the health of individuals and their families. Indeed, through the notion of social determinants of health, academics have proven the importance of good housing conditions for people's health, particularly for tenants. This acknowledgment also gave social movements and third sector actors in the housing sector, and in other fields, new arguments in their struggle for better housing rights and conditions. To defend those rights and improve living conditions for tenants, one sole group is not enough: a network of actors needs to be mobilized. What networks are mobilized by tenants to improve living conditions and/or defend their rights?

This presentation proposal is based on a doctoral dissertation and focuses on the social inequalities in tenants' housing experience and aims to 1) describe the housing experience as expressed by the tenants themselves; 2) to identify the different networks present in their account of this experience according to types of realm (private, parochial and public – Hunter, 1995) contribute to tackle housing problems; 3) and to identify social inequalities present in their account of this experience and how it presents itself in the form, among others, by a deficit of social network. To do so, we turned to the notion of social experience and propose a qualitative study based on semi-structured interviews and over 100 hours of observation of a Montréal tenants' association activities. Analysing accounts of social experiences allowed us to categorize them as belonging largely to three types of "épreuves" (hardships or challenges), as conceptualized by Martuccelli (2006): relational, financial and spatial.

For each of these hardships, we analysed the processes of the production of unequal social relations as constructed through social interactions (McAll, 2008a). We conceptualized three such processes: 1) exploitation, the appropriation by others of their capacity to produce and reproduce; 2) exclusion and segregation, the monopolistic appropriation of territories and resources; and 3) symbolic violence, the appropriation by others of their capabilities to think and to decide. We learned how unequal social relations are constructed through interactions between tenants and other housing actors. This finding leads us to give more importance to "symbolic violence" as a process of production of social inequality, in so far as it makes the other processes acceptable or even invisible to tenants. This finding highlights the importance of social networks (as conceptualized by Hunter, 1995) in the social exclusion of tenants and the value and usefulness of social movement in the defense of housing rights.

**Social networks of opioid users: A mixed methods study of social support and peer influence in initiation, escalation, treatment, and recovery**

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The interplay between social networks and health is complex. For persons who use drugs, specifically those addicted to opioids, social network members can be a source of social support that facilitates desistance and recovery, limits risks of overdose, and acts as a break on escalating use patterns and risks. But, social networks can also influence use patterns negatively at initiation and other critical junctures like entry to treatment. We present results from a unique mixed-methods study of persons who use opioids in Western Pennsylvania that we collected in 2017 and 2018. This study measured retrospective, contemporaneous, and prospective ego-network data on four domains of social support and interaction (romantic, friendship, advice, and interactions) as well as detailed life and drug use history from each participant. In total, we draw on data from 30 in-depth qualitative interviews and 125 quantitative surveys (including both retrospective and contemporaneous ego-network measurement) from survey participants and additional prospective, longitudinal follow-up in-depth interviews (n=10) and surveys (n=30, including network measurement) with a subset of the first wave respondents. In addition to information about the role of social networks in respondents' lives and drug use, data collection focused on demographic and socioeconomic indicators, criminal history, interactions with the justice system, sharing and selling of drugs among peers, drug and alcohol use, perceived and experienced health, and occupation and employment. The qualitative and quantitative results point to important roles played by peers and others in the initiation, escalation, and relapsing of opioid misuse, but also highlight that the availability of social support, and respondents' perceived obligations to provide it to others, factor heavily in respondents' decisions to seek treatment and maintain recovery. Familial obligations and romantic relationships play outsized roles in these decisions, in complex ways, moderated strongly by respondent's own and respondent's partner's gender. Drawing on the richness of these data, we theorize some mechanisms by which persons who use opioids' social support networks become, or fail to become, saturated with others who use opioids, which is a critical risk factor for continued use, escalation, and relapse.

**Social Networks, Social Support and Weight-Related Behaviours in Adolescents: a pilot study**

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Keywords (max 3): Obesity, adolescents, social support

Background Social networks (SN) have been implicated in the development of obesity, but mechanisms are unclear. Greater understanding of this dynamic may be useful to target specific SN features in order to promote healthy weight, both in clinical and population settings. To this end, a pilot study was conducted to explore these relationships.

Objectives: In addition to describing process outcomes, we used an ego-centric SN approach to examine i) relationships between SN characteristics and weight-related outcomes, ii) possible mechanisms implicating social support (SS) in the SN-obesity relation, and iii) whether any associations were modified by gender.

Methods: Data were from the QUALITY study, an ongoing longitudinal study of the natural history of obesity in youth among 630 Quebec families. Of these, 45 adolescent participants (egos, 64% male) took part in the pilot study. Each ego nominated up to 10 people (alters) using the following

name generator: With whom have you discussed important matters in the past year? The name-interpreter questions included age, sex, relation with the ego (family, friend), body shape (based on 7 sex-specific silhouettes), frequency of lifestyle behaviors (being active, recreational internet use, eating healthfully, exercising with ego), and of encouraging ego to exercise. Motivational and role-modeling SS scores were created. Egos also reported alter-alter ties, defined as how well members of each dyad knew each other. Structural characteristics included network size, network density and homophily index for sex; and network composition characteristics included level of SS from family members and friends. Multiple linear regressions were conducted to assess the relationship between network features and ego-level outcomes including body mass index z-score (zBMI) and accelerometer-measured minutes of moderate-to-vigorous physical activity (MVPA), adjusting for age and stratified by sex.

Results: There was negligible non-response and adequate variation in responses across most questions. Mean age was 16.4 years, zBMI ranged from -1.2 to 3.9, and mean MVPA was 22.4 minutes/day. Participants nominated a mean of 6.6 alters (38% family and 62% friends), and the average network density was 0.5. As expected, network size was favourably associated with weight-related outcomes, and network density was adversely associated. From multiple linear regression models, motivational SS was adversely associated with zBMI in girls and favourably associated in boys (respectively +0.19 zBMI for a 10% increase in the proportion of supportive alters,  $p=0.05$ ; and -0.14 zBMI,  $p=0.03$ ). Motivational SS was not associated with MVPA, nor was role-modeling SS associated with any outcome.

Conclusion: Our results suggest that perceived motivational SS may be involved in the SN-weight status relation, but that its role differs between adolescent boys and girls. These preliminary findings suggest that it may be possible to activate ego SS by leveraging SN and enhance lifestyle interventions. In addition to examining these relationships in subsequent large scale investigations, qualitative research could further elucidate the role of gender-based beliefs and how specific types of social support are implicated.

### **Social normative and social network factors associated with adolescent pregnancy in rural Honduras**

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#### **Background:**

Adolescent birth (AB) is common throughout Central America. While gendered beliefs promoting motherhood are a known risk factor, their association with AB within the social networks of Central American communities is unknown.

#### **Methods:**

This was a cross-sectional study with full social network and reproductive health data on most individuals  $\geq 15$  years of age ( $N=24937$ ) in rural Honduras across 177 villages. Our unit of analysis was women between aged 15-20, for whom an AB would have been recent ( $N=2,990$ ). The outcome, AB, was defined as having had a child < age 20. Network contacts (alters) could be anyone she nominated within that village, across a range of 14 different name generators, including familial relationships.

#### **Findings**

Girls who nominated a father in the village had a lower likelihood of AB, while nominating a mother was not significant. The likelihood of AB was lower when fathers and close friends reported an attitude supporting older age of first birth for girls. Girls AB was strongly associated with the AB of alters across alter types, including mothers, siblings, those in the same household,

those with whom she spends free time, and asks advice. Alters perception of normative support for AB in the community was also associated with AB however, village level norms in the models attenuated that association across most alter types except for providers. When an alter a girl named as a provider reported community norms in support of AB, the girl was more likely to have had an AB. The association of alter level AB was not impacted by the inclusion of village level AB. Girls who in general had stronger tie strength across relationships were less likely to have had an AB, and the association of alter AB with girls AB was significantly stronger as tie strength increased. The association of alter AB and ego AB was weaker the greater the age difference between the ego and the girl. Girls who have had an AB had higher closeness centrality and betweenness centrality, but lower transitivity and eigenvector centrality.

#### **Interpretation**

A girls risk for AB is associated with norms and attitudes in support of it, with those potential influences coming from the level of the village, as well as proximal familial and household relationships. The stronger associations seemed to be descriptive- where girls were exposed to AB around them, they were more likely to have had one. We have evidence that girls who have had an AB may have higher overall exposure in the network, perhaps due to the need for advice or assistance, but have less closely connected relationships overall.

#### **Funding**

The Bill and Melinda Gates Foundation and NICHD.

### **Social Support and Refugee Mental Health: A Latent Class Approach**

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Social support networks have shown to be a significant determinant of mental health, also in the context of forced migration. Nonetheless, the way in which refugee social networks are structured and how structure relates to the provision of resources for mental health after resettlement has not been explored so far. Are refugee social networks mostly composed of family members? Or are friends and acquaintances the most importance source of social support in the host community? What impact has this diversity in network structure on the types of support provided? And how does this social support associate with refugee mental health? Aim of this study is to understand who provides which kind of support in the German refugee population. Moreover, the question is raised whether certain sources and types of support have a more positive effect on refugee mental health than others.

The paper uses data from a representative sample of refugees in Germany, pooling the IAB-BAMF-SOEP Survey of Refugees for the years 2016 and 2017. First, latent class analysis simplifies social support by role relations, creating typologies of support networks. The typology combines features of source of support and nature of support provided. Second, regression analysis includes the derived typology from the latent class analysis to investigate the association with refugee mental health. Refugee mental health is measured with two distinct indicators: first with the Refugee Health Screener, pointing towards the existence of trauma related symptoms. Second, the Mental Health Component Summary Scale (MCS) of the Short Form Health Survey (SF-12) is used as indicator for every day mental health languishing and flourishing. The study provides novel insights into optimal support networks of refugees and their association with refugee mental health.

**Social Support and Social Influence Functions of Friend, Family and Online Ties: Relationships to Social Network Characteristics and Smoking Abstinence among Adults**

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New media such as Twitter have provided portals into online social worlds which represent novel opportunities for creating and maintaining virtual social ties. In this study, we focused on three major types of social network ties adults maintain - family, friends, and online relationships - and two characteristics of these network ties with major relevance for health behavior - the number of ties individuals maintain and the closeness of these ties. We study how these social network tie types and network characteristics relate to two theoretically relevant domains of social support for health behavior - emotional support and confidant support - and two social influence processes that are important to smokers including pro-smoking influence and anti-smoking social influence. We utilized data from a randomized controlled clinical trial of smoking cessation and relapse prevention wherein adult current smokers attempting to quit were surveyed prior to the start of the trial to assess their family, friend and online network ties, and their perceptions of the social support and social influence provide by each person they named. Our results indicated that for all three types of social network ties - family, friend, and online - both network size and tie closeness related significantly and positively to smokers' perceptions of social support and social influence. Pro-smoking social influence from family network ties related significantly and negatively to 30 day abstinence. Only emotional support from online social network ties related significantly and positively to 30 day abstinence. Implications of our findings for adult social ties, social support, social influence and smoking behavior will be discussed.

**Social support networks of underrepresented graduate students**

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Underrepresented Minority (URM) graduate students in science, technology, engineering and mathematics (STEM) graduate programs at Predominately White Institutions (PWIs) encounter many trials. URM graduate students, those from known underrepresented groups who are African-American, Latino/a, Chicano/a, Native-American, and Pacific Islander, encounter different hindrances compared to their white counterparts when enrolled in Predominantly White Institutions (Guiffrida & Douthit, 2010). Support networks are important for URM students in graduate programs (Carlone & Johnson, 2007; Clewell, 1987; Joseph, 2012; Johnson et al, 2011; Sweitzer, 2009). Previous research displays how the first year is vital in developing relationships with peers and faculty to help solidify their roles in graduate programs (Sweitzer, 2009). Previous research also shows that URM students are also known to leave graduate programs within the first two years of these programs (Joseph, 2012). The act of integrating into an existing scientific community in a PWI can be very challenging for URM students, especially when they lack a strong support network to help them make this transition. URM graduate students can find support in many different forms, some including academic, cultural, social, emotional, and professional. This study investigates the role that mentoring and support networks have on the persistence of URM students in STEM graduate programs, how the evolution of these support systems affect the graduate student's program success, and if URM graduate students gravitate towards support systems that match their cultural background. It is imperative to identify who forms these support networks and who the key members are, in addition to the roles they play. This study was done through an extensive interview process (3 years and 6 interviews) as URM graduate students progressed through their programs and social network analysis based off three social network

surveys done in Qualtrics at the beginning, middle and end of the students' programs. Data was also collected by several people coding interviews in HyperResearch and analyzed in a spreadsheet to track changes in social networks over course of the study. It was seen that many participants in this study needed and found a strong support network through student organizations that matched their ethnicity. Most URM graduate student participants that were successful had strong family support, even if the family did not fully understand what the participant was doing in graduate school. The support of the advisor also seemed to impact the success of the URM students in their graduate school endeavors.

### **Social Tolerance in Rural America as Afforded by Persistent and Pervasive Networks**

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Intolerance toward minority and immigrant groups has increased across much of the United States. While intolerance can be found everywhere, it is unevenly distributed; residents of rural areas are considerably more likely to express intolerant views than those who live in cities or suburbs. The divergence between urban and rural attitudes has been tied to two factors, rural areas tend to have lower levels of educational attainment, and more homogeneous social mixing. As a result of educational attainment and social mixing, those who leave rural areas to attend university become more tolerant. Yet, low rates of students returning home after university have left levels of intolerance largely unchanged in rural areas.

Social media may be changing the structure of people's social networks in ways that potentially reduce or reinforce insularity. Previously, ties would have gone dormant or dissolved as a result of mobility, but now, when people move neighborhoods, go away to school, change jobs, and so on, their relationships persist over time, online and often offline. Such persistence in relational ties is often accompanied by heightened awareness. Awareness results from the short exchanges that typify social media. Often perceived as trivial (e.g., photos of a meal, broadcasting attendance at a party, etc.), one outcome of these exchanges is increased exposure to the events, activities, and opinions of friends and family.

If social media use increases relational persistence and awareness of activities in other people's social networks, then the opinions and relationships of those who leave rural areas for educational opportunity might be visible to rural residents who stay behind, and vice-versa. Those who leave for university maintain ties using social media. Through the images and updates they post, they make their new ties visible to friends and family in rural areas in a way that was not previously possible. This social media activity may increase rural residents' exposure to tolerant attitudes and diverse others, as they see close friends and family in relationships and conversations with diverse others. This persistent and pervasive contact via social media may extend the influence of diverse social mixing and education, reducing intolerance among those who remain in rural areas (e.g., the parents of children who leave to attend university). Yet, this vicarious, or second-degree social mixing, may be eclipsed by the power of persistent, dense, homogeneous personal networks to reduce the influence of educational attainment and social mixing on those who leave rural communities.

This presentation provides preliminary findings from a survey of 500 first-generation university students from rural areas, and at least one of their parents/guardians. Students and parents were surveyed about their attitudes toward immigrant and minority groups. Looking across five cohorts—incoming students, and those at the end of their freshman, sophomore, junior, and senior years—variation is explored in student and parent attitudes, perceived student/parent homophily, and actual attitudinal homophily, based on core network structure and composition,

middle-class ties, social mixing with immigrant and minority groups, religiosity, conservative/liberal values, family interaction, and internet/social media use.

### **Social-ecological networks and adaptive responses to a changing climate**

Michele L Barnes<sup>1</sup>

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To effectively manage the chronic and stochastic impacts of rising global temperatures, people need the capacity to adapt. Social networks have long been advocated as a crucial component of adaptive capacity, and recent research has further argued that particular patterns of social-ecological linkages can lay the foundation for adaptive action. Yet, we lack explicit empirical evidence demonstrating how specific aspects of social networks and social-ecological linkages may drive responses to a changing climate. Drawing on comprehensive social and multilevel social-ecological network data from a Papua New Guinean island experiencing dramatic impacts from climate change, here we employ a series of autologistic actor attribute models (ALAAMs) to demonstrate how social networks, social-ecological linkages, and other theoretical components of adaptive capacity relate to (1) adaptive and transformative responses to current/past impacts and (2) people's stated ability to cope with future impacts. Less than half the surveyed population had made changes in response to climate change impacts and/or felt they had the ability to cope with future impacts. Fisher's social networks show strong clan-based homophily, and adaptive responses were more likely within certain clans and among clan chiefs. Livelihood flexibility and cross-level social-ecological linkages that support the accumulation of diverse knowledge from fishers targeting difference species were significant drivers of transformative responses. Fishers with greater livelihood flexibility were also more likely to feel they had the ability to cope with future impacts from climate change. Surprisingly, factors that are often the focus of adaptive capacity building programs, such as assets, were not significantly related to any of our studied responses. We also found no significant contagion or direct social influence effects – though networks do appear important for social learning.

### **Social Inequalities in the Personal Network and Development of « Relational Skills » / Inégalités sociales dans le réseau personnel et développement de « savoir-faire relationnels »** Jeremy Alfonsi Laboratoire d'Economie et de Sociologie du Travail

The analysis of social networks does not replace the traditional categories of sociology. On the contrary, it shows that the socio-demographic characteristics of individuals have effects even in the size and shape of their personal network.

In a survey conducted in the south of France in Montpellier, the social origin of the young participants thus proved to be a decisive variable for capturing the different types of personal networks observed. Young people from poor and wealthy backgrounds have relational structures with distinct forms and effects, reinforcing their position in their own social environment.

But how are such different relational structures shaped during the lifecourse ? The survey showed that these gaps are partly supported by specific sociability practices. Ways of building and maintaining relationships transform the personal network. Here too, these habits of sociability are socially situated. A detailed analysis of these practices and their combinations shows, however, that the primary effect of the social background can be tempered, or even transformed, by other factors in the course of the biographies. In the end, it is true « relational skills » that can be developed, contributing to a virtuous dynamic between modes of sociability, form of personal network and available resources.

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L'analyse des réseaux sociaux ne se substitue pas aux catégories traditionnelles de la sociologie. Elle montre au contraire que les caractéristiques sociodémographiques des individus ont des effets jusque dans la taille et la forme de leur réseau personnel.

Dans une enquête menée dans le sud de la France à Montpellier, l'origine sociale des jeunes participants s'est ainsi révélée être une variable déterminante pour saisir les différents types de réseaux personnels observés. Les jeunes issus des milieux populaires et aisés présentent des structures relationnelles aux formes et aux effets distincts, contribuant à situer chacun dans son milieu d'origine.

Mais comment se façonnent, au cours de la trajectoire des personnes, des structures relationnelles si différentes ? L'enquête a montré que ces écarts sont notamment soutenus par des pratiques de sociabilité spécifiques. Les façons de nouer et d'entretenir des relations transforment le réseau personnel. Là aussi, ces habitudes de sociabilités se révèlent situées socialement. Une analyse fine de ces pratiques et de leurs combinaisons montre toutefois que l'effet primaire du milieu social d'origine peut être tempéré, voir transformé, par d'autres facteurs dans le cours des biographies. A termes, ce sont de véritables « savoir-faire relationnels » qui peuvent être développés, contribuant à une dynamique vertueuse entre modes de sociabilité, forme du réseau personnel et ressources disponibles.

### **Socio-semantic networks on Twitter: Re-tweet networks as intensifiers of communication**

[Iina Hellsten](#)<sup>1</sup>, Sandra Jacobs<sup>1</sup>, Anke Wonneberger<sup>1</sup>

<sup>1</sup>University of Amsterdam, ASCoR

#### **Abstract**

Socio-semantic networks have been analyzed, for example, in terms of connections between social actors, and the semantic content of their communications. Social media provide rich data for the analysis of socio-semantic networks consisting of social actors (authors of the messages), the content of those messages, and several medium-specific affordances. Twitter data, for example, allows for mapping social networks (authors addressing other users), semantic networks (co-occurring #hashtags, and co-occurring #hashtags and addressed other @usernames) as well as socio-semantic networks (authors co-occurring #hashtags). Authors can also spread information to other users by re-tweeting messages authored by other Twitter users (RT@username networks).

So far, in most social media research, re-tweets have been excluded from the research as non-authentic content. In this paper, we argue that socio-semantic networks of authors re-tweeting messages provide important information about the intensification of communication networks. We analyze social networks (author-to-@username), semantic networks (co-occurring #hashtags) and socio-semantic networks (author-to-#hashtag and @username). As a meta-level, we show the re-tweet networks of authors spreading the messages produced by other authors (author-RT@username) as intensification of communication.

Our methodological approach builds upon a novel automated tool for mapping co-occurring #hashtags and addressed @usernames (Hellsten & Leydesdorff, in-press). This whole-matrix approach enables us to map both heterogeneous and homogeneous sets of nodes and links in an integrated design – for instance co-occurrences between #hashtags, @usernames and RT@usernames as attributes to the tweets (Hellsten & Leydesdorff, in press). To account for the social networks of authors, automated analysis of the tweet content has been combined with manual coding of the Twitter users into stakeholder categories (Hellsten, Jacobs & Wonneberger, in-press). Combining the manually identified authors and the automated analysis of Twitter-specific affordances opens up new avenues for socio-semantic network analysis.

We apply the approach to an analysis of two food quality debates, first, on over-fed mass-produced chickens, and, second, cheap meat sold in supermarkets. Our data set consists of 18,631 tweets on over-fed chicken, and 7,687 tweets on cheap-meat that were sent in 2015-2017 in Dutch. We coded manually the Twitter user accounts that sent 5 or more tweets during our period into six stakeholder categories (media; environmental organizations; individual citizens; eco-industry; conventional industry and others). Our results show that in both debates individual citizens and environmental organizations use hashtags in a similar vein, whereas the media forms its own separate cluster. In the re-tweet networks, individual citizens play a prominent role, in particular in re-tweeting messages authored by environmental organizations (Wonneberger, Jacobs & Hellsten, in-prep.). Comparison across socio-semantic networks of authors and their hashtag use, on one hand, and authors and their RTs, on the other hand, provides an additional layer to the whole-matrix approach (Hellsten & Leydesdorff, in-press). Building upon actor-network theory, and issue arena approach, we discuss the implications of the methodological approach to socio-semantic network analysis.

### **Sociocultural and sexual partner influences on pre-exposure prophylaxis (PrEP) views, history of PrEP use, and future PrEP use**

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**Introduction:** Despite its proven effectiveness in reducing HIV transmission, PrEP use remains low. The purpose of this study was to investigate social, individual, and partner influences on PrEP views, history of PrEP use, and future PrEP use among men, transmen, and transwomen who have sex with men.

**Methods:** *Together 5000* is a US-national, internet only-based cohort that enrolled 16-49 year olds between 10/2017 and 6/2018 to investigate HIV incidence and correlates of infection among persons at higher risk for HIV transmission. This study used data assessing demographic, behavioral, social, and sexual partner influences on PrEP views ( $n = 1,675$ ), experience with PrEP ( $n = 2,315$ ), and intentions to use PrEP ( $n = 1,675$ ). All participants were required to be not taking PrEP at enrollment. We defined PrEP views as how participants first learned about PrEP, what was/who were the greatest influences on PrEP views, and how people they were close with viewed PrEP (favorably, opposed, no strong opinions, etc.). We used multivariable logistic regression to examine individual and partner characteristics associated with each PrEP outcome.

**Results:** The most frequently reported methods of first hearing about PrEP among our participants were through a friend (25.5%), social media (25.3%), or the news media (14.7%). Considerably lower proportions were introduced to PrEP through a main (2.3%) or casual (5.7%) sex partner. Similarly, participants reported that social media (22.2%), friends (20.5%), and news media (14.3%) were more influential on their current views of PrEP, than main (4.1%) and casual (4.8%) sexual partners. Most (64%) participant's networks were in favor of PrEP. Multivariable analyses found that history of PrEP use was associated with individual demographic characteristics—e.g., non-binary gender-identified participants (aOR = 3.96; 95% CI: 1.36—11.54; ref: cis-male), Black/African American (aOR = 1.91; 95% CI 1.22—2.99, ref: white), and known HIV-negative participants (aOR = 1.77; 95% CI 1.49—2.09, ref: unknown status)—and sexual partner factors. Participants who knew that their main sexual partners used or had used PrEP were 2.2 times more likely to be also be former PrEP users (95% CI: 1.45—3.33, ref: no use). Intentions to use PrEP were also associated with individual demographic factors—e.g., Black/African American (aOR =

2.23; 95% CI: 1.18—4.23) and engaging in sex work in the past 3 months (aOR = 1.82, 95% CI: 1.10—3.02)—and sexual partner characteristics—e.g., participants with a HIV-positive main partner (aOR = 2.77; 95% CI: 1.31—5.87, ref: HIV-negative partner). Notably, participants who did not know their main partner’s HIV status were less likely to intend to use PrEP (aOR = 0.19; 95% CI: 0.05—0.71, ref: HIV-negative partner).

**Conclusions:** Friends and social media were common and influential sources of information regarding PrEP. Sexual partners were less frequently reported as being initial or influential communicators about PrEP, however sexual partner characteristics were associated with both a history of PrEP use and intentions to use PrEP. These results suggest that broader reaching positive PrEP messaging may filter through social and sexual relationship pathways to positively influence individual PrEP views and use.

### **Sources and Types of Support and Barrier Derived from Semantic and Sentiment Analyses of Floridians’ Tweets in Hurricane Irma**

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Impacted Twitter users’ needs during Hurricane Irma have been examined via “need tweets,” which are tweets that express at least one concern. A variety of social and physical entities may provide support or barrier to impacted people as they attempt to address their needs. For example, faith-based organizations serve a critical function as sources of physical, material, and spiritual support following hurricanes, while the voice of the government has been notably silent on Twitter during storms, which might present a barrier. This study seeks to build on existing knowledge about need tweets during Hurricane Irma to examine the different sources and types of support and barrier expressed on Twitter as impacted users prepare for, endure, and recover from the storm. Research questions include: What sources (nodes) and types (ties) of support and barrier related to Hurricane Irma are identifiable from Floridians’ tweets? What is the contrast between pre-existing and emergent ties? And how do insights from Twitter analyses contribute to understandings of the link between social-physical nodes?

The context for this study is Hurricane Irma. Hurricane Irma made landfall in the United States on September 10, 2017 as a category four storm in the Florida Keys and a category three storm on the coast of southern Florida. Data include all the tweets with geo-location tags from inside the state of Florida between August 25 and September 30, 2017. The sample is roughly one million tweets from nearly 100,000 unique users. Preliminary explorations of the data were conducted on all the data from five timepoints, including the storm’s landfall and three days and six days pre-storm and post-storm. Semantic network analysis indicated lack of gasoline presented a barrier three days prior to the storm, while lack of power was a barrier three days after the storm. Further analyses will use smaller sub-samples of the data – tagged with “Irma” or “hurricane” and/or geo-located in southern Florida – to examine how support and barrier change in the two weeks before and after the storm. A mix of quantitative and qualitative semantic and sentiment analyses will be used. This study builds knowledge about the interdependence of social and physical systems in networks and hurricane resilience. Findings will suggest areas of strength in hurricane preparation and recovery and areas needing improvement. Understanding what or who helps or hinders impacted people, and how, is essential to finding ways for institutional and community relief efforts to facilitate individual and community resilience and recovery after natural disaster.

**Spatial representation of public discourse**Nico Blokker<sup>1</sup><sup>1</sup>University of Bremen

Building on the foundation of discourse network analysis and the spatial theory of voting we seek to answer the following question: How do actors position themselves in relation to each other during a public discourse? Accordingly we propose an approach that utilizes latent space modelling in order to improve understanding of public media discourse. The goals of this process are twofold. The first is to model and estimate (and potentially predict) the positioning of content and actors in an unobserved social space and in relation to each other. This hopefully results in a meaningful spatial representation of the actor-concept relations akin to established scaling techniques (e.g. ideal point estimation). The second goal is to isolate the network generating process by including additional covariate and structural properties. By choosing a network based approach we hope to capture second and third order dependencies, which might help explain coalition building and, in a dynamic setting, their shifting as well as the transformation of the discourse. We use German newspaper data focusing on the so called “migration-crisis” in Germany in the year 2015. By connecting political claims and their corresponding actors a bipartite network structure is being formed, which resembles a structure known from rollcall data. However, instead of focusing on ballots and rollcalls we trace the preceding public discourse. In place of established techniques to scale political dimensionality a latent distance model is being induced. This follows the assumption of node based homophily, which groups similar voting or “claiming” actors closer together. This hypothesis is in line with the spatial theory of voting, where voters vote for concepts or candidates closest to them. This approach can be extended to include a dynamic setting to trace actor-concept positions over time and in relation to the surrounding space and might help to analyse a change in the discourse. Hopefully this novel approach not only increases readability of (often arbitrarily arranged) discourse networks but also maps them meaningfully into low dimensional space.

**Special Panel on the Future of Negative Tie and Signed Graph Research**Giuseppe Labianca<sup>1</sup><sup>1</sup>University of Kentucky

Within the special mini-conference-within-a-conference, we will be convening a special panel of distinguished researchers in the area to discuss their perspectives on where negative tie research should be headed in the future. The following panelists have agreed to participate: Patrick Doreian, Beate Volker, Brian Rubineau, Martin Everett, Steve Borgatti, Alex Gerbasi, Nicholas Harrigan, Filip Agneessens, and Andrew Parker.

**Spheres of Life and Context Collapse at Birth and Death of an Online Social Network**László Lőrincz<sup>1</sup>, Júlia Koltai<sup>2</sup>, Károly Takács<sup>2</sup><sup>1</sup>Hungarian Academy of Sciences, Centre for Economic and Regional Studies, <sup>2</sup>Hungarian Academy of Sciences, Centre for Social Sciences

The social life of an individual is traditionally segmented to different circles in society: friends from school, colleagues from work, acquaintances from different hobby activities, friends of the spouse, neighbors, and relatives. When users enter large Online Social Networks (OSNs), these distinct spheres of life with different norms and expectations are merged and might conflict with each other. This phenomenon of context collapse could largely determine the emergence as well as the decline of certain OSNs and could imply certain network characteristics that were previously attributed to different mechanisms. In this chapter, we investigate the relevance of context collapse by using computational social science tools on a database that contains the entire

network structure of an OSN. We analyze the effect of ego-network structures in the time of building up and also in the abandonment of the Hungarian OSN iWiW that had approx. 3.5 million active users at its peak of popularity and was the most attended OSN in Hungary before the appearance of Facebook. Our results bring new light also to the literature on echo-chambers: results underline the confusion of a large proportion of users due to context collapse and indicate self-selection into filtered OSN worlds or abandonment.

### **Standing in the Light of Reflected Fury: Prismatic Effects of Negative Ties**

Dan Halgin<sup>1</sup>, Steve Borgatti<sup>1</sup>, Zhi Huang<sup>1</sup>

<sup>1</sup>University of Kentucky

Existing work on negative ties has focused primarily on the harm they do. In this paper, we show that negative ties can also have beneficial effects. We argue that, like positive ties, negative ties can link actors together in the minds of observers. As a result, we theorize that negative ties with high-status actors can benefit a focal actor, whereas negative ties with low-status actors can harm the focal actor. This prismatic effect depends on the existing status of the focal actor: a focal actor of low status is likely to benefit far more from negative ties with high-status actors and suffer more from negative ties with low-status actors than will an actor of high-status. To test our ideas, we analyze the phenomenon of "diss songs" in hip-hop music. A diss song is a song in which a rapper makes derogatory comments about another rapper, constituting a negative tie. We analyze the effects of negative ties among 53 rappers over 20 points in time on audience reaction as measured by record sales. We find that negativities with high-status actors enhance future sales for low-status actors. However, negative ties with lower-status actors have no effect on the future sales of both low- and high-status actors. Just as some researchers have reported both positive and negative consequences of social capital, our study demonstrates that negative ties can also have both positive and negative outcomes.

### **Strategic Closure and Brokerage of in Kyoto Gion - Behind the Closed Doors**

Yuki Yasuda<sup>1</sup>

<sup>1</sup>Kansai University

Gion, a district of Kyoto, has been worldly known for its luxurious entertainment by maiko. The purpose of this paper is to describe the details of business model of Gion kobu (hereafter Gion), an eastern part of Gion, based on hearing and observation of a 100-years old bar called S in Gion from 2011 to 2017. The main questions addressed are; (1) who the customers are, and (2) what kind of social networks customers form at ochaya (tea house) in Gion. My focus is not on maiko nor geiko, but on the relationships among their customers.

Gion kobu is the largest Hanamachi in Japan, and it has attracted many kinds of guests from royal family members, world-famous sports players, singers, cinema celebrities, COEs of international enterprises, politicians to ordinary people. There are 60 ochaya in Gion where maiko entertains customers. They all obey the customs of Gion, such as daily greeting, seasonal ceremonies, what to wear, and language accent workers speak. Now Gion kobu is the biggest Hanamachi in Japan, holding 119 maiko and Geiko, traditional Japanese dancers and music players in 2018. They were 92 in 2009. Most of them are not Kyoto born, though their accents are well trained and are uniquely to Gion. Some can speak foreign languages without being educated in high schools. A well-known lady who was called "Elisabeth Maiko" who entertained Queen Elisabeth at an ochaya is still at work.

Traditionally ochaya are for "members only." For a newcomer to become the member, he needs a reference from pre-existing members. After he becomes a member at ochaya, he needs no wallet. All cost of foods, drinks, tips for maiko and traditional music players will be charged 2 or

3 weeks later to the customer. As this ochaya system is very closed, basically one needs a special acquaintance to get involved. However, a bar called S, which I observed was functioning as a loophole for this system. S is basically open for public customers, which is located on a ground floor of an ochaya. Both S and ochaya are owned by a family of 100-year old business groups. Many of customers of S are the customers of ochaya, that include, ex-prime ministers, CEOs, artists, monks, Kyoto traditional business owners, restaurant chefs and Kabuki actors.

Their regular customers can be classified by groups. (1) old and young leaders of tradition Japanese culture business such as manufactures of Japanese kimono, foods, tea, ceramics, papers. They form over-generation BtoB business relationships reciprocally. (2) COEs and high-rank workers of international business firms, especially Kyoto looted old firms. VIP circles develop within these 2 categories. (3) Local residents worshipping Yasaka Shrine and Naginataboko owners form religious and friendship ties. (4) High-class tourists, celebrities and S' regular customers. As walk-in guests bring little business chance for Gion, they are out of these social networks. Other groups form cross-cutting circles at the core of social networks in Kyoto.

### **Structural balance and polarization in global virtual teams: grounding the role of negative ties onto large scale disorder**

Marc Idelson<sup>1</sup>, Yuki Yasuda<sup>2</sup>

<sup>1</sup>OWI Technologies, <sup>2</sup>Kansai University

**Negative ties inspiration.** Spurred by the negative ties Social Networks special issue and its companion session held at Sunbelt 2017, we acquired access to an empirical dataset that has produced over 20 scholarly publications since 2013, none of which approach the set in question from a network perspective, despite 15,000 non null peer-to-peer (network) data points.

#### **Focus of Sunbelt 2019 communication.**

We plan to share our structural analysis of the negative and positive dynamics within 2,000 global virtual teams working simultaneously and independently (within 24 consecutive sessions since 2010) on a standardized set of tasks over a set period in order to produce a standard output. The 14,000 team members, based in 40 countries, were assigned to teams randomly within the session in which they participate.

The analysis will be two-fold: a straightforward multilevel analysis of discrete positive and negative intra-team ties, and a static and dynamic analysis of the patterns stemming from both the teams' processes and outputs.

**Empirical context.** Several times a year, X-Culture operates a two-sided platform where undergraduate and postgraduate students produce in global virtual teams an international business plan for an existing company to enter a new country with an existing or new offer. At session start, the X-Culture platform forms teams with 6 or 7 members, based in 5 or 6 countries. Participants fill an initial survey prior to team assignment. For the next 8 weeks, team members progress on intelligence gathering, analysis, and report writing, and fill surveys weekly within which they assess their peers. After the team files its report, a final survey with more peer assessment is undertaken to wrap up the session. A process for voting members out during the session also exists.

#### **Further theoretical development.**

Inspired by models of granular matter in material science (which leverage fractals to model phenomena such as percolation, porosity or lightning), we plan to put forward a model of large scale organisational disorder born of negative tie micro-foundations. We envisage to use agent-based simulations to test the model's viability.

#### **Further empirical exploration.**

For this prime exploration of the dataset from a network perspective, we will limit our empirical investigations to static and dynamic structural multilevel network analysis and their mutual interplay with team-level traits (such as team inputs and outputs). The dynamic network analysis will focus on three periods in each session: mid term situation, ultimate rush to polish to the final report/output, and post session perspective —experience as instructors has taught us the team formation period is subject to too many exogenous factors, including contrasting national and institutional calendars of participants, to safely infer anything.

Future directions include: injecting individual-level traits into the analysis (e.g. negative affectivity; institutional, occupational or regional cultural considerations; languages; time zones...), individuals' contribution to team inputs and outputs, and, of course, interplay between network characteristics and node traits.

### **Structural Cohesion and Social Influence in Corporate Networks**

Richard Benton<sup>1</sup>, Mark Mizruchi<sup>2</sup>

<sup>1</sup>University of Illinois, <sup>2</sup>University of Michigan

Research on social influence across organizational networks has largely ignored the role of social structure. We extend prior work on inter-organizational social influence through board interlock networks by considering how social influence processes are stronger when nested in structurally cohesive subgroups, characterized by multiple redundant and overlapping ties. Structurally cohesive network topologies ensure that ideas and practices are encountered repeatedly and reinforced, thus enhancing social influence. Drawing on research on structural cohesion in social networks and inter-organizational social influence and diffusion over board interlocks, we show how dyadic social influence processes are more powerful when actors are mutually nested within cohesive networks. We find evidence for cohesion contingent social influence in corporate governance using data on board interlocks among S&P 1500 firms from 1998 to 2014. The results show how network cohesion, and its decline, may have important consequences for the spread of corporate governance approaches in corporate America.

“This abstract is related to Corporate Networks”

### **Structural inequality in corporate board interlocks in Sweden: A big data full sample approach**

Peter Dahlin<sup>1</sup>, Ossi Pesämaa<sup>2</sup>

<sup>1</sup>Mälardalen University, <sup>2</sup>Luleå University of Technology

Corporate board networks is fundamentally two or more companies sharing a common director that enable the company to adopt, imitate and transform strategies, policies and practices from the other company directly. By sharing a director companies may gain beneficial resourceful informational and relational advantages over other companies that do not. In principal, we drew this work on social network theory to describe and suggest tentative differences in structures of boards of directors. As some boards of directors are more centred than other they also benefit more from this position. This type inequality directly tied to a board network of ties is known as the Matthew effect (Merton, 1968). Furthermore, consistent with notion of this, social network theory posit that certain corporate boards are formed, motivated and based on principles of homophile meaning that same groups support each other reciprocally (Ben Barka and Dardour, 2015; Wong, Gyax and Wang, 2015). The theoretical consequence is unequal structures (Kogut et al., 2014). To explicate this question further we mapped the entire Swedish board structure comprising 712 716 individuals in 501 746 companies in Sweden in 2016. Our findings reveal (i.e., at a company level) that 33.25 % (166 828) belong to a main component directly or indirectly linked to another company while 23.75 % (169 259) individuals were related (i.e., at an individual level) in a main component of individuals. Moreover, recent studies imply that Swedish corporate

boards are represented by so called “old boys’ networks – implying a social elite” (Edling, Hobdari, Randøy, Stafsudd and Thomsen, 2012:183) which outsiders cannot reach. Therefore to further explore we asked if board structure would differ in a randomly generated sample (i.e., using Bernoulli allocation) and in a sample accepting given same in equal terms (i.e., Monte Carlo Bootstrapping) such as biased age, sex and number of assignments. Our results reveal that a random allocation and given same structural attributes generate different structure implying that there is a selection mechanism determining these board networks. These findings have implications on inequality were selection is a structural property.

### **Structure and Content of Rural STEM Councils**

Eric C Jones<sup>1</sup>, James Middleton<sup>2</sup>, Jeremy Babendure<sup>2</sup>

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Existing structured opportunities to learn about science, technology, mathematics and engineering outside of school/class are considerably fewer in rural areas compared to urban areas, and their accessibility/outreach is typically also more limited or narrow. This development and research project supports four rural innovation councils in Arizona to foment experiences with math, engineering, science, and technology outside of formal schooling/in-classroom activities. We asked 10 participants in each council to list and describe all the informal STEM-related relationships they have had in their community with other local and extralocal individuals and institutions. Councils varied in level of sectoral diversity, core density, number of pendants, degree centralization, reciprocal and strong relationships in the core and periphery and between core-periphery. In some cases, this variation allows each council to leverage local resources and ways of doing things. In other cases, some of this variation suggests missed opportunities. For intervention, each council was presented with the network study results in order to improve local initiatives and coordination. They used this as a chance to look in the mirror and evaluate which activities/ties/efforts needed maintenance vs. pruning vs. augmentation vs. changed directions. A second round of data collection will provide insights into change in these newly formed councils—giving us information on sustainability, coherence of core efforts, and attraction of new partners and audiences.

### **Structure-based Identification of Threats and Opportunities for Participatory Systems**

#### **Mapping**

Verena Knerich<sup>1</sup>, Alexandra Penn<sup>2</sup>, Pete Barbrook-Johnson<sup>2</sup>, Ananya Mukherjee<sup>2</sup>

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We propose a new analytical typology that makes structure-based suggestions of aspects within a problem field representing opportunities or threats during decision making processes. We are using a modified version of Fuzzy Cognitive Mapping as a participatory modelling tool in the context of evaluation and design. In the course of a workshop, a group of stakeholders collaboratively goes through the process of constructing a systems map of an issue. These networks represent the collective, semi-quantitative representation of what stakeholders deem of relevance to their context. They are comprised of factors, actors, resources and any other elements identified by the participants as well as the causal interrelations made between these nodes. Unlike conventional fuzzy cognitive maps, we treat these system maps as directed graphs and include additional stakeholder information. Going through the process of first constructing, verifying and then analysing such maps can be of great value especially to a diverse group of participants to facilitate project planning, to sense-check assumptions, to achieve a common understanding of an issue, to aid in decision making and to identify intervention opportunities. The novel typology we propose is based on combining various centrality measures with subjective

ratings by participants on how much control they assume to yield over a factor. The potential implications of the structural position of said factors is communicated to the participants by using intuitive names and graphical representations. They are meant to open up discussions about potential threats they may encounter in planning processes or point towards intervention opportunities. In essence, it serves as a thinking tool enabling stakeholders to identify factors whose structural properties may have implications to the issue they are trying to solve. This approach can be applied in very diverse settings including policy evaluation, planning of community projects and in projects at the intersection of different stakeholder groups. The general premise is to empower participants from all backgrounds to contribute their perspective and specifically to harvest local knowledge that may not be available in quantitative reports. We tested our methodology on pre-existing networks from past workshops and are currently setting up further tests with participants. The use-cases so far had an ecological focus and ranged from developing community-led eco projects on energy, improving the ecological health of a river system to mapping the potential of community infrastructures to support citizen innovation and action. Overall, we seek to aid participants in their unique settings by facilitating their discussions through harnessing network analysis coupled with subjective assumptions.

### **Sustainability Governance Networks: Forest Management in the Argentine Chaco**

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Native forests are precarious and complex systems and institutions governing them strongly affect the ecosystem services provided. The forest management in Chaco Salteño, in North-West Argentina provides a case study for how governance networks can impact forest management. The region has experienced one of the highest deforestation rates in Argentina and is a “contest arena” between large-scale agricultural producers (beef, soybeans and other commodities), small-scale “criollo” cattle ranchers and indigenous peoples, whose livelihood depends on the remaining forests.

There is a number of contrasting and overlapping legislative frameworks including: environmental and climate change legislation; family farming legislation; large-scale agricultural production support legislation; legislation protecting individual private land property rights; legislation protecting the human rights of forest inhabitants and their right to land and territory (including communal lands). In short, the land question in the Chaco Salteño is associated to numerous conflicts, which manifest themselves at the local, regional, federal and international level. Poverty is also a critical issue in discussing forest management policy. For some stakeholders this does not present a sustainable development issue but is instead framed as a social issue.

We employ a social network analysis lens and adopt a mixed methods approach with original data collected between May and October 2018. We combine the study of policy network topology, with the analysis of stakeholders’ discourse. During data collection we have adapted a widely used instrument (COMPON) while further incorporating stakeholder visions of risk, land tenure regularization and forest management policy, so as to identify discourse coalitions of different stakeholders. We focus on key policy implementation events with an impact on forest management. These include: forest use planning boards; international projects; regional governance boards; climate change plans; and native forest action plans.

We analyze and present the co-participation of all stakeholders in different policy fields, as well as map direct ties among stakeholders reflecting their exchange of scientific/technical information, mutual support, and direct interactions.

We examine:

**Synergies between Social Network Analysis and Necessary Condition Analysis – The case of an innovation network**

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This study seeks to explore necessary but not sufficient conditions in a networked innovation context. Forming and maintaining social networks can be characterised by some necessary conditions and some conditions that may support network outcomes but are not necessary in nature. Without the required levels of necessary conditions ‘failure’, i.e. the absence of the outcome condition is guaranteed. The absence of necessary conditions cannot be compensated by other conditions, thus the necessary condition can be a bottleneck, critical factor, constraint, or disqualifier.

For example, there are necessary conditions for clustering for the nodes of a graph to be separated into two or more subsets (Wasserman & Faust, 1994), to manage successful acquisitions in business networks (Naudé et al., 2014) and presumably to reach higher status in advice networks (Lazega et al., 2010). Various further network examples may apply, in fact, according to Goertz’ first law, for any area of interest one can find necessary condition hypotheses (Goertz & Starr, 2002).

To assess necessary conditions in an innovation network context we apply Necessary Condition Analysis (NCA) (Dul, 2016). By using NCA we explore cause-effect relations in terms of "necessary but not sufficient" and distinguish between some necessary and “nice-to-have” conditions. NCA enables us to study different levels of conditions relevant to innovation being necessary for different levels of network outcomes. We use the innovation network example as an illustrative case to discuss potential synergies between SNA and NCA but also to open up a discussion about conditions that may not have been discussed as necessary in literature but appear as such according to the analysis.

**Taking the Bad with the Good: Change in Signed Ties and Well-being Following a Traumatic Incident**

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**Background:** A fire in the ABC day care center in Hermosillo, Mexico in June 5, 2009, caused 49 deaths, at least 40 hospitalizations, and dozens of injuries. After the fire, caretakers in our study suffered from a traumatic incident, and their network relationships were sources of support or pressure, potentially leading to a better or worse mental status, such as PTSD and depression. However, individuals having mental distress are also likely to develop negative interactions with others. **Objectives:** To examine whether ego’s (participant) negative social relationship with their nominated network members would predict ego’s depression or PTSD at follow up, and whether ego’s depression or PTSD would predict ego’s negative social relationships. **Methods:** We interviewed 224 caretakers at 8 to 11 months (time 1) and 205 parents and caretakers at 20 to 23 months (time 2) after the ABC daycare fire. Each interviewee (ego) was asked to nominate 7 other parents/caretakers (alters) of the children. An ego’s negative tie toward each alter was created based on three questions: closeness, desire to spend time together, and agreement. We first used generalized estimating equations (GEE) to assess if ego’s time 1 negative ties with alters would predict ego’s time 2 depression or the PTSD subscales arousal, intrusion and avoidance. The models controlled for interviewee’s gender, role (parent/caretaker), whether or not they are bereaved, mental status at time 1 and whether they received emotional support at time 1. Then, we utilized random-effects ordered logistic models to assess whether ego’s depression or PTSD subscales at time 1 would predict ego’s negative ties at time 2, controlling for interviewee’s

gender, role (parent/caretaker), whether or not they are bereaved, and whether they received emotional support at time 1. **Results:** Having depression or PTSD at time 1 predicted increased likelihood of ego's depression (OR=7.53, 95% CI=3.41-16.61) or PTSD (arousal OR=3.04, 95% CI=1.04-8.82; intrusion OR=4.07, 95% CI=2.02-8.22) at follow up. Having depression (OR=0.27, 95% CI=0.07-1.04) or receiving emotional support (OR=0.02, 95% CI=0.00-0.16) predicted decreased likelihood of developing negative ties. **Conclusions:** The study suggests that having negative ties does not predict depression or PTSD a year later. Also, having depression does not predict increased, but rather decreased likelihood of developing negative ties a year later.

### **TalkTracker: Dynamic word networks to track conversations over time**

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Online social networking has become an integral way we communicate, share ideas, and consume news and media. This phenomenon, while beneficial in many ways, has resulted in analytic challenges when attempting to find insights in streams of data that are dirty, unstructured, and incomplete. Traditionally researchers have relied heavily on keyword lists to filter unstructured data at scale. However, as the volume, velocity, and variety of such data has grown, traditional keyword based methods have struggled to keep up. Researchers simply don't have the time or resources to constantly update, refine, and test the efficacy of such lists. Yet, the world keeps changing and conversations with it. As a result, researchers using keyword-based methods are often left with an aged, biased, or incomplete view of events. While there is broad consensus in the applied text analysis field that keyword lists are here to stay, it's clear that researchers require new approaches to keyword generation and implementation that are dynamic, efficient, and effective.

TalkTracker is a revolutionary new tool that enables users to analyze and visualize real-time dynamic word networks, illustrating emerging issues and trends over time. Applying validated statistical methods drawn from the world of marketing, TalkTracker identifies significant associations between words occurring together frequently in online posts. This association algorithm learns from and automatically adapts to changes in streaming social media data in near-real time. TalkTracker's intuitive user interface allows researchers to filter and explore visualizations of these word associations over time, making it easy to monitor topics or events and dynamically adjust related keyword lists as conversations evolve. In addition, a scoring capability allows the user to quickly identify the most relevant posts as they come in, leading to reduced data cleaning activities and, as a result, more complete insights from social media data.

During testing, TalkTracker demonstrated a remarkable ability to rapidly adapt to changes in global Twitter conversations in real-time. When primed to look for Tweets related to national security related events (shootings, bombings, etc) TalkTracker identified such events 15-30 minutes before international media sources in most cases. Additionally, TalkTracker correctly classified over 95% of tweets as relevant or not relevant during each test event.

A Sunbelt 2019 session will highlight the early successes of TalkTracker and the potential value the approach can provide to researchers in a variety of fields. We will give an overview of the methods behind our adaptive, real-time association algorithm and the resulting construction of dynamic word networks. A demonstration of the tool will show how TalkTracker can be used to monitor conversations around specific topics or events of interest, even as these conversations evolve and shift in response to new developments. The widespread adoption of social media in recent years has emphasized that our world is far from static. TalkTracker illustrates an effective way to apply text and network analysis methods to adapt to this new reality.

**Team Trust and Performance: Examining the Predictive Validity of Network Approaches with Traditional Methods**

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The increasing use of empowered teams and self-managed team structures (Mathieu, Maynard, Rapp, & Gilson, 2008) has elevated the importance of team trust which has been argued to be an important factor of work relationships and one of the most regularly examined constructs in the field (De Jong, Kroon, & Schilke, 2017; Fulmer & Gelfand, 2012). Although numerous studies have examined the relationship between team trust and performance across a different contexts and team categories, results have been inconsistent, with some work showing support for a positive trust performance relationship (De Jong & Elfring, 2010) to others showing no impact (Aubert & Kelsey, 2003) or a negative trust—performance relationship (Langfred, 2004). We believe that to develop a more nuanced understanding of team trust and address inconsistent results researchers need to examine and contrast measurement approaches more thoroughly. Specifically, we contrast the referent shift approach—which asks team members to mentally aggregate all the dyadic member relations and to develop a general estimate of how much trust is going on within the team—with the social network approach—which accounts for configural patterns of trust among team members—to explore the association between team trust and performance.

Drawing from the perspective of trust as a multidimensional construct, including cognitive (i.e., competence) and affective (i.e., benevolence) dimensions, we investigate the joint effects of functional diversity (i.e., specialized knowledge or unique functional expertise that make team members distinctively capable) and team cohesion on team performance through their effects on trust. Our sample consists of 170 students distributed across 51 teams in eight sections of undergraduate and graduate-level strategy courses at a large northeastern university. Each student was part of a 4 or 5-member team that participated in a 10-week business simulation that required teams to make a variety of strategic decisions (e.g., operations, marketing, finance, and R&D) for each week representing 10-simulated years. This sample mirrors organizational projects as participants are engaged in a 'real world' simulation with reward implications (i.e., grades) in a complex, two and a half month project. In contrast to the reported effects comparing trust network and traditional measures in De Jong et al.'s (2016) meta-analysis, our study suggests that the network effects on performance are stronger (in the case of competence trust). Theoretical and methodological implications of modeling different dimensions of trust using a social network approach will be discussed along with the implications for self-managed teams and informal leadership emergence.

**The Ambivalence of Cultural Homophily: Field Positions, Semantic Similarities, and Social Network Ties in Creative Collectives**

Nikita Basov<sup>1</sup>

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This paper utilizes a mixture of qualitative, formal, and statistical socio-semantic network analyses to examine how cultural homophily works when field logic meets practice. On the one hand, there is an implicit association between the intersubjective mechanism of cultural homophily and 'objective relations' structuring social fields: Because individuals in similar field positions are also imposed with similar cultural orientations, cultural homophily serves reproduction of the 'objective' field structure at the level of intersubjective social network ties. On the other hand, fields are operative in practice, which often refracts their prescriptions as individuals, to accomplish their pragmatic goals, creatively reinterpret the field-imposed cultural orientations.

Moreover, local practical contexts often group individuals who occupy different field positions to combine diverse forms of capital in order to address complex tasks. Group idiocultures, locally emerging from such practical encounters, are a source of cultural similarities alternative to the position-specific ones. Drawing on these emergent similarities, the cultural homophily mechanism may also lead to social network ties between members who occupy different field positions, thus contesting fields. I examine this ambivalent role of cultural homophily in two creative collectives which members are positioned at the opposite poles of the field of cultural production. I find different types of cultural similarities to affect different types of social network ties within and between field positions: Similarity of vocabularies stimulates friendship and collaboration ties within positions, while engagement with the same cultural structures stimulates collaboration ties between positions. I also find the effect of practice contesting field via cultural structures visible under statistical analysis of ethnographic data, but easy to oversee in qualitative analysis of texts, because informants tend to flag conformity to their positions in their explicit statements. This highlights the importance of mixed socio-semantic network analysis, both sensitive to the local context and capable of unveiling the mechanisms that underlie the interplay between culture and social structure.

### **The analysis of theoretical contributions for empirical articles of Social Networks Journal from 1979**

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The idea of academic “impact” has been on the forefront of many fields for a number of years. To illustrate, multiple studies, especially in the field of management, have looked at the scholarly impact. There were two levels of research - on the author level: "What causes a management article to be cited - article, author, or journal?" [2] , and on the journal level: "The influence of management journals in the 1980s and 1990s" [3]. Nevertheless, at the current moment there are no studies that have looked at the journal-field co-evolution. In this paper, we present the preliminary results of an ongoing research project based on data from a sample of 41 top-cited articles of the Social Network Journal are presenting the dynamics of citation rates of the journal within the timeframe and citation network of the Social Network Journal.

The goal of this study is to analyze the Social Networks Journal contribution to the sphere of social network analysis and as a result, improve the methodology that reflects the theoretical contribution of empirical articles within three dimensions: theory building, theory testing and applied method. In addition, the paper includes the examination of journal co-evolution within the field of social network analysis. In this study, we build a model of social network journals and identify the place that Social Networks occupies within this network, with its unique impact.

### **The Anti-Social Network: The Role of Dark Triad Behavioral Predispositions on Positive and Negative Tie Formation**

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This paper investigates the influence of three anti-social behavioral predispositions - Narcissism, Psychopathy, and Machiavellianism, what psychologists term the “Dark Triad” - on the formation of positive and negative ties. The authors argue that individuals with dark triad traits have a unique network structure. The paper tests hypotheses derived from the theory on the individual, dyadic, and triadic levels using a unique longitudinal socio-centric dataset. The authors present preliminary results, which show that individuals with anti-social dispositions appear to exhibit less tendency towards structural balance, and argue that this is likely because these individuals feel

less need to abide by normative constraints. The paper concludes by discussing implications of this work on the long-standing sociological question of how micro-level traits, such as personality, influence and are influenced by the larger social structure.

### **The Attack Tolerance of Dynamic Networks: The Case of Darknet Drug Trafficking**

Scott Duxbury<sup>1</sup>, Dana L. Haynie.<sup>1</sup>

<sup>1</sup>The Ohio State University

Interconnected systems in physical, biological, and social sciences are often at risk of attacks from exogenous sources. As a result, a growing number of studies focus on network attack tolerance. In general, this body of research assumes that damage to cross-sectional networks persists over time and has almost ubiquitously focused on attack strategies that target integral vertices or edges. At issue, however, is that many networks are dynamic, especially in the social sciences, and capable of adaptive responses to attacks. Relatedly, network attack strategies may be diffuse, targeting an array of weak links or saturating a network with noisy signals, rather than deleting high profile vertices. Yet, few, if any, studies have assessed the attack tolerance of dynamic networks. As a consequence, social scientists and network researchers know little regarding the attack strategies which are likely to yield the most time persistent network damage, or whether the results from cross-sectional research on network attack tolerance apply to the dynamic context.

Expanding on prior work, we examine data collected from an online illicit drug trafficking network comprised of 7,295 actors and 16,847 illicit drug exchanges observed over 14 months. We use these data to develop an empirically grounded agent-based simulation experiment evaluating how the drug trafficking network responds to three attack strategies: attacks that target actors with high degree centrality (targeted attacks), attacks that delete a large number of actors with low degree centrality (weak link attacks), and attacks that flood the network with a noisy signal (signal-based attacks).

Results show that, while targeted attacks yield substantial damage at high levels of intervention (when a large number of vertices are deleted), they tend not to yield time-persistent damage at low levels of intervention (when a relatively small number of vertices are deleted). Alternatively, both weak link and signal-based attacks often yield comparable damage to targeted attacks in dynamic settings. Moreover, these diffuse attack strategies yield more damage than targeted attacks at low levels of intervention. Findings also indicate that signal-based attacks curb network growth more-so than any other attack strategy at low and medium levels of intervention. Finally, we identify a positive correlation between change in the number of isolates and change in assortativity following an attack, indicating that increases in the number of isolates can drive increases in assortativity. This result raises questions about the interpretation of assortativity as an indicator of dynamic network attack tolerance.

Results illustrate the need to consider network adaptations to exogenous shocks in the literature on network attack tolerance. Our agent-based simulation experiment reveals that many of the assumptions in the cross-sectional literature on network attack tolerance are questionable when applied to dynamic adaptive networks. Of note is the positive relationship between assortativity and the number of isolates, which suggests that assortativity can increase, despite the network losing a large number of vertices. Pertinent to policy, findings also illustrate that signal-based attack strategies may be an effective strategy for curbing online drug trafficking—an issue which has vexed law enforcement for some time.

### **The Collective Interests of Large Corporations: Social Movement Protest and the Policy-Planning Network**

Tarun Banerjee<sup>1</sup>

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Note: This abstract is related to corporate networks

Is the corporate class fractured or it is able to transcend individual interest in favor of a collective interest? I address this ongoing debate through a unique application – how large corporations respond to social movement demands. Through a statistical examination of an original database of protests, I find mechanisms still exist that unify the interests of firms targeted by movements. Specifically, policy-planning groups shape and unify firm strategies over whether to concede to protest demands. In asking how the social relations of large corporations shape social movement outcomes, this paper bridges broad questions in organizational, social movement, and class analysis.

### **The construction of the national social protection policy in Madagascar: an inter-organizational network analysis**

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Like many low-income countries, Madagascar is characterized by a "social system of insecurity" illustrated by low social security coverage by public insurance; a huge gap between legal norms and socio-economic conditions; and social safety nets with very limited scope. Since 2015, the country has adopted a "National Policy for Social Protection" as part of its development strategy that aims to guarantee a formal social protection for 50% of the population by 2030. Achieving this goal requires the implementation of a common vision and a shared strategy between various organization types currently involved in this field. Rather than an established national system of social protection, the social protection in Madagascar a new public policy that builds on existing programs. The formulation of this policy rests on a specific political arena, the GTPS (Social Protection Thematic Group), led by the *Ministry of Population, Social Protection and Promotion of Women* and gathering about fifty actors (ministries and related structures, international donors, NGOs and civil society, private sector).

This article questions the form of the political compromise that underpins the development of the social protection policy in Madagascar. What coalition of actors is at stake, in a context where the economic and institutional conditions for the implementation of such a policy do not presently appear to exist (a "failed" state, declining economic capacities, an employment structure characterized by informality, etc.) ? It draws on the policy networks literature and proposes an analysis of the inter-organizational network of actors involved in the policy making process. Combining in a pragmatic approach different methods (nominalist and realistic) and tactics, the specification of the complete network's boundaries start form the list of GTPS' members from which some actors have been removed and others added. An original survey was conducted between 2018 and 2019 to interview key informants within each of these organizations. The sociometric questionnaire focuses on six types of relationships between actors: (i) collaborative links; (ii) information-sharing links; (iii) links of agreement on the orientations of the policy; (iv) links of disagreements on the orientations of the policy; (v) links of influence; (vi) interpersonal links.

The collected data then make it possible identify within the policy making process of the social protection in Madagascar: the key actors with strong capacity for mobilization and influence, the

emerging coalitions of actors, the main circuits for information circulation and resource exchanges.

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Comme nombre de pays les moins avancés, Madagascar est caractérisé par un « régime social d'insécurité » (pour reprendre la terminologie de Wood & Gough, 2006) avec une faible couverture sociale dans le cadre formel public (assurances sociales), un décalage important entre le droit social et les réalités socioéconomiques et des filets sociaux de sécurité à portée encore très limitée.

Depuis 2015, le pays a adopté une « Politique nationale de protection sociale » intégrée à sa stratégie de développement et visant à garantir une forme de protection sociale à 50% de la population d'ici 2030. Cet objectif suppose de mettre en œuvre une vision et une stratégie partagée en coordonnant depuis l'Etat la multitude de programmes et d'acteurs actuellement impliqués dans ce champ. Moins qu'un système national de protection sociale institué, la protection sociale est à Madagascar une politique publique nouvelle qui prend appui sur des programmes existants. Le temps de la formulation de cette politique s'inscrit dans une arène de négociation privilégiée, le GTPS (Groupe Thématique Protection Sociale), pilotée par le *Ministère de la Population, de la Protection Sociale et de la Promotion de la femme* et regroupant une cinquantaine d'acteurs (ministères et ses structures rattachées, bailleurs internationaux, ONG et société civile, secteur privé).

Cet article s'interroge sur la forme de compromis politique qui fonde l'élaboration de la politique de protection sociale à Madagascar, quelle coalition d'acteurs la porte, dans un contexte où les conditions économiques et institutionnelles de mise en œuvre peuvent sembler « absentes » (un Etat « liquéfié », des capacités économiques en régressions, une structure d'emploi dominée par l'informalité, etc.). Il prend appui sur la littérature des *policy networks* (Kapucu & al., 2017 ; Ingold, 2011 ; Varone & al., 2016 ; Laumann & Knoke, 1989) et propose une analyse du réseau inter-organisationnel des acteurs participant à l'élaboration de cette politique publique. Combinant dans une démarche pragmatique différentes méthodes (nominaliste et réaliste) et tactiques (Laumann, Marsden & Prensky, 1983), la spécification des frontières du réseau complet prend pour point de départ la liste des membres du GTPS de laquelle ont été éliminés et ajoutés certains acteurs. Un dispositif d'enquête inédit a été mis en œuvre entre 2018-2019 afin d'interroger des informateurs clés au sein de chacune de ces organisations. Le questionnaire sociométrique porte sur six types de relations entre acteurs : (i) liens de collaboration ; (ii) liens de partage d'information ; (iii) liens d'accord sur les orientations de la politique ; (iv) liens de désaccords sur les orientations de la politique ; (v) liens d'influence ; (vi) liens interpersonnels.

Les données collectées permettent alors de répondre aux différentes interrogations relatives à l'identification des acteurs clés à forte capacité de mobilisation et d'influence, des circuits de circulation de l'information et d'échange de ressources et des coalitions émergentes dans la fabrique de la politique de protection sociale à Madagascar.

### **The Content and the Form: Conceptualisations of Mass Behavior as a Source for Enrichment and Interpretation of Network Collective Dynamics Models**

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We could consider classical theories of mass and crowd behavior as first attempts of the scientific analysis of collective dynamics. Such authors as Gustave Le Bon, Gabriel Tard, and Sigmund Freud analyzed nature of behavior spread, but could not give a formal description to these phenomena. The first attempts for creating formal models of collective dynamics appeared closer to the middle of the 20th century, and in the postwar period these models were actively developed. Today

behavior spread examples are analyzed by models of information cascades, collective dynamics, which were created in the context of the development of Social Network Analysis (SNA). However, they are used apart from the conceptualisations of mass behavior, the concept that does not have strict conceptual boundaries and exist within the framework of various scientific fields and traditions.

We will present refined concept of mass behavior and show how it could be used to enrich network collective dynamics models. We will also compare different network collective dynamics models and identify which of them are more suitable to the analysis of mass behavior.

### **The Effect of Genetic Ancestry Testing on Ethnoracial Network Diversity**

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Genetic ancestry testing is a controversial industry, with scholars questioning the tests legitimacy as well as their potential to increase racial essentialism. Yet despite these controversies, genetic ancestry testing continues to grow in popularity in the United States as a way to either confirm or uncover ethnoracial ancestry. While research is beginning to examine people's interpretations of their ancestry test results, little consideration has been given to realworld outcomes of taking these tests, like their impact on changes in the ethnoracial make-up of social networks. This paper asks whether (1) taking the test, and (2) receiving results of non- European background impacts ethnoracial network diversity for a sample of White Americans. We address these questions using an original randomized controlled trial of White, non-Hispanic Americans, half of whom received genetic ancestry tests. Unexpected findings show that testtakers network diversity shrinks post-test, and especially for those with more diverse networks to begin with. We further explore these patterns, drawing on 57 qualitative follow-up interviews with study participants, and present three potential theoretical explanations for the finding. We discuss how future research can adjudicate between these explanations.

### **The effect of gossip on friendship networks in an organisational context**

Jose Luis Estevez<sup>1</sup>, Francesca Giardini<sup>1</sup>, Rafael Wittek<sup>1</sup>

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'Gossip' (evaluative talk between two people (i, j) about an absent third party (k)) is a recurrent means of human communication. Previous studies have found it to account for roughly two thirds of people's speaking time (Dunbar, 2004). Such pervasiveness can be explained in terms of the various functions gossip may play for those who engage in it: getting information, gaining influence, fostering interpersonal intimacy, etc. (Gambeta, 1994; Martinescu, 2017; Giardini & Wittek, 2019). Some functions – venting negative emotions – exclusively depend on intra-personal mechanisms and, therefore, its effects can be tested studying gossipers individually. Other functions – creating inter-personal bonds – are based on strictly dyadic outcomes: 'if i and j gossip together, they will trust each other more'. In these cases, the effects of gossip are located at the i-j dyad, and these can be studied regardless of k. The scarce studies on gossip using SNA have mainly constrained their attention to the effects gossip has on this dyad (Grosser, Lopez-Kidwell & Labianca, 2010; Ellwardt, Steglich & Wittek, 2012). Far less is known about the effect of gossip on targets (k). Various scholars have suggested that gossip is mostly about influencing others' image of k (Burt, 2008; Smith & Collins, 2009), or about collecting information about the 'quality' of k from others' experience (Emler, 1994; Mills, 2010). These, however, have been devoted little empirical attention outside of the experimental literature on reputation (Sommerfeld et al., 2007;

Sommerfeld, Krambeck & Milinski, 2008). Accordingly, whether gossip actually has an impact on the relation between  $i$  (or  $j$ ) and  $k$ , remains largely unexplored.

Our research addresses the effects of reputational information, heard via gossip, on a friendship network. Assuming that gossip always depicts either a positive or a negative image of  $k$ , and that a pair of gossipers can be split into two different roles: the sender ( $i$ ) and the receiver ( $j$ ), we test whether the reputational information  $j$  hears from  $i$  has any effect on the  $j$ - $k$  tie. The reasoning is as follows: presuming that reputational information influences  $j$ 's image of  $k$ , and the image one has of someone influences the relationship to her in turn, we deduce that reputational information will have an impact on  $j$ 's tie to  $k$ . Concretely, we hypothesize that reputational information will have an impact on friendship tie formation and termination. Additionally, we hypothesize that the more  $j$  hears coherent information about  $k$  (the larger the number of  $i$  who sent either positive or negative reputational information), the more likely these changes occur. To test these hypotheses, we use longitudinal network data from three different departments of a Dutch child care organisation. The data was collected in two waves. We will employ Stochastic Actor Oriented Modelling (Snijders, van de Bunt & Steglich, 2010) to check whether the reputational information in wave one helps explain the actual changes in the friendship network from wave one to wave two, whilst controlling for the endogenous evolution of the friendship network, as well as some covariates.

### **The Effects of Individual Attributes on the Emergence of Knowledge Sharing and Hiding Networks in Organizational Teams**

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The goal of this study is to examine how individual attributes influence the emergence of knowledge sharing and hiding networks in organizational teams. In this study, a knowledge sharing network is defined by “who shares work-related knowledge with whom” within an organizational team. A knowledge hiding network, on the other hand, is defined by “who hides work-related knowledge from whom” within the team. This study seeks to provide an in-depth understanding of how the knowledge sharing and hiding networks can be influenced by a multitude of team members' attributes including personality, motivational traits, person-organizational relationships, cultural orientation, and demographics.

Whole-network survey data were collected from a total of 200 individuals working in multiple organizational teams in the U.S. and China, including 16 teams from the U.S. (N=95) and 15 teams from China (N=105). Such data yield 31 knowledge sharing networks and 31 knowledge hiding networks of various sizes. ERGM (Exponential Random Graph Modeling) analyses reveal that individual attributes have different effects on the emergence of knowledge sharing and hiding networks. On the one hand, the knowledge sharing network is positively influenced by a team member's extroverted personality, extrinsic motivation, organizational identification, and need for power, but negatively influenced by a team member's competitiveness, performance goal orientation, and tenure in the organization. On the other hand, the knowledge hiding network is positively influenced by a team member's need for power, performance goal orientation, individualism orientation, but negatively influenced by a team member's agreeableness, organizational commitment, and learning goal orientation. Finally, a team member is less likely to hide work-related knowledge from another member of the same gender.

The findings of this study suggest that knowledge sharing and hiding networks co-exist in organizational teams. In addition, knowledge sharing and hiding are separate relationships that connect team members (i.e. knowledge hiding is not the opposite or absence of knowledge sharing). The emergence of knowledge sharing and hiding networks can be influenced by different

attributes of individual members in different directions. This study provides important implications for knowledge management research as well as managerial practices.

### **The Effects of Ingroup and Outgroup Friends on the Development of Outgroup Attitudes: A Five-Wave Longitudinal Social Network Study**

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#### **Background**

An extensive body of research shows that contact with members of ethnic outgroups improves attitudes towards the outgroup. Yet, the corresponding influence of contact with ethnic ingroup members has been largely ignored. The few studies that have examined the effects of ingroup contact suggest it may decrease outgroup contact, increase ingroup bias and intergroup anxiety, and underlie prejudice socialisation. Our research provided a necessary holistic investigation of the development of outgroup attitudes by considering adolescents' social experiences with both ethnic ingroup and outgroup members. This was achieved through the use of longitudinal social network analysis.

#### **Method**

Five waves of data were collected over the academic year 2017-2018, in two diverse secondary schools in North West England. The 1170 respondents (829 Asian, 341 White; 558 male, 612 female; aged 11 to 14 years) were nested in 67 classes across three year-groups in the two schools. Students completed surveys approximately every eight weeks, which contained both network and self-report measures. Friendship networks within each school year group were elicited using peer nomination procedures, and contact was operationalised as the number of nominated ingroup and outgroup friends. Outgroup attitudes were measured via self-report.

#### **Results**

Cross-sectional and longitudinal network analyses (RSiena) revealed high levels of ethnic segregation and homophily, despite each school's diverse student body. As expected, we found outgroup attitudes to be similar among friends. We used multilevel models to estimate the divergent effects of ingroup and outgroup friendships on students' attitudes. We used RSiena co-evolution models to determine to what extent attitudinal similarity among friends resulted from friendship selection or socialisation processes. Together these analyses provided insights into the importance of friendships for spreading and shaping adolescents' outgroup attitudes.

#### **Conclusions**

The present research demonstrates the importance of taking both outgroup and ingroup contact into consideration when examining intergroup relations, and illustrates the value of innovative social network analyses in understanding prejudice development.

### **The Embeddedness of Capitalism: How the Networked Relations of Large Corporations Unify their Responses to Protest**

Tarun Banerjee<sup>1</sup>

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Capitalism is going through a crisis of legitimacy, and with this, large corporations are the ever frequent target of protest by social movements. While we know much about how the tactics of movements and the organizational features of targeted firms shape chances for success, we know relatively little about the ways in which the networked elements of these business targets matter. Quantitative social movement analysis, in particular, tends to treat these business targets as atomistic actors operating purely out of self-interest. In contrast, I show that large firms continue to operate collectively, including in their responses to social movements. I do think by a)

constructing networks of relationships between large corporations (through overlapping boards of directors and the shared leadership of different firms in policy-planning organizations) and b) statistically testing the impact of a firm's embeddedness in these capitalist networks on its responses to protest. Through an analysis of protest against Fortune 500 corporations in the U.S. over 6 years (2005-2010), I find that these networks not only shape the behaviors of individual firms, but help unify their responses to protest. The impact of these networks is strong enough to sometimes motivate firms to take actions that appear to be against their economic self-interests. This has implications for a fundamental question in social movement studies – how insurgents attain leverage against targets. Net of the tactics of movements, the targets of protest matter in important ways. By targeting firms in precise locations in corporate networks, movements can maximize the likelihood of success and minimize risks of repression. In asking how the social relations of the corporate class shape social movement leverage, this paper also bridges broad questions in organizational, social movement, and class analysis.

### **The Emergence and Stability of Groups in Social Networks**

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An important puzzle in social network research is to explain how macro-level structures emerge from micro-level network processes. The emergence and stability of groups is particularly difficult to explain with micro-level social network mechanisms. First, because structural groups are a complex outcome characterized both by cohesion within and lack of connectedness between them. Second, because multiple micro-level network processes jointly contribute to the explanation of how individuals form social groups and agree on their boundaries. We argue that traditional social network theories that are concerned with the evolution of positive relations (forces of attraction) are not sufficient to explain the emergence of groups. Models that additionally express the development of qualitatively different ties between individuals in different groups (forces of repulsion) are a possible way to explain the emergence and stability of groups in social networks. We take social network theories on the formation of negative and positive ties as a starting point to develop a theoretical micro-macro framework. We illustrate this proposal by fitting stochastic actor-oriented models (SAOMs) to empirical data of co-evolving networks of friendship and dislike among 479 secondary-school students. The SAOMs include a number of newly developed effects expressing the co-evolution between positive and negative ties. We then employ the estimated micro-level models as empirically calibrated agent-based simulation models to explore the micro-macro link. We find that a model that jointly considers forces of attraction and repulsion is able to explain emergence and stability of groups in social networks.

### **The Entanglement of Words and Relationships / L'entchevêtrement des mots et des relations**

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In order to present work carried out in French, we offer, in this paper, an overview of studies conducted by members of a research group based at UQAM. We will follow the historical thread of the studies and reflections that led to the current work on the analysis of sociosemantic networks: first studies on the meaning attributed by ego to his/her relationships and development of an instrument for gamers in treatment; differentiated pathways of diffusion according to sex / gender for specific content; differentiated relationships for coping with ambiguity and uncertainty in organizations; shared information and social influence within working groups. We will conclude

with an overview of our more recent work on the impact of language homophily on the position of people in an organizational network of digital communication and on the prediction of missing data in an epistemic network.

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Dans l'optique de présenter des travaux qui se réalisent en français, nous proposons, dans cette communication, un aperçu de travaux réalisés par les membres d'un groupe de recherche basé à l'UQAM. Nous suivrons le fil historique des études et réflexions qui ont conduit aux travaux actuels sur l'analyse des réseaux sociosémantiques : premiers travaux sur le sens attribué par égo à ses relations et développement d'un instrument utilisé auprès de joueurs en traitement; identification de chemins de diffusion différenciés de certains contenus en fonction du sexe/genre; relations différenciées pour composer avec l'ambiguïté et l'incertitude dans les organisations; informations partagées et influence sociale au sein des groupes de travail. Nous concluons par un aperçu de nos travaux plus récents sur l'impact de l'homophilie de langage sur la position des personnes dans un réseau organisationnel de communication numérique et sur la prédiction des données manquantes dans un réseau épistémique.

### **The Evolution of Knowledge Creation Online: Examining Wikipedia as a Dynamic System**

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How is knowledge created collectively? This is one of the most fundamental questions in knowledge management and information system studies. In this study, Wikipedia, the collectively created encyclopedia online, was explored as a dynamically evolving organizational system. The tradition of viewing organizations as dynamic systems has had a long intellectual history in organizational theory, and the ecological and evolutionary model for studying organizations has proven beneficial in understanding traditional organization forms. However, not much work has been done in applying the evolutionary perspective in studying online knowledge creation systems, such as Wikipedia. This study draws from socio-cultural evolution theory and evolutionary epistemology to propose an analytical framework in understanding self-organized knowledge creation systems online. Specifically, this article aims to advance the theoretical understanding about what types of traits of such a dynamically evolving system are driving evolutionary force? The population under natural selection is defined as the population of Wikipedia articles. For this population, the traits could be categorized as characteristics-based traits (traits that could be derived from analyzing each individual article) and network-based traits (traits that could be derived from analyzing the relative network position of each article within the population). An empirical examination answers the following questions: What are the most important characteristics-based traits under selection in the Wikipedia system? What are the most important network-based traits under selection in the Wikipedia system? Comparing the two categories of selection criteria, which type of traits is more critical for natural selection? How does the selection force change as a function of time? How to identify development stages of articles based on the natural selection force they underwent? Answering these questions will help us better understand self-organized online knowledge creation platforms as adaptive and evolving systems.

**The HelpMeDolt! trial: Engaging Social Support For Weight Loss.**

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**Introduction**

The support of family, friends and others is crucial in helping people to achieve and sustain healthy lifestyles. HelpMeDolt! is a app/website that harnesses social support for weight loss by enabling participants to nominate friends/family/colleagues to help them with their weight loss goals. **The main aim of the study is to** test the feasibility of the intervention in supporting adults with obesity to achieve weight loss goals. A secondary aim was to explore whether characteristics of helpers and their relationships with participants were associated with participants' weight loss.

**Methods**

The study design was a feasibility randomised controlled trial with a process evaluation and exploratory network analysis. Participants were adults interested in losing weight, BMI  $\geq 30$  kg/m<sup>2</sup>. The intervention group (and their helpers) had access to the app/website. Participants nominated one or more helpers to support them. The control group received a leaflet on healthy lifestyle. Follow-up data were collected at 12 months, focussing on the progression criteria for the trial, the feasibility of delivering the intervention and the trial methods. The study assessed: (i) recruitment and retention; (ii) usability and acceptability of the app/website and (iii) three primary outcomes: BMI, physical activity (7 Day PAR and accelerometer) and diet (DINE and multiple-pass 24 hour recall) for use in a full trial. For the exploratory social network analyses we used mixed methods. We interviewed participants and also asked them to complete a sociogram and egocentric network questionnaire.

**Results**

Pre-specified progression criteria were met demonstrating that the HelpMeDolt! intervention and trial methods were feasible and acceptable. 109 participants (73 intervention, 36 control) were recruited, with 84 participants (77%) followed-up at 12-months. Data were successfully collected for most outcome measures ( $\geq 82\%$  completion). Participants were positive about the app and website. Engagement with the app was reasonable and participants and helpers engaged with the concept of HelpMeDolt!, interacting via or outside the app. Although underpowered, quantitative data suggested some potential of the intervention, particularly on physical activity. The network analysis suggested that there was an association between weight loss and having same gender helpers and also having close friends as helpers increased the chances of losing weight.

**Conclusions**

The intervention was acceptable to participants and the trial methods feasible. The progression criteria were achieved which supports progression to a full evaluation. The network data provided a rich source of information on the ego networks of the participants and the impact of these on behaviour change success or failure. Social support is crucial in helping people achieve and sustain lifestyle behaviour change and this intervention is a novel way of mobilising that support.

**The IDB Loan Network: Assessing the Role of Impact Evaluations**

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<sup>1</sup>Georgetown University

This paper explores loan citation data collected from the Inter-American Development Bank (IDB), an inter-governmental institution that offers loans to governments in Latin America and the Caribbean to reduce poverty and inequality. Loan proposals describe a project's objectives, strategy, and intended outputs. In addition, loan proposals typically cite other loans; although the purpose of citing other loans varies, citations often indicate that a project draws on "lessons

learned” from previous or ongoing projects. For this reason, the loan citation network can be used to map the influence of ideas across the organization. To understand the breadth of innovations shared across the IDB, and the effect of impact evaluations on loans made by IDB, we develop an ERGM model to examine the likelihood of citations based on loan attributes.

The dataset was created by extracting citations from 1,700 loan proposals approved over the past 18 years. The network contains 2,405 nodes (loans) and approximately 7,000 directed edges. Loans are encoded with country and department attributes, principal amount, approval year, and other features. For 55% of the loans, we also map the “evaluability score,” which ranks the rigor of project evaluation methodology. We then develop an exponential random graph model (ERGM) to measure which factors influence the probability a loan is cited.

We find that multiple factors influence the probability that a loan is cited, but the strongest factor is shared country, followed by shared economic sector (e.g. education, housing and urban development, energy, etc.). Loan proposals are written with the client government in mind, which logically requires that same-country loan examples are cited. However, the differential between same-country citations and same-division citations is surprising: it is ten times more likely that same-country loans share a link than same-division loans. This might indicate that there is a need for developing greater cross-country synergies, particularly when loans target the same economic sector – an opportunity for IDB to highlight its unique role as an institution that can share policy innovations across the region.

We also explore the role of evaluation rigor in edge formation, namely: does higher evaluation rigor lead to a higher probability of citation? Our preliminary analysis shows that loans with high evaluability are cited less often; however, loans with high evaluability cite other loans more frequently, and they are also more likely to cite less rigorous evaluations. This indicates that loans with rigorous evaluations help “drive the network”: they draw on lessons learned from previous projects. This suggests that rigorous impact evaluations build off past successes and grow the network of ideas within the organization.

We conclude with policy implications for the IDB (as well as similar institutions) to further increase its effectiveness and improve knowledge sharing within the Bank as well as with clients and partners in the region. By examining the natural growth of the loan network, as well as the network behavior of loans with strong evaluation methodology, the authors identify how the IDB can better position itself as a long-term innovative partner for the region.

### **The impact of Kinship Networks on Party Formation and Civil War Alignments in Nineteenth-Century Chile**

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Using social network analysis I map the kinship ties among all 1,449 members of the political elites of Chile in the period 1828-1894, including all parliamentarians and ministers. I use community detection algorithms to identify core families, and I follow their electoral trajectories over six decades. Based on the electoral data, I infer the political allegiance of families in two civil wars: 1829 and 1891. Further, based on secondary sources I identify the families that formed the Liberal party in 1849. The Chilean Liberal party was formed by families that were defeated in the 1829 civil war together with families that supported the winning side but were subsequently marginalised. But the Liberal party split in two in the 1880s, and using a quadratic assignment procedure (QAP) I show that political alignment in the civil war of 1891 is predicted by family alignment in the civil war of 1829.

**The inclusion of female students within Chilean math classrooms: Gender bias in teacher-student interaction networks**

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Gender gaps in motivation, self-efficacy and academic achievement in mathematics are well documented internationally and of considerable magnitude in Chile, where they increase over the educational trajectories of students, to the detriment of women. These differences affect career choices and future job opportunities.

The international literature has shown that the educational system plays a relevant role in generating these gaps, particularly through differences on teachers' expectations and encouragement for boys and girls. However, the evidence in this regard in Latin America is incipient. Despite the large and persistent gender gaps in the region, the study of the processes associated with gender gaps has been hampered by the lack of data on classroom processes. Therefore, more evidence is needed to understand the effect of gender on students' learning opportunities.

Teaching and learning are relational phenomena and research on these processes requires theoretical perspectives and methodological approaches that go beyond the study of the individual and examine the interactions (links) between actors within social structures. The videotaping and coding of 69 Chilean classrooms with 2,000 students in 33 schools allowed us to investigate the relative position of girls within the teacher-student interaction networks in mathematics classes, the moderating effect of academic achievement and the variation on the inclusion of girls across classrooms.

The observed teacher-student interactions were coded using a protocol adapted from the Brophy-Good Dyadic Child Interaction System and the TIMSS Videotape Classroom Study, instruments that propose distinctions regarding the initiator of the interaction, public and private domain interactions, and contents of interactions. The data derived from this coding process resemble partial ego network data, with a focal node "ego" (the teacher) and the nodes to which ego is directly connected, "alters" (students). Thus, the networks of teacher-student interactions were represented using sociograms, explored via descriptive social network analysis and modeled with multilevel Poisson regressions.

It was found that girls interact less frequently with their math teacher in all the interactions analyzed (i.e., pedagogical, instructional, administrative and behavior management interactions), particularly in interactions initiated by the teacher. Academic achievement moderates these differences, in interactions initiated by students. In addition, there is a significant variation in the inclusion of girls across classrooms that is neither explained by teacher's gender nor by the composition of the class. Thus, it was found that, generally, students do not experience the same learning opportunities, as this depends on their gender.

This study advances the field substantively and methodologically by (1) exploring the educational inclusion of girls in a country with a significant and sustained gender gap in mathematics, (2) introducing a new approach to researching and monitoring equality of learning opportunities within and across classrooms, and (3) demonstrating the combined use of systematic observation of classroom interactions, social network analysis and multilevel Poisson regression models as methods to explore the structure of relations between teachers and students.

**The Inequality of Social Capital for College Graduates: Impacts of Social Skills in Earlier Periods**

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The inequality of social capital is produced through the creation and outcome of social capital along life stages. Most of previous studies used cross-sectional data to examine these research problems; however, very few studies have used longitudinal data to examine the creation and outcome of social capital for young adults. Bringing the social skills during adolescent stages and college stage into the analysis of the creation and consequences of current social capital at age 25-26, this study used two cohorts of the Taiwan Educational Panel Survey Beyond (TEPS-B) data for our analyses. The subjects of TEPS-B were interviewed in 2010 and 2014 when they were 25-26. The first wave of these subjects of two cohorts were surveyed in 2001 when they were 7<sup>th</sup> grade and 11<sup>th</sup> grade respectively by Taiwan Educational Panel Survey (TEPS). Because these two cohorts of subjects all experienced the expansion of higher education, we specify our study sample to the college graduates. In order to analyze the outcome of social capital, we furthermore choose currently employed subjects. Social skills of adolescent stages included family social capital, intergenerational closure and noncognitive ability. We include the following research questions: Do family social capital and intergenerational closure at adolescent stage affect the current social capital and job performance? Do non-cognitive ability at adolescent stage affect current social capital and job performance? Do the number of associations attended in college affect the creation and outcome of social capital? Social skills in high school was recognized as an important factor on the performance at work for young adults 10 years later. Many jobs demanded individuals to generate social connections and establish collaborations in organization, because social skills are advantageous for building trust and collective actions, the productivity of team work. In terms of creation of current social capital, noncognitive ability of careful planning at 7<sup>th</sup> grade and 11<sup>th</sup> grade, and associations attended in colleges directly affect current social capital for young adults of college graduates in 2010 and 2014. As to the return of current social capital, current social capital has significant effect on job wage, job prestige and subjective class rank for young adults in 2010 instead for those in 2014. Noncognitive ability of careful planning at 7<sup>th</sup> and 11<sup>th</sup> grade also have direct effects on job wage, and intergenerational social capital at 7<sup>th</sup> and 11<sup>th</sup> grade have indirect effects on job prestige through number of associations attended in colleges.

### **The influence of development aid networks on the participation in International Large Scale Assessments**

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<sup>1</sup>University Bremen

With this paper we investigate the connection between development aid and education policy making. We show the influence of networks of aid to education on a country's susceptibility to taking part in educational assessments.

International large-scale assessments (ILSAs) like the Programme for International Student Assessment (PISA) by the OECD have gained massive attention and attracted participants since the 2000s. Prior to 2001, only 68 countries participated in an international large-scale assessment targeting school age children. That number nearly doubled to 116 ILSA participants in the time period of 2014-2018.

Educational attainment is often used to measure and compare states in their capacity as a site for creating human capital. While ILSAs were originally created in the developed western world under a specific perspective on education, they have spread to many developing countries, transferring detailed models on what constitutes a "successful" education system. In this context the question is whether the expansion of participation can be explained by a rational isomorphism as expected by constructivist institutionalism, or whether other determinants could be detected. Past academic research has focused on distinct state structures to explain the rise in participation.

Recent studies have mostly concentrated on the influence of the development aid network on enrollment rates. However, they have not emphasized the impact of development aid networks: bilateral (i.e. between states), as well as multilateral (i.e. between states and IOs) on states' participation in ILSAs.

We add to the discussion about global networks as arenas of diffusion and catalysts in transforming education systems. Indeed, network approaches in the past focused on the outcomes of the global embedding for performance of education systems. By taking this a step further, we show how inter-state relationships – especially those incorporating a significant power gap – and state-IO relationships influence the participation in ILSAs.

In this specific case, we use a longitudinal network approach to show the influence of embeddedness on the susceptibility of taking part in international large scale assessments. We argue that the degree and position in the networks of aid-flows determine the likelihood of participation in ILSAs. We want to show that the more embedded a country is in a network representing capital flows, which also entails trade and development aid, the more likely it is to participate in ILSAs.

### **The influence of organizational and legal changes on the structure of networks created from police data**

Jason Gravel<sup>1</sup>

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Arrests and other police records has been one of the main source of data to study the structure of criminal networks. It is common practice to combine several years of records to create such networks. However, police practices are constantly evolving often driven by changes within their organizations or to the legal landscape. Prior studies using network data extracted from police records have been largely uncritical of the context in which they are collected. This study examines how major changes in the Long Beach Police Department (LBPD) and to California law between 2008 and 2013 potentially influenced the collection of records used to create co-arrest networks. The analysis reveals that a large proportion of relationships extracted from police records come from events where the decision to arrest involves substantial police discretion. The findings suggest that changes in police leadership and the decriminalization of marijuana were responsible for an important reduction in the number of relationships observed in the network. Implications for the use of police records for network analysis in criminology and criminal justice research are discussed.

### **The Interplay between Professional Heterophily and Geographical Proximity in Outpatient Healthcare Provider Networks**

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Regular and intensive exchange among complementary healthcare providers is indispensable for outpatient care provision. Care for patients is organized by providers' interdisciplinary cooperation, which routinely takes place at local levels. Fast accessibility and seamless transfer are necessary to guarantee the full supply of healthcare services. However, it is still unclear to what extent geographical proximity affects this interdependence between different healthcare providers. This is in particular of interest given the increasing importance of studying patient-sharing which reflect already existing network patterns between various healthcare organizations. We therefore investigate the interaction between professional heterophily and geographical proximity within regional patient-sharing networks of outpatient healthcare providers. We use claims data to identify interorganizational patient-sharing, comparing urban with rural districts in

Germany. Applying a class of exponential random graph models, our results emphasize that heterophilous actors being geographically close create collaborative ties. This interrelation is especially decisive for network formations in outpatient healthcare settings since primary and more specialized providers have to interact for completing patients' treatment process. The geographical proximity between them facilitates this teamwork in both, urban and rural regions. In addition, our study leads to practical implications for healthcare system planners to enhance the coordination of ambulatory patient treatment at the regional level.

Keywords: Interorganizational patient-sharing networks; professional heterophily; geographical proximity; exponential random graph models; outpatient sector

### **The Koch brother's anti-democratic social movement as a network**

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Most social movements are discussed in terms of the underprovided and underrepresented people mobilizing to achieve their rights and voice their concerns. But, arguably, one of the most successful social movements is located at the opposite end of the economic spectrum. The billionaire Koch brothers have formed an alliance of organizations and actors to further their own ends. They includes removing all regulation of their industries, especially regarding the environment and workplace safety, shrinking the size of government to create a government of the very wealthy, run by the very wealthy, for the very wealthy and to destroy democracy. An alarm has been sounded in two books, *Democracy in Chains* and *Dark Money*. Both books list some of the organizations in this very secretive network. Using these names, VOSON, a web search algorithm was used to identify a large network of units. We present results regarding this network in terms of its size, the aims of its major actors, its structure and organization. We note that their goal is to destroy this nation's political institutions and democracy itself. It is a social movement whose success must be feared.

### **The liability of balance: on the relation of work-team polarization and quality in open peer-production**

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Online peer-production projects typically incorporate information infrastructures designed to support social evaluation so that participants can assess and appraise the contributions of others. Evaluation can be either positive (expressing agreement among participants) or negative (expressing disagreement) giving rise to signed event networks connecting participants through their contributions. How does the structure of this emergent network of positive and negative events affect the quality of peer production?

We address this question in an analysis of the entire production history of more than 10,000 articles in Wikipedia - one of the largest and most successful examples of peer production currently in existence. More specifically, we search for evidence that balance shapes the structure of social evaluation in Wikipedia where two participants consider each other as "friends" if they are linked by positive relational events and consider each other as "enemies" if there is negative interaction among them. Because Wikipedia contributors, for instance, tend to agree with the enemies of their enemies and disagree with the enemies of their friends, we find that balance is an important determinant of polarization in the production of Wikipedia articles.

In a comparison of the network mechanisms underlying the production of about 5,000 high-quality articles with the network mechanisms in a contrasting sample of comparable articles of lower quality, we find that contributors to high-quality articles display weaker tendencies to

conform to the behavioral predictions of balance theory. This result supports the "liability of balance" hypothesis claiming that polarization of teams in open peer-production decreases the quality of the output produced by them.

**The Liberal Peace Theory Revisited: Trade Networks, Multilateralism and International Conflict**  
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This research analyzes the liberal peace theory in international relations through social network analysis theory and methods, with implications for foreign policy making. I focus on the economic aspect of the liberal peace while controlling for political (democratic) variables. Extant research on the liberal peace shows that trade interdependence and economic multilateralism increase the costs of conflict and hence decrease the likelihood of war between states. However, rising nationalism, charismatic leaders and trade protectionism characterize our international system today. Somewhat chillingly, the era today portends increasing international conflicts of greater magnitude in the near future. As world leaders look inward and scale back on their commitments in global production networks (GPNs) and multilateral trade regimes, how and to what extent would these actions affect the prospect of international conflict? Importantly, how and to what extent do GPNs and multilateral trade regimes help to foster peace in the international system? I argue that for countries that are tightly embedded in GPNs and trade regimes, complex interdependence will not only increase the costs of international conflict, but also invite intervention by third parties and higher order states involved, thus greatly altering the strategic calculus of aggressors and making interstate conflicts less likely.

Through a statistical network analysis -- the Temporal Exponential Random Graph Model (TERGM) -- of inter-state conflicts from 1993 to 2010 based on 156 economies that together account for over 95% of world trade (435,240 observations in total), I find that hyper-dyadic trade ties through multilateral economic institutions and networks such as Free Trade Agreements, Preferential Trading Agreements and Economic Unions have significant dampening effects on inter-state conflicts, while dyadic (or bilateral) trade ties based on direct trade in value-added measures are not significant. The results point to the strong pacifying effects of complex trade network regimes that are not normally captured through direct bilateral ties. Structurally, the international conflict network is also characterized by mutuality conditions. Methodologically, the TERGM differs from traditional statistical methods in that it takes into account interdependence among observations in the dataset and allows me to estimate endogenous structural characteristics of networks, such as mutuality, triadic formation, popularity and activity effects over time. In my model, I also implement a bootstrap resampling method for computing the 95% confidence intervals and 1000 bootstrap iterations are used. Data is drawn from the Correlates of War (COW), UNCTAD and OECD databases. The overall implication for foreign policy is clear: that trade protectionism and scaling back on economic multilateralism would not only hurt home economies and consumers via greater inefficiency and product costs, but also has significant international security consequences.

**The moderating role of social networks on the effects of career intervention on work engagement among older workers**

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There are increasing demands for older workers to work later in their life and many organizations need to develop age-specific practices and training in order to retain older workers. Unfortunately, only few studies have focused on interventions designed to support older workers

at work. Furthermore, research is also needed to examine boundary conditions of interventions among older workers, i.e. who benefit from the intervention and related training. Thus, we were interested in to examine to what extent older workers' social networks define boundary conditions for the effects of the career intervention on their work engagement. More specifically, an earlier study showed that career management preparedness mediated the effect of the intervention on older workers' work engagement. By capitalizing on data collected from the same sample, we extend this earlier finding by examining to what extent the characteristics of social networks moderate the relation between the intervention and work engagement. Older workers (a mean age of 58) who participated in randomized controlled trial (RCT) in seventeen organizations (N=699; training group: N = 359; control group: N = 340) also filled in measures related to their social networks. We indicated the characteristics of their social networks by strength of ties, upper reachability and network density. The preliminary results indicate that strength of ties and somewhat network density moderated the effects of the career intervention on older workers' work engagement. Specifically, the intervention enhanced work engagement for older workers whose social networks were characterized by weak ties or high network density.

### **The Network Formation Origin of Tribal Societies**

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This paper proposes a network formation model for explaining the stability of tribal societies. The model is supported by the idea that every two members of a tribe should have benefited from being connected to each other in order for the whole tribe to be stable. It also considers the constraints that the ecosystem brought to social interaction in pre-modern contexts. The model has three predictions. First, both homogeneous and heterogeneous tribes could have been stable regardless of technological development. Second, the social complexity of tribes was a function of technological development (having access to agriculture should have enabled the emergence of larger and more complex societies), interaction costs (if they were too low or too high, no complex society should have emerged), and environmental conditions (poor ecosystems should not have allowed the formation of complex societies). Finally, the model predicts that the collapses of agricultural societies could not come from environmental pressures, but from high interaction costs. The predictions are consistent with some of the most relevant human history patterns.

### **The Network Underpinnings of Knowledge Retrieval: The impact of brokers and central inventors of two distinct networks**

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The aim of this research is to examine the network underpinnings of knowledge retrieval, which is defined as the "reabsorption of one's own spilled knowledge that has been leveraged externally". Specifically, the study shines new light on how two structural features, namely, structural holes and degree centrality affect the phenomenon of knowledge retrieval in two distinct networks; in a social network of inventors and in a knowledge network of their knowledge elements. Inventors with more structural holes (brokers) or higher degree centrality (central inventors) in an intra-firm social network among their colleagues, are found to have a tendency to retrieve more of their pre-owned knowledge, after it spills to and is leveraged by external inventors (knowledge retrieval). Furthermore, inventors whose knowledge portfolios include knowledge elements with few structural holes in an intra-firm knowledge network, is supported that have a tendency to retrieve more of their pre-owned external knowledge. Finally, the

research advocates that the degree centrality of inventors' knowledge portfolio elements in a firm's knowledge network has a U-shaped relationship with the extent of their reabsorption of pre-owned knowledge, which has spilled to and been leveraged by external individuals.

In order to examine the aforementioned aspects, the research uses as a sample, an industry where firms have significant rates of knowledge creation and diffusion; the semiconductor industry. Specifically, the validity of the hypotheses is examined on the United States Patents and Trademark Office (USPTO) collecting data for 4222 unique inventors of leading world-class semiconductor firms, over a long period of monitoring (1976-2016). The exploratory variables (structural holes and degree centrality) and the dependent variable (knowledge retrieval) are measured in a five-year rolling window for forty years (individual level of analysis). Therefore, a longitudinal data structure is employed explaining the dependent variable in a subsequent period with exploratory variables in a previous period, allowing tests of causality assumptions between the phenomena under study.

The research presents theoretical and practical implications. Specifically, the study fills the gap in current global literature regarding the social and knowledge network underpinnings of knowledge retrieval. Furthermore, the findings reexamine the interrelationship between the theory of absorptive capacity and network theory based on the characteristics of individuals' positions and their knowledge elements' positions, and supports the recent declaration that knowledge network and social network are decoupled and not isomorphic.

As for the managerial implications, the research identifies the social and knowledge antecedents under which knowledge retrieval strategies are more effective, where a firm may increase the benefits of its R&D investment in its own original knowledge and increase its knowledge capacity due to the addition of the new retrieved knowledge. Finally, the results of the study support that the managers enhance the bundling and combination of a variety of knowledge assets avoiding inventing in a single knowledge element or in a single inventor, and preserve a balance between the knowledge capital and human capital without disregarding any of these significant channels in order to improve knowledge retrieval.

### **The Networked Disclosure Landscape of #MeToo**

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Acts of sexual violence often go unreported because of the stigmatization surrounding disclosure. Although nearly 1 in every 3 women in the United States will experience an act of sexual violence in her lifetime, almost half of those women will never disclose that incident to anyone. Consequently, the pervasive social and public health problem of violence against women has been relegated to a "whisper network" outside of public conversations. More recently, many survivors of sexual violence have sought community and support online, where they can anonymously connect with one another via anonymous and private message boards. Research has emphasized the importance of anonymity and privacy in these communities. It is therefore unexpected that women would publicly and identifiably broadcast sexual violence disclosures on non-anonymous social media platforms. However, on October 15th, 2017, thousands of women publicly did exactly that, disclosing their stories of sexual violence after actress Alyssa Milano called on women to share the phrase "me too" if they have ever been sexually harassed or assaulted. The resulting cascade of disclosures that followed Milano's tweet came to be known as the #MeToo movement. We argue that the uncharacteristically public #MeToo disclosures can be explained by the concept of network-level reciprocal disclosures, in which women disclose in response to

the reduction in stigma as other women disclose. At a macro level, the #MeToo disclosures activated an online network that brought the typically-marginalized experiences of sexual assault survivors to the mainstream, bringing attention to the systemic issue of violence against women and reducing stigma against further disclosures.

Through a mixed-methods analysis of 1.4 million #MeToo tweets and replies to those tweets posted during the first two weeks of the movement, we disentangle the dynamics of network-level reciprocal disclosure and measure the feedback dynamics between disclosures, stigma reduction, and collective action. We first hand-code 2,500 tweets for disclosures of sexual violence, allowing us to train a machine learning model capable of accurately identifying disclosures in #MeToo tweets. The model allows us to map the disclosure landscape of the network that emerged around the hashtag. Finally, through the alignment of the #MeToo network with the underlying follower-following network, we are able to provide estimates of both the effect of previous disclosures within an individual's social network on a later disclosure and the effects of reciprocal support and positive replies on continued engagement with the #MeToo movement. By bridging the theories of network-level reciprocal disclosure and networked feminist counterpublics through quantitative and qualitative analyses of the #MeToo movement, we are able to clarify the micro mechanisms that govern the disclosures of stigmatized experiences on public social media platforms and the macro mechanisms that govern the emergence of the #MeToo movement and other feminist hashtag campaigns that address the pervasiveness of sexual violence against women such as #YesAllWomen, #NotOkay, and #WhyIStayed.

### **The Networked Question in the Digital Age: The Shapes of Community Through the Life Course**

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Although there has been much discussion about “networked individualism,” there has been little evaluation since Wellman first proposed the concept in 2001. Meanwhile, the populace has become even more networked with the internet and mobile devices connecting them. We present the first paper to evaluating the prevalence of “networked individualism” in the era of digital media. We use in-depth interviews with 101 participants in the East York section of Toronto, Canada to understand how digital media enhances social connectivity in general--and networked individualism in particular--for people at different stages of the life-course. Although people of all ages intertwine their use of digital media with their face-to-face interactions, younger adults use more types of digital media. People in different age-groups conserve media, tending to stick with the digital media they initially used. We develop a typology of networked individualism. One-third of the participants are Networked Individuals: At each age, they are most actively using digital media to maintain ties and to develop new ones. Another one-third are Socially Bounded, often actively using digital media but keeping their connectivity within a smaller set of existing groups. The one-third who are Socially Limited are least likely to use digital media. Age, digital media use, and networked individualism are interrelated.

### **The Networks of Dam Resistance Social Movements in the Amazon**

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This paper investigates how people impacted by large dams organize social movements and pressure the government to respect their rights and protect their environment. The study traces how local communities, nonprofits, journalists, and environmentalists in Brazil create social

movements that challenge policymakers' attitudes towards dams. The structure of these networks reveals how these social movements operate. The central hypothesis here is that groups who build networks with diverse partners (i.e. organizations in sectors different than their own) are more successful in gathering resources and influencing policymakers than groups who are mostly connected with organizations similar to their own. A coalition of ten organizations where eight of them are community associations is less effective than a coalition of ten organizations where two are community associations, two are nonprofits, two are religious groups, two are journalists and two are academics. This research tested and confirmed this hypothesis.

The paper explains how these activist groups gather resources, share material goods, grants and human capacity to create dam resistance movements. They form alliances, coordinate numerous strategic activities, and engage in intense negotiations with the government. The study traces how these networks manage at least partially to secure their interests, such as altering the design of dam projects, delaying construction efforts, and securing more financial and in-kind compensation for local communities.

Social movements are no new phenomenon and have been studied by different fields for decades. The emerging area of social network analysis is now opening new possibilities to better understand the internal workings of these movements as well as their influence on policymakers. Classic authors such as Tarrow and Tilly have conceptualized social movements based on their abilities to capitalize on political opportunity structures and to display their worthiness, unity, numbers and commitment to a certain cause. The SNA method now allows us a more granular understanding of how different groups come together to form alliances and how social movements operate. This research is part of this emerging field that uses an SNA approach to gain new insights into social movements.

### **The Paradox of Building Bridges: Examining Countervailing Effects of Leaders' External Connections on Team Members' Perceptions of Support and Team Performance**

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As a complement to traditional leadership perspectives that focus on human capital (e.g., leaders' traits or behaviors) and situational attributes (e.g., task structures), there is a burgeoning literature that adopts a relational view of leadership. Indeed, leaders are embedded in webs of relationships within and across organizations, and these relationships can facilitate or constrain key organizational outcomes. In this paper, we address at least two gaps in the extant literature. First, while research on leaders' relationships has traditionally examined connections that exist between a leader and his or her followers *within* the work team, team leaders' roles not only involve managing internal relationships, but also jointly require activities directed toward leveraging external relationships. Given that leaders' external connections can be leveraged to acquire resources, monitor the external environment, align teams' activities with other teams, and bridge teams within the organization using their external ties, these relationships are especially important in understanding the organizational context in which teams operate. Second, the boundary spanning, or "liaison," positions leaders fill in informal social networks endow them with access to strategic opportunities, information, and prestige (Krackhardt, 1990) that can translate into performance advantages for their teams. However, extant research privileges the benefits of these connections in the form of access to resources, power, and reputation, without jointly considering their liabilities.

Drawing from network leadership theory (Balkundi & Kilduff, 2006) and boundary spanning theory (Druskat & Wheeler, 2003), we examine the countervailing effects of leaders' external network ties—informal connections to peer leaders or supervisors who are not members of their focal

team—on their teams’ perceived climate for organizational support and team performance. On one hand, we expect that liaison brokerage—the extent to which a leader serves as a broker between actors who members of independent teams—is positively associated with team performance through its boost to team members’ perceptions of organizational support. On the other hand, we expect that liaison brokerage can be detrimental to team performance by compromising team leaders’ own commitment to their team, and ultimately their team’s performance, because building, maintaining, and navigating demands associated with informal ties requires considerable time and energy and pull them in competing directions (Krackhardt, 1999). In a sample of 485 team members in 81 teams distributed across 10 conglomerate organizations, we found support for joint positive and negative effects of a leader’s centrality in external networks. This study demonstrates both benefits and liabilities of team leaders’ networks and spotlights perceptual processes through which a leader’ networks affect members’ attitudes and performance. Taken together, we advance the burgeoning research exploring leaders’ network connections because leadership is “strongly affected by the embedding social context” (Carter et al., 2015, p. 613).

### **The personal support networks and wellbeing of older people living in care homes**

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The support that older people living in care homes receive on a day-to-day basis is essential for maintaining wellbeing. In Scotland, older people who live in care homes require specialised care and support. As people are living longer with multiple care needs, the level of support required in care homes is predicted to rise. Despite needing increased support, research suggests that the social support networks of older people living in care homes may decrease for multiple reasons, which may result in lower wellbeing. The support networks of older people are composed of a range of people from friends and family, to specialised staff and carers. These relationships provide different types of support, resources and knowledge, which can help residents in a number of different ways.

In Scotland, the combination of an ageing population and the increasing specialised needs of older residents, means it is important to understand how best to support this population and maintain high wellbeing. This paper will discuss how the support networks of older residents are structured and explore how these networks may differ from person to person, depending on their socio-economic status. Further, I will discuss how these networks may be affected by the care home itself, and how the organisational culture may affect what resources the resident utilises and how this may affect their wellbeing. Visualisations of networks will be complemented with qualitative data which will illustrate how older people utilise their networks. This research aims to identify where residents are receiving the most support and determine if there are certain types of ties that are more likely to support older people living in care homes, which will lead to heightened wellbeing.

### **The power of comment networks on social Q&A sites**

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<sup>1</sup>Ajou University

(Motivation) On social Q&A sites, askers and answerers freely interact each other. In addition to that, many third party users also observe these interactions. Social Q&A sites like StackExchange provides a comment function which allows anyone leave their opinion on the interaction between askers and answerers. Some comments may contain helpful information or knowledge (i.e., resources) and others may express feelings of gratitude, support, or criticism for other posters.

This kind of additional interaction can also influence users' asking and answering behaviors in the future. However, the comment network's influence was rarely examined. Specifically, various types of comment networks' positive or negative influences should be assessed. (Methods) To categorize comments based on their contents, text mining will be used. Categorized comments will be grouped respectively to generate various types of comment networks. To examine comment networks' effects on users' behavior, panel data analysis, which can consider both time-invariant attributes of users and time-variant network measures of users (i.e., centrality, structural hole, etc. for each time period), will be used. (Expected Conclusion) In addition to question and answer network, various types of comment networks will show significant positive or negative effects on users' asking and answering behaviors. These results will provide valuable insights to facilitate users' participation and maintain successful Q&A sites.

### **The Power of Network Analysis and Modeling for Social Movements Studies: Increasing Importance of the Protest Online Mobilization**

Grigoriy Khvatskiy<sup>1</sup>, [Dmitry Zaytsev](#)<sup>1</sup>, Valentina Kuskova<sup>1</sup>

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The current wave of globalization is greatly affected by development of the Internet and social networks (Facebook, Twitter), and citizen participation in political processes, including social movement, is taking new forms. This is clearly illustrated by the mass protests of early 2010s, covering all continents and most countries of the world (eg "Occupy movement" and events of "Arab Spring").

This study aims to address whether a network approach can be applied to grasp new dynamics in civil participation development: appearance of "network communities," online and offline forms of civil activism, and the mobilization capacity of the Internet compared with other traditional forms. When researched in a setting of Russia, it could also help address some of the controversies raised by previous studies discussed above.

This study is the empirical investigation into the role that online approaches play in the mobilization process. Previous theorizing has developed the idea that internet was becoming more important, but few has quantified this importance or even made an attempt at measurement. In this study, using recent protests in Russia in 2017-2018, we have looked at online and offline mobilization forms using the largest Russian social network, vKontakte, and a number of active offline opposition groups.

Our results appear to empirically validate two major lines of theorizing. The first one concerns the issue of protest organization – the who and the how of the mobilization protest. It appeared intuitive *a priori* that certain public opposition organizations, such as the Yabloko party or the Anticorruption Foundation, play an active role in a mobilization process. While it certainly may indeed be that way, a review of individual profiles seems to indicate that none of the more active individuals were actively recruiting on behalf of such organizations, so their role is unclear.

The second addresses the role of the online approaches to mobilization. It has been theorized previously that internet is becoming more important in mobilization efforts, especially as was indicated by the events of Arab Spring, for example. Our study appears to empirically validate this theorizing, as individual coefficient for the online mobilization effort is about 20% higher than that for the offline. However, offline mobilization remains a statistically significant instrument, that predicts tie formation above and beyond what could be provided for by the network structure alone. Overall, we can imply the increasing tendency towards online mobilization, and in the future, we can expect this tendency to increase.

**The Research Networks of Productive Librarian-Researchers**Marie R. Kennedy<sup>1</sup>, Kristine R. Brancolini<sup>1</sup>, David P. Kennedy<sup>2</sup><sup>1</sup>Loyola Marymount University, <sup>2</sup>RAND Corporation

What are the factors, intrinsic and extrinsic, that result in a librarian becoming an accomplished researcher? In academia the proxy for productivity is publication activity, and so we identified librarian-researchers who are authors/co-authors on the highest number of publications over the past ten years. We recruited these librarian-researchers into the study to seek information from them about their research training and current environment, their research networks, and their beliefs about the research process. We analyze the resulting data to learn if there are commonalities among these librarian-researchers that may demonstrate the factors that lead to productivity.

Recent literature has begun to focus on factors that contribute to the success of librarians conducting research. Hoffman, Berg, and Koufogiannakis (2014, p. 19) identified three broad categories of success factors: individual attributes; peers and community; and institutional structures and supports. Our interest in the relational nature of librarian research communities spans two of those categories, both individual attributes and peers and community. Despite the identification of the importance of these relationships, there is a distinct lack of literature in this area. The aim of our project is to address this gap in the literature by measuring the personal research networks of accomplished librarian-researchers.

Our population for this current study includes highly productive librarian-researchers (based on number of publications completed at libraries that are part of the nonprofit organization of 124 research libraries, called the Association of Research Libraries, and/or inclusion in the list of top authors in library and information science, compiled by Walters and Wilder in 2015). We invited the librarian-researchers (78 people) to participate in a web-based egocentric network interview, using the freely available survey software, EgoWeb 2.0. Respondents were asked to identify up to 40 members of their personal research interaction network and were asked questions about their relationships and interactions with these people, as well as the interactions among the people they name. We also requested current CVs, to examine the types of scholarly activities each participated in, in the last ten years.

This paper presents results about the research training and environment, research network, and statements about the research process from the 47 respondents. The paper will address network composition, the number and types of mentor relationships of each respondent, the proportion of relationships that are helping/offering help/equal, whether the respondents identify the people in their networks as friends/colleagues/both friend and colleague, and how closely tied the networks may be. We will also discuss whether these network characteristics can be tied to research output.

**The role of commercial sex venues in the diffusion of sexually transmitted infections: evidence from the largest online sexual network in the UK**Giulia Berlusconi<sup>1</sup>, Luca Giommoni<sup>2</sup>, G.J. Melendez-Torres<sup>3</sup><sup>1</sup>University of Surrey, <sup>2</sup>Cardiff University, <sup>3</sup>University of Exeter

This paper presents the results of a study on the largest online community of female sex workers and their male clients in the United Kingdom. It focuses on commercial sex venues and their role in the diffusion of sexually transmitted infections (STI) to draw implications for public health policy and practice. Commercial sex venues have received considerable attention for being settings in which opportunities for risky behaviours – often associated with STI – arise. It is therefore important to understand how clients select the venues, and what the characteristics of popular venues are. This study focuses on the structure of a sexual affiliation network of male clients. The

data, organised in a bipartite network, cover the period 2014-2017 and include 2,607 clients and 1,670 venues (e.g. brothels, massage parlours). Additional information based on clients' reviews of sex workers and the sexual services received includes venues' reputation, average price of the service, and location. This paper uses descriptive network statistics and exponential random graph models for bipartite network data to explore clients' purchasing patterns and venues' popularity. The results suggest that venues' reputation and affordability are predictors of clients' selection. These results are used to develop STI prevention strategies targeting venues, rather than individual sex workers, and to test their effectiveness in limiting contagion opportunities.

### **The role of diverse social networks in the academic success of under-represented minority students in a diverse urban university**

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Under-represented minority (URM) students are less likely to complete higher education in Science, Technology, Engineering, & Mathematics (STEM) fields than their white counterparts. Yet, the lived experiences of many URMs are ones in which the negotiation of ethno-racial and cultural boundaries are common. These experiences influence the development of diverse social networks that support the formation of multicultural identities and multicultural skills. We argue that multicultural identities and the ability to interact effectively within ethno-racially diverse social networks are key resources predisposing students to effective cross-cultural communication, adaptability, and creativity, qualities known to translate into success in STEM. This presentation will present the results of a 3-year study in an ethnically and racially diverse university in Boston, Massachusetts. Through life history interviews, 500+ surveys, and personal network analysis, we document how URM students develop and leverage ethno-racially diverse relationships in academic contexts, and assess the benefits of diverse social networks, and relationships within and between ethnic groups, for academic success.

### **The role of gender in leadership networks among young Africans**

Anne Laesecke<sup>1</sup>, [Leslie Miles](#)<sup>1</sup>

<sup>1</sup>IREX

In this paper, we explore the role that gender plays in how young Africans who participated in the Mandela Washington Fellowship program network with one another. The Mandela Washington Fellowship (MWF), launched in 2014, aims to build the skills of young African leaders necessary to improve the accountability and transparency of government, to start and grow their businesses, and to better serve their communities. The program brings young African leaders to the United States where they received six weeks of intensive executive leadership training, networking, and skills-building. Upon completion of their U.S.-based programming, Fellows received a range of interconnected networking and professional development opportunities in Africa, one of which is to serve on a peer-elected Regional Advisory Board (RAB) to promote governance and accountability.

As part of our program evaluation, we conducted a socio-centric network analysis over time to learn more about the network of Mandela Washington Fellows after they return to their home countries, using the RABs as a sample. To guide the analysis, we explored the following research questions.

In every round of data collection and for nearly every interaction type, we found statistically significant differences in the average number of connections and betweenness centrality scores between men and women despite gender parity in the networks. These findings, which echo results from other studies of gender and leadership networks, have prompted us to examine

networking practices by gender using qualitative methods and build the evidence base around relational strategies.

### **The Role of Gender in the Development of Social Capital During “Early” Academic Careers**

Luisa Barthauer<sup>1</sup>, Simone Kauffeld<sup>2</sup>

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The aim of this study is to assess the role of gender in the development of social capital among German academics in their Ph. D. und postdoc phase. Social capital is well-known to be an important predictor of career development and career success. However, research has shown that men and women differ in their access as well as mobilization of social capital. This is highly relevant since women are still less present in the workforce and especially within certain sectors and positions. Within academia, the dropout of women after the Ph. D. phase is tremendous. Research suggests that women withdrawing from traditional employment is related to their access of resources. Therefore, this study’s research question is how women’s and men’s social capital evolves in time. We assume that men build up more social capital during their Ph. D and postdoc phase than women, increasing women’s risk to drop out from an academic career.

The sample consists of 427 German academic in their Ph. D and postdoc phase from various research fields who were asked about their developmental networks within annual surveys over five years. Social capital was measured by means of the structural setup of developmental networks with parameter such as the network size, density, efficacy, and constraint. Latent Growth analysis was conducted in Mplus 8.3.

First results indicate that the social capital development (network size, density, efficacy, constraint) takes a non-linear shape with a negative overall trend and that men and women do not differ in this non-linear development. However, results also indicate that men and women differ in the initial access of social capital, which is not amended throughout the observed development. Nevertheless, in contrast to our assumption, the non-linear development of social capital is not lower for women than for men. The results will be discussed in the context of career development for men and women in academia.

### **The role of gender, performance and special educational needs in help-seeking networks of students in inclusive classrooms**

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The number of students enrolled in inclusive classrooms has increased over the last decades, due to policy changes promoting inclusion in schools. In this context, where students with and without special educational needs (SEN) are enrolled together; heterogeneity in terms of performance is expected to be high. And since performance is a factor affecting the everyday life of students, it is probable that it has an impact on social behavior, such as seeking help from others. For instance, the performance level of students might influence from whom they seek help from and whether they are asked for help. To address these questions data were collected on the help-seeking networks of 283 students (51% girls) in 14 Grade 4 classrooms across six elementary schools in Cyprus. A stochastic actor-based model implemented in R-Siena was run to identify selection effects in the help-seeking networks. Changes of ties from t1 to t2 (average Jaccard coefficient .47) were analyzed in relation to gender, performance level (teacher rated; range 1 to 3 or low, average and high), and SEN (5.7% of students). The results revealed that students with higher performance levels were more likely to be chosen as helpers from their peers and they were at

the same time less likely to seek help from peers. Pupils with similar levels of performance were more likely to seek help from one another. Further, gender was related to the help-seeking networks: a gender homophily effect was found and girls were more likely chosen as helpers and were less likely to seek help from peers than boys. Interestingly, SEN was not related to the help-seeking networks. In conclusion, performance seems to be a factor related to the help-seeking behavior of students in inclusive classrooms. Whereas students with high levels of performance seem to attract help-seeking behavior, similarity in the performance level is important as well. The question arises whether students actually profit from their help-networks. Hence, further analyses (behavioral model) are planned to study the impact of the help-seeking networks on the performance of students over time.

### **The role of physical space in collaboration network change**

Bryan Stephens<sup>1</sup>, Jonathon Cummings<sup>1</sup>

<sup>1</sup>Duke University

We track the collaboration networks (via grant co-application and publication co-authorship) of 205 biomedical faculty members over a 10-year period at a medical school in the United States. When starting their position in the university, faculty are provided office/lab space to conduct their research. We examine the extent to which the building location on campus and amount of space provided upon arrival influences the size and composition of their collaboration networks over time. We focus on changes in two aspects of network composition: departmental affiliation and institutional rank of collaborators. In particular, we explore the extent to which the location and amount of a new faculty member's office/lab space influences the likelihood of adding collaborators from the same vs different department (e.g., biochemistry, immunology, or neurobiology) and from the same vs different rank (e.g., assistant, associate, or full professor). We also study the extent to which ties within the collaboration network strengthen over time, such as when an initial grant co-application or publication co-authorship is followed up with another grant or publication with the same collaborator. In predicting the change in size and composition of the collaboration networks, we measure characteristics of the ego (location, department, and rank), alters (distance away, same or different department, and lower, same, or higher rank), and building in which the faculty member works (variety of faculty departments in building and variety of faculty ranks in building). Our main findings suggest that the building where faculty are assigned an office/lab space creates an opportunity structure that influences network size as well as the extent to which ties strengthen over time. Building assignment also influences network composition, especially when faculty from the same department are in the building. We discuss the implications of our results for models of network change that take into account features of ego along with features of the environment (such as physical space).

### **The role of policy advisors in the formation of innovation network (the case of Russian STI policy)**

Nikita Talovsky<sup>1</sup>, Dmitry Zaytsev<sup>1</sup>, Grigoriy Khvatskiy<sup>1</sup>

<sup>1</sup>Higher School of Economics

Research on innovation networks sometimes underestimates the role of policy advisors. Their role is not limited to providing policy recommendations to the government which run science, technology, and innovation (STI) policy. Instead, they often succeed as facilitators and moderators of communication between diverse range of innovation network actors (organizations, large and small, public and private, and the individuals nested within) and integrators of different levels where innovation networks operate (intra- and inter-organizational, regional, national and international levels). They function as knowledge-brokers

and barrier-bracers to improve social outcome from innovations. This paper is focused on the STI policy in Russia. We argue that innovation networks in Russian STI policy are developing due to the unique role and position that policy advisors have in them. They act as brokers integrating and bridging together different parts of innovation networks that otherwise are falling apart. They become responsible for formation of a community that provides innovations, and, finally, turn out to be accountable for progressive change.

**The role of social networks and social support in weight management for first-time pregnant and postpartum women.**

Bernardette Bonello<sup>1</sup>, Lynsay Matthews<sup>1</sup>, Chiara Broccatelli<sup>1</sup>, Jennifer Logue<sup>2</sup>, Sharon Simpson<sup>1</sup>

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**BACKGROUND:** Maternal obesity is a growing public health problem. It is associated with adverse maternal and child outcomes. Interventions focusing on individual behaviour change have had a modest impact on clinical outcomes. Previous research shows that our social networks are important drivers for obesity-risk behaviours. Weight management interventions are increasingly showing the importance of social context and a supportive environment for increasing interventions' success. However, there is currently a lack of research on the relationship between social networks and weight management for women during pregnancy and postnatally. **OBJECTIVES:** To look at the role of social networks and social support in weight management for women that are overweight or obese during pregnancy and postpartum. We aim to explore the social network characteristics of first-time pregnant and postpartum women, the relationship between the network (structure and composition) and the women's lifestyle and weight, and the social support that women need and receive for weight management during these times and its association with the participants' lifestyle and weight outcomes.

**DATA COLLECTION:** Pregnant and postpartum women were recruited from antenatal clinics, community groups and social media. Women completed an egocentric survey followed by a qualitative semi-structured interview. The egocentric survey was computer-assisted using the EgoNet software which comprised of: (1) mothers' egocentric network characteristics, (2) mothers' healthy eating and physical activity intentions and behaviours and alters' healthy eating and physical activity behaviours, and (3) mothers' gestational weight gain or postpartum weight retention and alters' weight category. At the end of the survey, the egocentric network visualisation was created which was used to facilitate the qualitative interview. In the interviews, we explored the social influence and social support in more detail such as examples of positive and negative social support from the participants' social networks and perceived ways their behaviours were influenced by the persons around them.

**ANALYSIS:** Firstly, social networks of pregnant and postpartum women will be explored by means of composition and structural measures to discover the main characteristics of the ego networks. Univariate level analysis will explore the associations between different ego, alter and network level measures and participants' intentions for behaviour change, lifestyle and weight variables. Exploratory multilevel logistic regression models will be run to explore the determinants of successful lifestyle and weight management and determinants of a supportive social network. The qualitative interviews will be analysed thematically. Finally, the quantitative and qualitative analyses will be brought together to provide a more holistic interpretation of the social processes related to weight management in pregnancy and postpartum. [The results of these analyses will be available by the time of the conference.]

Findings from this mixed methods study will highlight the mechanisms and social processes that could be targeted in an intervention to prevent or reduce obesity in pregnancy and postpartum.

**The Semantics of Striking in West Virginia: A Semantic Network Analysis of the Press-Public Relationship**Eric C. Wiemer<sup>1</sup><sup>1</sup>Purdue University

Since February 2018, more than 400,000 public school teachers have participated in walkouts, strikes, and work stoppages. This number is nearly four times higher than the last major wave of education work stoppages in 1968. The prevalence of striking workers in America has revitalized a conversation about labor issues, particularly as they relate to public school teachers. The power of a national movement to spark conversation affords communication scholars a unique opportunity to examine how discursive environments concerning an issue are created and influenced by one another. However, traditional metrics for measuring communication (e.g., surveys and public opinion polls) may be missing the substantive conversations occurring about such a salient issue. More innovative computational methods, such as text mining and semantic network analysis, and less traditional datasets may help to reveal the conversations that are actually happening.

This project will test the role of several media effects theories such as agenda-setting and associative framing in the modern media landscape. I will use these approaches in tandem with network perspectives on the cognitive map of language to analyze the semantic connections used by both the news media and the public when discussing the West Virginia teachers strike on Twitter. Particularly, I am interested in how the similarities and differences in word co-occurrences used by both the news media and the public change over the lifespan of this strike in West Virginia. I will compare the correlations between word associations during a period of time one week before the strikes occurred (February 14th, 2018 through February 21st, 2018), during the strike itself (February 22nd, 2018 through March 7th, 2018), and one week after the strike was concluded (March 8th, 2018 through March 15th, 2018). Understanding the connections between words used by the press and the public reveals modes of influence the two groups have with one another in an issue-focused discursive environment. Said differently, it is meaningful when two groups use the same language to discuss an issue and can be seen as a marker of influence.

Recognizing the processes of influence in this context can benefit from sophisticated computational research approaches. Text mining and semantic network analysis can isolate meaningful connections between words used by the press and the public during each of the three date ranges pertinent to the strike. All discourse about the strike from both groups of interest has been pulled from Twitter using Crimson Hexagon, a social media archiving platform. Implementing Quadratic Assignment Procedure (QAP), I will use this same dataset to analyze the word associations in multiple ways (e.g., weighted co-occurrences, non-weighted co-occurrences) in order to showcase the usefulness in approaching the same dataset with different outcomes in mind. Previous research utilizing this approach has only examined the presence or absence of congruent word associations used by different political entities. The objective here is to further an understanding of the press-public relationship during the presence of an unconventional yet salient issue by analyzing discursive environments from multiple methodological angles.

**The Social Structure of Employee Participation in a Representative Democratic Firm**James A. Coutinho<sup>1</sup>, Peng Wang<sup>1</sup><sup>1</sup>Swinburne University of Technology

A representative democratic firm displays a combination of employees' direct participation in lower-level, operational decision-making and indirect participation in higher-level decision-

making via representatives. A representative democratic structure has been thought to benefit firms by increasing the efficiency of decision-making, and by improving the well-being and productivity of employees. However, it has also been argued that the most skilled and politically active employees will come to dominate the informal processes around decision-making in representative democratic firms, leading to democratic degeneration and harms for both employees and the firm. We present evidence on the effectiveness of representative workplace democracy from an in-depth case study of a worker co-operative with 143 employees in the UK retail sector. We use a mixed-methods approach incorporating social network analysis, survey research and in-depth interviews to study the informal processes around workplace decision-making, who participates in decision-making and who is excluded from participation, and the outcomes of participation in terms of employee satisfaction. Unlike previous research, which tends to rely on self-report indicators of employee participation or on qualitative evidence, we use a social network approach to capture the interpersonal nature of participation at multiple levels of decision-making. We find that while employees are generally able to participate in lower-level, day-to-day decisions and they gain satisfaction from participation, many employees are excluded from effective participation in higher-level issues such as those around pay and benefits, and their exclusion creates considerable disaffection with firm governance. The paper contributes to evidence on the individual, social and contextual factors that determine the effectiveness of employee participation in workplace governance. It presents a nuanced picture of the outcomes of workplace democracy by showing how it can create both benefits and challenges for a firm.

#### **The spatial distribution of neighborhood social ties with longer residence**

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How does the spatial distribution of social ties change as residents live longer in a neighborhood? Do "imported" ties from elsewhere tend to fade out over time and become replaced by local ties? We address these questions using data from the American Social Fabric Study (ASFS), a large-scale, spatially stratified egocentric social network survey of residents in the western United States. We explicitly explore the relationship between length of residence in the neighborhood and the spatial distribution of social ties of residents. We assess the degree to which local ties (nearby) form over time and the extent to which they augment or replace long distance ties. We also consider whether certain characteristics of the local context impact this relationship.

#### **The stability of blockmodeling of signed networks in the face of actor non-response**

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Signed networks are used to represent like and dislike relationships among actors. One of the widely used approaches to reveal the underlying network structure is signed blockmodeling. More precisely, the goal of this approach is to reduce a large incoherent network to a smaller simplified structure where units are partitioned into clusters and relationships among clusters are revealed. The blockmodeling of signed networks has foundations in structural balance theory. Social network data are mostly gathered by surveys or observations. Regardless, the relationships among actors, the collected network data are prone to measurement errors. Errors can occur in many forms. One of the easiest types to detect is an actor non-response appears when an actor refuses to respond or participate in the research so that a row of unavailable or missing data is problematic. This is especially the case with signed data.

Previous studies of actor non-response treatments on the stability of blockmodeling outcomes has shown that one of the best determined treatments is the k-nearest neighbors approach which considers the k closest actors according to their incoming ties and then calculates the outgoing ties of the non-respondent as the median of outgoing ties of selected nearest neighbours. Here we assess the extent to which actor non-response treatment performs well in signed networks according to the stability of signed blockmodeling. Simulation results on real and generated networks are presented.

### **The Stickiness of Poverty: Adolescent Friendship Networks**

Megan Evans<sup>1,2</sup>, Alexander Chapman<sup>1,2</sup>

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Research on intergenerational social mobility finds that growing up in poverty often results in the perpetuation of poverty across the life course, and into the next generation. Youth occupy a life course stage where parents, teachers, and mentors typically manage many aspects of the youth's environment. Yet, during adolescence, youth begin to exercise more influence over certain aspects of their lives such as their social networks. Factors such as the clothes they wear or the teams they play on can unite some students and isolate others. For adolescents living in poverty, their ability to pay for clothing and team fees, spend afterschool hours with friends or in extracurricular activities can be dramatically diminished compared to wealthier peers. Yet, an adolescent's social network represents the basis of their social capital. Hence, if poor adolescents have smaller social networks, then a youth's limited social capital may serve as another way in which poor adolescents face barriers to social mobility.

Theories of social capital suggest that people with resource-rich social networks have advantages over those with less resources in their network. People high in social capital not only have more resources, but they tend to use them more effectively. For adolescents, social networks can provide information on first-job opportunities, cultural information such as details about the college application process, and resources such as sharing lunch or providing transportation. Research on social capital suggests that lower incomes result in lower levels of social capital, but this literature is often restricted to adult samples. While recent work in Nordic countries has confirmed similar results for adolescents, to our knowledge, no researchers have examined the link between poverty and social capital for adolescents in the United States. Considering the stark economic inequalities that exist in the U.S. compared to the Nordic countries, we argue that it is important to examine how social capital and poverty are related in a U.S. context.

We hypothesize that poverty status will be an important determinant of adolescent friendship ties in a high school friendship network. To test our hypothesis, we use Exponential Random Graph Models (ERGMs) with the Wave I sample of the National Longitudinal Study of Adolescent to Adult Health (Add Health). Our preliminary results, both from empirical and descriptive analyses, support our hypothesis. Poverty impedes the expansion of social capital for high school students from disadvantaged households. Scholarly understanding of the life course is that disadvantaged youths often cannot escape the inequality that they were born into because of economic and cultural barriers. However, less is understood about how adolescents' social networks may represent pathways to social mobility. By examining this relationship, we help illuminate another avenue through which poor adolescents are more likely to transition into poor adulthood.

**The story of shared research bundles: Consumption Collectives**S. Kubra Canhilal<sup>1</sup>, Matthew Hawkins<sup>2</sup><sup>1</sup>ICN Business School, <sup>2</sup>ICN Business School

In this paper, we incorporate a network perspective to provide insights into the origins of consumption collectives of the *consumer identity* research. Research on consumer identity grew from one published article in 1979 to three articles in 1980, expanding to a total of 598 articles in 2015. Over these four decades, a consumer identity research consumption collective has emerged. Yet, where did it come from? Where do consumption collectives come from?

To answer this question, we examine academic papers published in the last 30 years (n=2815), using a text-mining approach, through which we conceptualize words as resources, and topics as resource bundles. Taking this further, we extend our analysis with a network perspective tracing back to the authors of the articles and connecting them with resources and resource bundles. To capture the key artifact of the consumer identity research collective, we extracted abstracts related to “consumer” and “identity” from five databases, and used the Schimago Journal List to categorize papers by field, selecting the fields with the most publications. To trace resource movement longitudinally we grouped time into periods of five years: from 1979 when the first article was extracted till 1995 which was a turning point in consumer research.

We demonstrate that the focal collective emerged at the nexus of the adjacent fields of sociology, social sciences, and psychology. Each field primarily focused on native topics until the early 2000s when an era of convergence or cross-fertilization occurred, while over the course of the following 10 years the consumption collective structuralized. Currently, roughly 50% of published articles on *consumer identity* contain the same resource bundle signaling the emergence of a shared schema and, thus, a consumption collective. Our work connects the resources and research bundles with authors/universities and geographies to provide more explanation about how a research consumption collective has emerged over a 30-year period.

**The Structure of Reasoning: Inferring Conceptual Networks from Free Response Text**Sarah Shugars<sup>1</sup><sup>1</sup>Northeastern University

Scholarship in a number of fields has long indicated that human thought is best represented as networks of interconnected concepts. Cognitive processes as diverse as reasoning, arguing, remembering, and learning are best modeled as conceptual networks in which the connection between similar ideas facilitates the storage and retrieval of relevant information. These models of human language and cognition are bolstered by behavioral observation – of arguments, deliberation, written texts, and self-reports – that repeatedly suggest that individuals perceive their ideas to be connected to each other in complex networks of support or contradiction. When speaking with others, we raise ideas that seem connected to what they said; when thinking to

ourselves, we move from idea to idea via their connections; and when assessing a complex issue, we weigh the pros and cons as well as their interconnections in order to arrive at a final judgment. Yet, these conceptual networks can only be observed in the form of semantic networks – as people use words to express or justify their reasoning. Furthermore, inferring these conceptual networks has proven to be a significant challenge, with existing efforts often relying on arduous hand-coding or simple word co-occurrence. In this paper, we move towards building a networked understanding of human reasoning by developing and validating a new conceptual network measure of reasoning in order to better understand how people structure and express their views. We present and test a series of approaches for measuring individual conceptual networks: this includes a semantic network analysis of free response text along with two approaches in which participants directly express the network structure of their reasoning. We validate these approaches against a bank of personality measures across a series of issue domains, finding that people structure their reasoning in distinct ways which are correlated with existing behavioral measures. Furthermore, we find that our approach for inferring conceptual network structure from free response text is effective and scalable to a variety of observational data. This work illustrates that the network structure of human reasoning provides meaningful insight into political behavior and can be inferred at the individual level.

### **The Temporal Dynamics of Negative and Positive Ties**

Martijn Jungst<sup>1</sup>

<sup>1</sup>EDHEC Business School

Social network research has recognized the importance of negative ties at work, which has been defined as: ‘an enduring, recurring set of negative judgments, feelings, and behavioral intentions toward another person’ (Labianca & Brass, 2006, p. 597). The core idea guiding research on negative ties is the creation of social liabilities and its asymmetrical effect on task and socio-emotional outcomes in comparison to positive ties (Labianca, 2014). This disproportional effect is due to the rarity in occurrence and salient nature of negative ties (Marineau, Labianca, & Kane, 2016). Organizational studies examining negative ties showed significant negative effects on affective commitment (Venkataramani, Labianca, & Grosser, 2013), satisfaction (Baldwin, Bedell, & Johnson, 1997), individual performance (Marineau, et al., 2016), and in- and extra-role performance (Sparrowe, Liden, Wayne, & Kraimer, 2001). Although these and other previous cross-sectional studies have been valuable in helping to establish an initial relationship between negative ties and performance outcomes, they are limited because interpersonal relationships are complex and dynamic (Balkundi & Harrison, 2006). Indeed, negative ties are judgments, feelings, and behavioral intentions that are developed through dynamic interactions over time (Labianca & Brass, 2006). Hence, one purpose of the current study was to extend previous research on the relationship between negative ties and performance by examining the dynamic nature of negative ties. Drawing on the conservation of resource theory and the social ledger model, we examine whether instrumental ties can mitigate the negative consequences of negative ties by conducting a four-wave diary study among graduate students. While using binary network data, in-degree centrality of negative and instrumental ties was calculated within UCINET (Borgatti, Everett, & Johnson, 2018) and performance was measured via peer evaluation for each time period. Results from 244 graduate students over a period of four weeks indicated that within-person negative ties negatively predicted individual performance. Analyzing the within-person moderation effects of instrumental ties, we find that having access to a large instrumental network buffered the decrease in performance associated with negative ties. While our findings are consistent with past studies that found a negative relationship between negative ties and performance (Sparrowe, et al., 2001), we go beyond past research by uncovering that the effect of negative ties varies within-

persons. The fact that we found that negative ties can be considered as episodic phenomenon which vary over time might lead to the idea that negative ties have both short- and long-term effects. Relatedly, we contribute to the social network literature which has predominantly focused on positive ties (see Burt, 2009; Granovetter, 1985; Ibarra, 1995; Lin, 2002) and respond to the call for empirical studies including both positive and negative ties (Labianca, 2014) by theorizing that instrumental ties buffer the effect of negative ties over time. Practically, individuals need to be mindful when dealing with negative ties to prevent a polarization and isolation of negative ties since negative ties carry both short- and long-term consequences. As such, individuals need to invest in positive relationships to balance the social ledger as soon as social liabilities are perceived.

### **The ti(m)es they are a changing - social competencies as predictors for changes in social networks during transition periods**

Britta Wittner<sup>1</sup>, Carina Bargmann<sup>1</sup>, Simone Kauffeld<sup>1</sup>

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Relationships have a complex relevance during transition periods in life. On the one hand — especially in tough times—people tend to lean on their network for social support. On the other hand, changes in life often also lead to changes in ego networks and thus the very people one leans on. Starting university is an example of such a turning point. Being used to seeing the same familiar faces, students often start their first semester by themselves, accompanied by the wish to make new friends and maintaining friendships from school. Yet, studies suggest that feeling supported by peers and family helps students to adjust to university life, buffers stress, shapes their identity and provides them with important social support (especially instrumental and informational) to help them complete their degrees successfully.

Most predictors for making friends we know of are difficult or impossible to control. We know that physical distance and homophily are important factors. In addition, an individual's past or context (family environment, domestic violence) can influence their friendships. Other results indicate that physical attractiveness can lead to being more accepted by peers and having more friends. However, considering the importance of social support, we are interested in factors that individuals can learn or change to facilitate making friends: What can students do (or learn) to influence their network parameters?

In this study, we analyse learnable competencies as predictors for change in ego network parameters. Based on research suggesting that self-reported sociability is linked to acceptance by peers, and that students value affective skills in their friends, we emphasize social and interpersonal competencies. We assume that having social competencies that are referred to as desirable in friends, increases the number of alters an individual adds to their network and keeps during transition periods.

To test our hypotheses, we used data from two time points of an online panel study following students attending a bachelor's degree in teaching during their first year at university ( $N=382$ ;  $M_{age}= 20,5$ ). The first measurement point was during orientation week (social competencies, and ego centred networks  $T1$ ) and the second was shortly before their second semester (ego centred networks  $T2$ ). We used psychological scales on social competencies (e.g., communication competence, establishing contacts, and empathy) as predictors for changes in ego centred networks (e.g., increased network size, increased number of alters from university).

Our results indicate a significant positive relationship of social competencies (especially empathy and establishing contacts) with network size at both time points as well as increased network size (increase of network size and peer network size) and received support (instrumental and informational support) in their new environment. We were able to specify, which competencies

are important predictors for expanding students' ego centred networks. Thereby we offer ways to help students gain social support and deal with their first semester. Since networking trainings often fail to improve social network parameters and social support, we discuss the results with particular focus on possible training strategies to improve these competencies in students.

### **The transmission of HPV in the sexual networks of swingers, a multilevel network approach**

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#### Background

Swingers, i.e. heterosexual couples who, as a couple, have sex with others within the swingers' subculture, are a subpopulation at risk for Sexually Transmitted Infections (STI). Human papillomavirus (HPV) has proven to be highly prevalent in female swingers (unpublished data). The different HPV virus genotypes can be distinguished in low risk (LR) genotypes, causing benign disease like genital warts, or high risk (HR) genotypes causing cancer.

The aim of this study is to assess how the different HPV genotypes are distributed within the sexual networks of swingers and whether certain HPV genotypes cluster in certain parts of the network.

#### Methods

We build a sociometric sexual network of swingers based on the ego-network data given by 115 swingers who participated in our prospective cohort network study on swingers between April 2011 and March 2012. The vaginal samples of all female swingers in the network and known in our STI clinic were tested for HPV. HPV genotypes were identified by the highly sensitive SPF<sub>10</sub>-LiPA<sub>25</sub> method detecting 25 different genital HPV genotypes: 17 HR genotypes and 8 LR genotypes. The multilevel transmission network consisted of the one-mode sexual network of the swingers and the two-mode network of the swingers and the HPV genotypes. Distribution of HPV genotypes in the sexual network was assessed using R packages Igraph and Multinet. Clustering of HPV genotypes will be assessed using multilevel exponential random graph models (ERGMs).

#### Results

The sexual network contained 1231 individual swingers of whom 556 female swingers. The sexual network consists of 38 separate components. The largest component contains 748 swingers (61% of all swingers in the network). Of 103 female swingers known in our STI clinic and tested for HPV, 96 (93%) were positive for at least one of the 25 HPV genotypes: 92 (89%) were infected by at least one HR HPV genotype and 65 (63%) by at least one LR HPV genotype.

All 25 HPV genotypes were present, but not equally distributed throughout the network. Based on visualisation of the network, some genotypes seem to cluster together in specific components of the sexual network. Further analysis is necessary to confirm clustering.

#### Discussion

All assessed genotypes of HPV were prevalent in the sexual networks of swingers. Despite the incomplete data in our study, multilevel network analysis turns out to be useful for studying transmission networks. Clustering of highly prevalent HPV could be used as a marker for sexual behaviour, potential STI risk and transmission in swingers.

The methodological challenge of using both incomplete sexual network data and incomplete HPV genotyping data will be addressed.

**The Uproar over Genome Edited Babies: A Semantic Network Analysis of CRISPR on Twitter**Christopher Calabrese<sup>1</sup>, Jade (Jieyu) Featherstone<sup>1</sup>, Benjamin Millam<sup>1</sup>, George A. Barnett<sup>1</sup><sup>1</sup>University of California, Davis

Genome editing technologies, such as CRISPR, have become an emerging socio-scientific issue. These technologies can precisely cut and replace sequences of DNA in the genome, revolutionizing biological technology and its applications to medicine and agriculture, but also facing social and ethical concerns regarding its application to humans. This study examines the framing of CRISPR online through the application of semantic network analysis, with a primary focus on Twitter. Three different sources of data are used to describe the semantic networks about this topic, including, content from Wikipedia and the top-seven webpages that resulted from an online Google search; structured interviews with biologists, policy makers, farmers, and the general public; and Twitter posts from April to December 2018 through Twitter's Premium API using the keyword "CRISPR." All datasets were analyzed with ConText (Diesner et al., 2013). Preliminary results suggest that technical science terminology and an overall neutral sentiment dominate these online representations. However, the semantic networks on Twitter posts tend to focus on the social and ethical concerns. To further understand these differences, the effects of events on Twitter are examined through comparing the semantic networks before, during, and after the release of the breaking news story involving the creation of "CRISPR babies." Further analyses will unveil the common themes on Twitter, as well as the overall sentiment surrounding genome editing technologies at these different time points. Findings will provide researchers with a snapshot of how genome editing is portrayed online and how public opinion of genome editing is formed. This will aid in the development of message strategies to bridge the gap between the scientific community and the public.

**The weakness of the "weak tie" concept: an empirically-grounded theoretical critique**Martin Santos<sup>1</sup><sup>1</sup>Pontificia Universidad Catolica del Peru

The distinction between "strong" and "weak" ties lies at the core of ego-centric network research. While we know a lot about strong ties (for instance, kinship or friendship ties), we know less about "weak ties". In fact, the notion of "weak tie" is a residual category where different non-strong ties are included, from acquaintances to people one has seen once in life. The purpose of this paper is to problematize Granovetter's notion of "weak ties". To accomplish this goal, this study will analyze longitudinal personal network data (2011-2014) originally collected to understand the role played by the social support networks of low-income and middle class Peruvian youth in the transition from school to college.

The name generator technique was used to collect students' personal networks. Several types of ties within personal networks were measured: kinship, friendship, student-professor and acquaintanceship. In-depth interviews asked for demographic characteristics of respondents, the educational and occupational background of parents, quality of the parent-child relationship, child's educational trajectory, college enrollment and college adaptation, field of study and academic achievement, among other key variables. Network analysis techniques were used to analyze college students' personal networks, while content analysis was used to analyze in-depth interviews.

Findings suggest that it is crucial to distinguish analytically types of "weak ties", showing the particular contexts and dimensions for which they matter. Also, some "weak ties" are multidimensional, in that they matter, at the same time, in different contexts (for instance, academic and extra-academic). Likewise, over time some "weak ties" become stronger and different in nature. Theoretical and methodological implications are discussed. The paper

suggests the need to take social context seriously into account, moving beyond the formal "strong-weak" tie distinction.

### **Time Scales of Social Influence: Evidence from American College Students**

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Scholars of American public opinion have long been interested in the effect of social influence on political attitudes. However, one challenge in studying social influence is a lack of understanding of the time scales over which this influence operates. How quickly should we expect peer influence to change one's attitude toward a presidential candidate versus their party identification? College provides an ideal test of social influence mechanisms, as students experience abrupt changes in their individual social networks. We present evidence, drawing on longitudinal network data from dormitories at 14 American universities, of the differential time scales of social influence for a suite of attitudinal variables. To address concerns about the confounding effect of homophily, we estimate models of network formation; the results of these tests suggest minimal effects of homophily. This work provides a foundation for scholars hoping to compare the effects of social influence to other factors, such as elite discourse.

### **Title: Social networks as a "relation tool" and electronic social media as a "communication tool" in an educational context**

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Electronic social media is generally considered in terms of technology tool and online social media communication tool. But what about the impact of comments made via social media on the users and the people concerned by these same remarks. In fact, are there inherent dimensions to all these communicational interventions in education?

Ever-expanding social networks are introduced to the functioning of our society which, inter alia, schools, training centers, universities, as a means of communication. The social networking phenomenon in schools at primary and secondary levels is mainly related to their peers, their reading and intellectual curiosity. This reality is now perceived and experienced as an essential dimension in schools because of electronic social media (e-SM) are a new form of collective and individual communication.

In this context, the present communication aims to highlight the construction of a "professional" social network made up of school principals through which a scientific study dealing with the professional representations of school principal could be conducted from 2010-2013 (St-Pierre, 2013). Based on an inductive and qualitative methodology, this study explored and analyzed the data provided by this professional network in order to identify and grasp the contribution and influence of information technologies conveyed by social media in the school setting.

Thus, nine axes of analysis emerged following the analysis of representations made by these school actors regarding the presence of electronic social media (e-SM) and the use of information technologies in Quebec schools. In this specific framework, made up of the "Understanding Wheel of Social Media", we explore these nine axes from the analysis of the data collected. Then we try to show some links between professional social networks as a "relational tool" and electronic social media as "communication tool" in an educational context.

**Topology and Semantics of a Massive NSSI-Related Interaction Network**Dmitry Zinoviev<sup>1</sup><sup>1</sup>Suffolk University

Non-suicidal self-injury (NSSI), such as self-cutting or self-burning, is the deliberate destruction of one's body tissue in the absence of suicidal intent. Approximately one in five of adolescents and one in four of young adults in the USA, often referred to as "self-cutters," have engaged in NSSI.

The ample presence of self-cutters online makes it possible to research them noninvasively in a naturally occurring setting. For this study, we chose LiveJournal (LJ), a blogging social networking site hosting ~140 NSSI-related thematic communities with the cohort of 15,678 active users.

The goal of the study is to analyze the topology of an interaction network of the NSSI-related users and compare it to the vocabulary of the blog posts and comments. A correspondence between the topology and word frequencies, if observed, could be used to define bloggers' roles and identify corrective intervention mechanisms.

The study is based on ~63,000 original posts and ~169,000 follow-up comments posted by the cohort in 2001–2012. We constructed a directed weighted interaction network of users by connecting two users with a directed edge if one user commented on a post or comment by the other user (the number of follow-ups being the edge weight).

The network has an excellent community structure; it consists of 18 major clusters (modularity=0.73). We calculated the major centralities (indegree, outdegree, betweenness, closeness, eigenvector) and clustering coefficients for each node as plausible quantitative measures of the users' roles in the network. In particular, we hypothesize that a higher indegree (more comments) is associated with help requests and controversial statements; higher outdegree measures responsiveness; higher closeness is a proxy for immediate responses to the original posts, and higher betweenness is a degree of embeddedness into a conversation.

In addition to the interaction patterns, we obtained full texts of all posts and comments and identified 5,863 most frequent terms (word lemmas, bigrams, and HTML tags). Finally, we calculated VADER sentiment scores for each user.

We observed no relationship between the network measures and sentiment scores. We hypothesize that that overall sentiment level in the cohort is uniform and independent of the positions of the cohort members in the network.

We applied a random forest regressor to explain and predict the network measures using the frequencies of the most frequent terms as features. We trained the regressor for each measure on 67% randomly selected nodes, cross-validated on the remaining 33% nodes, and recorded the most significant features for each measure. The algorithm explained >0.85 of the variance of all five centralities and the clustering coefficient. However, only the indegree, outdegree, and betweenness could be predicted with an acceptable  $r^2$  score of >0.58. The most important terms for predicting the high indegree are: "want," "cut," and "bad" ("complaints"); for outdegree: "welcome," "hope," and "help" ("advise"); for betweenness: "welcome," "someone," "cut," "post," "blade," etc.

We conclude that the structure of the interaction network in the NSSI LJ communities is related to the users' vocabulary. However, the relationship is not straightforward and warrants further inquiry.

**Towards Multidimensional Understandings of Ego Networks**Alexandra Marin<sup>1</sup>, Chang Z. Lin<sup>1</sup>, Xiaowei Li<sup>1</sup>, Soli Dubash<sup>1</sup><sup>1</sup>University of Toronto

Ego network researchers commonly collect rich data on the nature of relationships between respondents and alters including support exchanged, the nature and frequency of interactions,

affect and conflict. Yet the common approaches to analyzing ego data do not engage with the complexity of these data. Typically, researchers take one of three approaches: combining ties that provide *any* kind of support or interaction into a single network, thus using the combined dimensions to create a network boundary; analyzing dimensions separately; or combining multiple dimensions to create a measure of multiplexity. Following these approaches tend to reduce relationships on which detailed data are available to the presence or absence of a tie, or at best, to ties with varying levels of intensity.

When we treat ties that provide *any* kind of support as *equal* and *equivalent* members of a social support network we ignore and mask variation in the *character* of relationships. Considering multiplexity or other measures of relationship intensity adds some nuance but can still treat very different relationships as equivalent. For example, a neighbour who socializes with ego and does small favours and a sibling who discusses important matters and would lend ego a large amount of money would both have a multiplexity of two despite having very different relationships.

We argue that researchers must dive into multidimensional understandings of ego networks to investigate how the character of relationships varies and changes. Understanding ego-centric social support networks as multi-dimensional involves considering how different dimensions of relationships intersect and combine. Which dimensions commonly vary together? What combinations of activity characterize different kinds of relationships? Are relationships fluid in shifting their forms of activity or do they display strong inertia? We draw on examples from the literature as well as from our own work to highlight the kinds of questions and findings that are possible when we rigorously engage the multi-dimensional nature of relationships.

We highlight in detail one example of multidimensional approaches to ego networks. Using detailed data on 607 relationships at two points in time at least 15 years apart, we use latent class analysis to develop a typology of ties based 12 dimensions of tie activity. Our model reveals 6 classes that vary, not only in their levels of activity, but in the nature of the relationship implied by the particular dimensions active among ties of each type. We show how relationships evolve and change categories over time and discuss the implications of these results. In particular, we highlight how ties that could be classified as dormant by a less multi-faceted analysis actually vary: While some may well and truly be gone, some are latent pools of social support and social capital ripe for reactivation.

We conclude by outlining a research agenda for developing strong multidimensional understandings of ego networks.

### Tracing Networked Gender Discourse on Reddit

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Digital platforms increasingly facilitate conversations surrounding central axes of human experience, including race, class, and gender; at the same time, the networked nature of many social media sites support distinct information flows and discursive dynamics. This research examines communities of gender ideology on Reddit moving within and across subreddits—specifically using feminist, trans and gender nonconforming, and manosphere discourse as vantage points. To do this, we study both network structure and pathways of potential information flow. We use shared moderator ties between subreddits to examine epistemic relationships; mentions and links in metadata fields as indicators of awareness and implicit self-definition; and subreddit names as evidence of how discourse evolved through time and digital space. Using this structural perspective, we test the association between network position and node-level covariates such as subreddit creation time to examine how these three movements evolve, interact, and articulate boundaries. We situate our findings as an empirical exploration of

"informal" knowledge production that leverages the networked and crowd-driven nature of online spaces to circumvent mainstream gender ontologies.

**Trans-boundary wildfire risk management networks: North Central Washington to the Wasatch Front in Utah.**

Derric B. Jacobs<sup>1</sup>, Max Nielsen-Pincus<sup>1</sup>, Cody Evers<sup>1</sup>

<sup>1</sup>Portland State University

Wildfire risks are imposed by a complex system of social, political, economic and ecological factors that interact to form what is generally considered a “wicked problem”. Wicked problems are difficult if not impossible to fix unconditionally due to the following: deficient and/or contradictory systemic knowledge, the number of stakeholders’ involved, considerable economic burdens, and the interconnected nature of the problem to others. Furthermore, wildfires are often trans-boundary events where the ignition occurs in one land tenured system and then transfers to other lands. Addressing wicked problems theoretically requires extensive and diverse networks of representative stakeholders to collaborate through the stages wildfire governance: pre-wildfire planning and preparation, wildfire event response and management, and post-wildfire recovery. In response to increasing wildfire events, increasing severity and increasing costs to manage the events, the U.S. Forest Service has set out to investigate the many social aspects of trans-boundary wildfire risks through a project known as the Co-management of Fire Risk Transmission (CoMFRT). This presentation begins where work presented at the North American Social Network conference in 2018, *Building a structural understanding to trans-boundary wildfire risk management systems*, left off; the analysis of the North Central Washington’s (NCWA) case study and the beginning work on the Wasatch Front of Utah (WFUT). The case study in NCWA has been fruitful in providing an approach to studying the wildfire risk management system yet has led to more questions than answers. We now have a better understanding that in Washington, the states agencies seem to operate collaboratively with local, maniple and private stakeholders much more than federal agencies and more specifically the U.S. Forest Service, and with the former being much more intra-organizationally focused when addressing wildfire risks. What we do not entirely know yet is why and to what extent this lesson holds in other regions like the WFUT. With another phase of surveying starting in NCWA and the initial effort for studying the WFUT region in winter and spring of 2019, this presentation will cover the lessons learned, the evolution of additional questions yet to be understood through this research program and the preliminary analysis of the data emerging from the winter and spring data collection seasons.

**Trickle Down Inequality: How Leader Networks Shape Racial Progress in Diverse Organizations**

Christopher Munn<sup>1</sup>, Korie Edwards<sup>2</sup>

<sup>1</sup>Indiana University Lilly Family School of Philanthropy, <sup>2</sup>The Ohio State University Department of Sociology

Leaders face an important challenge in diverse networks. How do they embrace the values of diversity with perpetuating the inequalities that exist in broader society? Work on the theoretical and practical implications of organizational diversity suggest that the complexities of managing racial dynamics within an organizational are compounded with the pressure to conform to external norms about diversity. Critical diversity scholars have challenged whether neoliberal policies and practices actually reduce racial inequalities within diverse organizations. Drawing from a multilevel analysis of leaders embedded in religious institutions and the social networks members of racially diverse organizations, we examine the organizational level factors that influence racial progress. Specifically, we analyze the associations between diversity practices

(i.e., promoting diversity statements) and the diversity and strength of members' closest friendships for those attending racially diverse churches. Data for this project come from the Religious Leadership and Diversity Project – a comprehensive, cross-national study of the head clergy of racially diverse religious churches and parishes. We draw from 121 surveys and in-depth interviews with head clergy and 674 surveys of attendees who described 1525 close friendships. Our findings reveal that when accounting for individual level factors, that increasing the proportion of paid leaders of color is the only diversity strategy that positively associates the diversity of member networks. Further investigation reveals that churches that receive funding for being diverse are less racially integrated and that race moderates the strength of close ties. We argue that the social network inequalities that leaders of diverse organizations face trickle down into the relationships of their members in ways that challenge scholars to question the efficacy of modern diversity initiatives.

### **Tweeting Climate Change in 2018: The Landscape, Opportunities and Challenges in Communicating Climate Change Discourse**

Yixi Yang<sup>1</sup>, Mark Stoddart<sup>1</sup>

<sup>1</sup>Memorial University of Newfoundland

Social media has increasingly become an important arena for climate change communication. Compared with mass media, its relatively decentralized information flow patterns have the potential to foster a more diverse and inclusive climate change discourse. Using social network analysis, we examine the texture of climate change's discursive fabric and explore how the network structures provide opportunities and impose constraints on interactions among climate change discourse segments. The top 15% of the most circulated tweets (n=64,353) are collected from all the tweets (English language) in 2018 that contain the hashtag "#ClimateChange". A network is constructed based on the co-occurrence among the hashtags (n=1972) in these tweets. This network presents how prominent frames in climate change communication interact with each other, thus sketching a snapshot of the landscape of climate change discourse on Twitter. First, we focus on the network's connectivity and fractionalization and break the network into twelve thematic communities based on modularity: Global South, Sustainability, Environmental Events, Canada Fossil Fuels, Climate Geopolitics, Climate Evidence, Renewable Energy, Australia Politics, Health & Food, Trump & the U.S. Politics, Oceans, and Environmental Campaigns. Second, we examine the structural and discursive characteristics of these thematic subgroups. Finally, we examine cleavages and brokerages among subgroups to explore potential coalitions that could bridge the current discourse divisions. By comparing key themes and their structural roles, we gain insight into their influences and potential for creating more effective climate change communication and encouraging better public engagement.

### **Twitter Adoption and Interorganizational Alliances Among International Health Organizations**

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<sup>1</sup>Department of Communication, University of Kentucky, <sup>2</sup>Department of Telecommunication College of Journalism and Communications University of Florida

Social media play an important role in how health organizations conduct community outreach and empower people about health issues (Klassen et al., 2018; Heldman et al., 2013). In particular, Twitter has become a popular tool for health organizations with an adoption rate approaching 80% (Park et al., 2016). However the literature shows that little is known regarding how the adoption of Twitter by these organizations spread. The goal of this study is to uncover whether there is a social contagion process and if yes what factors can explain the process.

Guided by the theory on the diffusion of innovation (Valente et al., 2015; Rogers, 2010), this study focuses on understanding the extent to which peer influence affects the adoption of Twitter. The theory on the diffusion of innovation explains how network affects behavior and behavior change (Valente, 2012). It assumes that diffusion of new ideas and practices typically take a long time and the adoption does not occur immediately after someone first learns about them. In this study, we examine a variety of relationships formed among health organizations to measure different contagion mechanisms and uncover what was the main driving force underlying the adoption of Twitter.

Data for this study were collected through the following procedures. First, we identified 175 international health non-governmental organizations (NGOs) from the Union of International Association's online database. Union of International Association (UIA) is a comprehensive source for identifying international organizations and its annual yearbook reports information about these organizations' partnerships and attributes (such as location and membership countries). The criterion we used to filter health NGOs is issues stated in the primary mission, including substance abuse (tobacco, alcohol, and other drugs), and HIV/AIDs, and so on. Second, we collected all the yearly partnership information of the sampled 175 organizations between 2005 and 2017. There were three types of partnerships recorded: collaboration, funding, and consultation. Third, we identified whether all the sampled international nonprofit health organizations had an active Twitter account, leading to a total of 92 organizations that fell into this category. In addition, we used Twitter API to collect the following data at the level of organizations: when a Twitter account was created, followers, followees, and the total number of tweets on each account.

This study applies a stochastic actor-oriented model, which estimates network evolution parameters with simulated network processes. Specifically, the SIENA within the R project package will be used to conduct the analysis of network data and attributes data over time. The outcome variables in SIENA are network patterns and the adoption of Twitter.

This research offers several important contributions. First, this research seeks to explain how network structures and the adoption of Twitter co-influence each other, aiming to generate insights on how network data and behavior data interplay in the diffusion process. Second, this research offers a preliminary examination underlying the micro-level decision making of adopting Twitter by individual organizations. Practical and theoretical implications for social media adoption by health organizations are discussed.

### **Typologies of Duocentered Networks among Low-Income Newlywed Couples and Associations with Relationship Quality**

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Decades of research indicate that the quality and structure of couples' social networks influence relationship satisfaction, conflict, and the success or failure of their marriages. The social network surrounding couples can provide support, constraint, as well as a normative template for couples to develop expectations for their own relationships. Understanding the social networks of low income couples is especially important because these couples may experience greater stress and less support due to lower social capital in their extended networks. It is also important to understand how couple networks are formed in the early stages of marriage as spouses begin the process of transitioning from their separate social worlds into a combined couple network. Prior research has recognized that the networks of couples are multidimensional with a mixture of composition (e.g., the proportion of family members vs. friends) and structural characteristics (e.g. density, degree of overlap between spouses' networks). Several studies have used cluster

analyses to summarize couple networks into discrete types that are associated with relationship quality. There are several limitations to previous research on couple networks. First, there is a lack of studies on the social networks of couples with low-incomes despite the importance of the social context of marriage for this vulnerable group. Second, few studies have examined the development of social networks longitudinally as they form in the early stages of marriage. Third, previous studies have primarily been based on global ratings of couples' network characteristics or network data collected from one partner or the other, rather than their combined, "duocentered" couple network.

This presentation addresses these limitations by presenting preliminary findings from a longitudinal study of low-income newlyweds. The study sample includes 3 waves of network data from 213 newlywed couples at the outset of their marriages. We conducted separate personal network interviews with husbands and wives, asking each partner about 25 of their network contacts, and then asked a series of questions about each of these alters. Spouses also evaluated the ties between each unique alter-alter dyad. After identifying which alters named by each spouse were the same people, the separate personal networks were combined into one 'duocentered' network for each couple. We generated a set of composition and structure measures for each of these duocentered networks and then used cluster analysis to identify duocentered network types. Network variables included in the cluster analysis include overall network density and the density of the sub-network of alters nominated by both the husband and the wife, counts of types of network members, such as family and friends, the number of network members nominated by both spouses, and the constraint for each spouse within the duocentered network. We present detailed descriptions of the characteristics of each network type identified by the cluster analysis. We also present results of analysis of the association between duocentered network type and spouses' relationship quality.

### **Uncovering the Complexity of China's Belt and Road Initiative: Global Production Networks, Trade Interdependence and ASEAN's Development**

Zhengqi Pan<sup>1</sup>

<sup>1</sup>Singapore University of Social Sciences

China's Belt and Road Initiative (BRI) is an ambitious geo-economic and geopolitical project that spans over 65 countries worldwide. The countries involved in the BRI are mostly developing economies, and the focus of the BRI is on infrastructure and logistics development. The heart of the BRI is in Southeast Asia, which is in China's backyard and is also a strategic group of countries deeply embedded in global production networks (GPNs). While China has touted the BRI as a win-win mega project that emphasizes joint gains through trade interdependence, skeptics have argued that the BRI traps developing economies with colossal debts and presents a form of neo-colonialism. This paper seeks to uncover the political economy of the BRI through network science. Based on Southeast Asian (or ASEAN) economies, I first investigate the configuration of the ASEAN production network (including China) and then explore how and to what extent domestic infrastructure and logistics development affects trade in value-added and GPN participation. Using a new trade in value added data from UNCTAD and a novel statistical network analysis method called the Generalized Exponential Random Graph Model (G-ERGM), which allows me to account for the complex dependence of observations and endogenous structural effects within GPNs, the results point to the salience of the quality of logistics and transnational shipment services in trade in value added and GPN participation. Moreover, trade within GPNs is characterized by reciprocity and highly transitive relations, which are often omitted in traditional statistical analysis. At first glance then, the BRI, with its focus on infrastructure and logistics would aid countries in industrial upgrading. However, upon more critical analysis, a country's overall

economic development would depend not only on its GPN participation, but also through the autonomy of its firms and key industrial sectors. In other words, a country might not be experiencing real economic upgrading if its strategic industries are financed, influenced and controlled by China under the BRI. This paper contributes to the existing literature by investigating the network structure of ASEAN supply chains and the implications of the BRI on ASEAN's economic and political development.

**Understanding interactions surrounding the choice of atypical work schedules impacting work-family balance: Contribution of a social networks analysis approach**

Mélanie Lefrançois<sup>1</sup>, Johanne Saint-Charles<sup>1</sup>, Karen Messing<sup>1</sup>

<sup>1</sup>Université du Québec à Montréal

Atypical schedules are also called “non-standard” schedules as they fall outside the traditional “Monday-Friday, 9-5” framework. Some characteristics of atypical work schedules are particularly problematic for occupational health and work-family balance (WFB) such as: unpredictability, instability and employees' lack of control. This implies that certain groups of workers have schedules that constantly change, into which they have very little input and for which they have very little notice. Such schedules are frequent in the retail sector but also in the health and transportation sectors. In the latter, continuous operations result in schedules extending over 24 hours/day, 7 days/week. Faced with these schedules, workers with family responsibilities must develop complex strategies to meet both family and work demands.

In partnership with a Quebec union in the transportation sector, we developed a research-intervention aimed at improving WFB in a cleaning department where many challenges related to extended, atypical schedules. Using an interdisciplinary framework, combining communication and French-tradition ergonomics, we analyzed workers WFB strategies with a focus on relationships as resources or constraints for these strategies. The first phase of this single-case study was based on direct and participant observations, semi-directed interviews, short questionnaires and administrative data analysis.

Our preliminary results informed our understanding of the work schedule structure and its implications for WFB. Schedules are chosen by seniority ranking through a bidding process, twice a year. A proposal made by management is first subject to a union-management negotiation that lasts two days. Then, final schedule options are posted for five days before the actual “bid day”.

The choice among schedule options triggers multiple interactions among colleagues. We identified six types of interactions related to the impact of the new schedule options on WFB as well as on the work itself. People interacted with others 1) to understand the proposed options; 2) to find out what colleagues are going to choose so as to predict what they themselves will obtain, given their seniority; 3) to share emotions about the schedule options; 4) to get advice on choosing a schedule; 5) to find people willing to accept specific certain shifts that pose problems for WFB or (6) to find a great team to work with. This last type of interaction is not surprising given that the cleaning activity itself implies an important teamwork dimension. For some, being on a “good” team mattered more than having a “good” schedule for WFB. This somewhat counterintuitive strategy led us to understand how team dynamics could indirectly influence WFB through work activity.

These initial observations led us to do more observations including a SNA tool to understand the structure of interactions. The objectives of this communication are to 1) explain how SNA was built in our research protocol to triangulate with our preliminary analysis; 2) discuss the methodological challenges of developing a tool in the specific context of manual, low-paid work; 3) present some of this project outcomes to illustrate the contribution of SNA for occupational health research-intervention.

### **Understanding Partnership Selection for Habitat Management Among Conservation Organizations Using Social Network Analysis**

Sarah Burton<sup>1</sup>, Daniel Kramer<sup>1</sup>

<sup>1</sup>Michigan State University

Applications of social network analysis (SNA) in the natural resource field have only begun to emerge in recent years. It can be a useful tool in natural resource management to help identify stakeholders, address conflicts, and ensure a diverse representation. This can be especially important when seeking to understand the behaviors of stakeholders and what influences their decisions. In this research, we aim to utilize selection models to better understand what drives partnership selection among grantees and non-grantees of the wildlife division (WD) of the Michigan Department of Natural Resources' (DNR) and whether DNR grants influence these networks. The goal of this research is to evaluate the effectiveness of DNR WD habitat grant programs in building successful relationships with the WD among the program's grantees and collaborators. This research focuses on the organization level grantees, which represents the largest portion of grantees. In this work, SNA is utilized to assess both internal and external ties to the grantee organization which will determine whether and how the grant programs are successfully strengthening partnerships with the WD. The SNA provides basic metrics of the network structure that help determine how robust the network is surrounding the programs. A selection model approach is utilized to determine what parameters are driving grantees to select certain partners. The outcome variable being modeled here is support received from a partner. Possible driving forces are: (1) having received a DNR WD grant; (2) proximity; (3) organization prestige; (4) gender of main contact; (5) type of organization; and (6) prior support received. Initial results show that the more influential drivers are geography, prior support, and receiving a grant. This valuable information will help the DNR WD to improve the efficacy of these and potential future grant programs to create successful partnerships and positive perceptions through eligibility requirements and application criteria, clarification and prioritization of program goals, and the identification of grant characteristics associated with successful partnerships.

### **Understanding Social Innovations in Urban Climate Protection through the Network Perspective**

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<sup>1</sup>RWTH Aachen University, <sup>2</sup>ILS – Research Institute for Regional and Urban Development

This paper presents empirical and theoretical results of the project "KlimaNetze" (2016-2019), a joint research project on sustainable transitions in urban climate and resource protection through the design of governance processes. The presentation focuses on social networks of climate protection actors (differentiated in specific fields of action) and the genesis of social innovations at the city level. Our proposed theoretical framework combines the multi-level perspective on socio-technical transition (Frank Geels) and the concept of network domains (Harrison White) with the differentiation of levels from multi-level network analysis. The theoretical framework is underpinned by empirical examples using a mixed method research design from our study on the role of social networks in urban climate change governance of a medium-sized German city. Research in urban climate change governance has so far concentrated on global cities, mostly ignoring the smaller cities. At the same time, the main emphasis of recent innovation research was on technological change and the social was primarily limited to the social formation of socio-technical innovation, while focusing on the national and international level, and therefore neglecting local or urban settings. With an increasing awareness of the effects of climate change and the scarcity of resources, sustainable development is increasingly becoming the focus of

human attention. This is clearly illustrated by the Sustainable Development Goals (SDGs) set by the United Nations in 2015. Since conventional innovation systems often benefit only a part of society through the social and technological changes associated with them, and since environmental challenges can just be met insufficiently, new forms of innovation, such as social innovation, are crucial for achieving these sustainability goals. Particularly in cities, a large number of different actor constellations have emerged in various settings, which can play a driving role in the desired sustainable transformations.

To operationalize our theoretical concepts, we refer to network data collected from an online survey, qualitative interviews with key actors in urban climate change protection and document analysis in combination with participatory observation and real-world laboratories. Overall, the role of the city, networks and social innovations in climate change protection will be discussed through the integration of innovation and network research perspectives.

### **Understanding the impact of virtual mirroring-based learning on collaboration in a data and analytics function: A resilience perspective**

Nabil Raad<sup>1</sup>

<sup>1</sup>Ford Motor Company

Large multinational organizations are struggling to adapt and innovate in the face of increasing turbulence, uncertainty, and complexity. The lack of adaptive capacity is one of the major risks facing such organizations as the rapid change in technology, urbanization, socio-economic trends, and regulations continues to accelerate and outpace their ability to adapt. This is a resilience problem that organizations are addressing by investing in Data and Analytics to improve their innovation and competitive capabilities. However, Data and Analytics projects are more likely to fail than to succeed. Competing on Data and Analytics is not only a technical challenge but also a challenge in promoting collaborative innovation networks that are based on two key characteristics of resilient systems. One characteristic is the ability to learn while the second is the ability to foster diversity.

In this study, we examine how a newly-established Data and Analytics function has evolved over a one-year period. First, we conduct a baseline survey with two sections. The first section captures the structure of Innovation, Expertise, and Projects networks using network science techniques. In the second section we extract four resilience-based workstyles that provide a behavioral representation of each phase of the Adaptive Cycle Theory. Following the survey, we conduct a controlled experiment where the Data and Analytics population is divided into four groups. One group acts as control mechanism while the remaining three groups are exposed to three different Virtual Mirroring-Based Learning (VMBL) interventions using simulation techniques. A virtual-mirror, which is a visualization of an employee's own social network that provides a self-reflection as a learning process. The premise is that exposure to self-insights leads to a change in collaborative behavior. After a period of nine months, the baseline survey is repeated and then the effects of the interventions are analyzed.

The findings provided original insights into the evolution of the Data and Analytics function, the characteristics of an effective VMBL design, and the relationship between resilience-based workstyles and brokerage roles in social networks. The applied and theoretical contributions of this research provide a template for practitioners in Data and Analytics functions while advancing the theory and measurement of resilience.

Key learning opportunities:

**Understanding War Reporting through Social Network Analysis**Kaberi Gayen<sup>1</sup>, Robert Raeside<sup>2</sup><sup>1</sup>Department of Mass Communication and Journalism, University of Dhaka, Bangladesh,<sup>2</sup>Edinburgh Business School, Heriot Watt University, Scotland

In this paper the aim is to demonstrate how social network analysis can be used to undertake a historical analysis of war reporting. Networks are constructed of proxy relations between journalists to explain how reporting at the time of the cold war and the hot war of Vietnam a 'constructed truth' about a war of independence in the global south changed to report not what the state machinery intended but what actually happened. It is shown that reporting on the Bangladesh War of Independence, which was started on 25<sup>th</sup> of March 1971 and ended on 16<sup>th</sup> December 1971, began as a 'communist inspired plot' changed to a 'heroic struggle for freedom' in the US Television news media. To undertake analysis, reporting by in studio and in field journalists of three major US TV news media (ABC, CBS and NBS) is followed and social network analysis is applied to explain how reports changed from reporting the insurrection of people in East Pakistan to increasingly questioning the legitimacy of rule by West Pakistan. To understand the process of change, social network ties between journalists were constructed on a monthly basis. The input data was short video clips of the TV news coverage of the war. The ties between journalists were measured by the similarity of reporting content, taking multivariate measures of bias to one side or another, degree of blame for the insurgence (East Pakistan), degree of sensationalism and degree of humanity displayed in the report. The measures from daily clips were aggregated to give monthly reports. From these, monthly sociograms were generated using the NetDraw package, and key network measures of centrality, power and cohesion were computed using the UCINET software. The monthly reports were then used to conduct a longitudinal analysis of network change over the ten month period. In this analysis it became apparent that although initial reporting views were diverse, perhaps explained by institutional ownership, regardless of initial views and media ownership, as the war moved on, a consensus or similarity of reporting emerged. This was not expected and challenged notions of institutional resistance to change. This, we interpret, endorsed journalistic integrity. This historical analysis contributes to social network methods and demonstrates the added insights that SNA gives in explaining the changing visions that the media presented of distant political and societal strife.

**Understanding Why Women do not Benefit as Much as Men from their Networking Actions: When Gender Stereotypes Prevent Women from Networking Efficiently**Zoe Ziani<sup>1</sup><sup>1</sup>ESSEC Business School

Networking behaviors refer to proactive and purposeful efforts made by individuals to create, maintain, and leverage relationships toward professional goals. Networking actions are beneficial to those who undertake them. Networking allows people to reach better positions in their network, and fosters career success through promotion, salary progression, and satisfaction. It improves learning and knowledge acquisition, favors economic exchanges, and helps people secure jobs.

Past research has shown that women network as much as men, but that their career benefit less from their networking efforts, and no explanation for this gender gap has been provided so far. One way to interpret this gap is that women network differently, and in fact less efficiently than men, because they renounce certain networking strategies.

Among the different networking behaviors distinguished in the literature, *maintenance* refers to efforts made to affirm, sustain, or strengthen ties: Inviting a colleague for dinner is an example of a maintenance action. The goal of those networking behaviors is to intensify selected

relationships. An effective networking strategy is to target those maintenance efforts at powerful others within organizations, and to establish personal connections with them. Unlike men, women are typically reluctant to undertake this type of networking action: They are less likely to instrumentally approach their supervisors, to ingratiate themselves with them, and to establish personal connections with them, even when they acknowledge it might help them get ahead.

In this paper, I propose that women do not try to deepen their relationships with their male supervisors for fear that their behavior will be misinterpreted, and that they will suffer negative consequences from it. Indeed, I argue that women are aware of the stereotype associated to such behavior: They have internalized that they could be viewed as flirtatious, promiscuous, seductive, or manipulative both by the target of the interaction (i.e., their supervisors), and the audience.

Since, in most organizations, most of those wielding influence are men, women who decide to undertake network-deepening actions toward their supervisors are at risk of being misjudged and stereotyped. On the contrary, women who decide not to implement such networking actions protect themselves from negative stereotypes, but at the cost of valuable relationships and therefore potential future career rewards. Ultimately, the range of networking behaviors that women can afford is narrower than that of men, which explains why networking benefit them less.

I provide experimental evidence for this effect using vignettes. First, I validate the existence of a negative stereotype: Women who engage in network-deepening actions with their male supervisors expect to be negatively evaluated. Second, I show that the awareness of this stereotype triggers anxiety about their reputation, which in turn undermines their motivation to use this networking strategy.

### **Unpacking Burt's Constraint part 2**

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<sup>1</sup>University of Manchester, <sup>2</sup>University of Kentucky

In Sunbelt 2018 we presented some results on Ron Burt's constraint measure. We looked at the special case when we have undirected binary data. In this presentation, after a brief review of the results presented in 2018 we consider both directed and valued data. Unfortunately these cases are a lot more complex and we are unable to obtain simple approximations like we had for undirected data. However we are able to give explicit formula for the upper and lower bounds of constraint allowing us to give a normalized version of the measure.

### **Using character network analysis to investigate the dynamic positioning of characters within film narratives**

Pete Jones<sup>1</sup>

<sup>1</sup>University of Manchester

In this paper I assess the analytical potential of character networks for answering questions about the positioning of characters within film narratives. This objective is related to my broader PhD research which explores the usefulness of a character network approach for investigating the representation of women in Hollywood film. Literature around post-feminism in film has identified a trend towards Hollywood narratives paying lip service to feminism, whilst simultaneously de-politicising and individualising women's roles in stories. This has the effect of leaving (ostensibly empowered) women frequently isolated among men in mainstream narratives, undermining narrative opportunities for collective empowerment and encouraging an individualistic model of female agency. However, much of the literature around gendered representation in Hollywood continues to consider females at the level of individual

characterisation, thus removing these characters from their positions within the broader narrative character system.

Character networks (network models in which the nodes are characters in a fictional text) seem to offer a promising method for analysing what film theorist E. Ann Kaplan calls “the broader structuring of the narrative and the placement of the woman within that narrative”. While character networks have been studied in relation to literature, the approach has not been pursued in the literature on representation in film. One of the key appeals of using a character network approach is the ability to use the tools of network analysis to make analytical claims about narratives. For example, measures of the relative importance of nodes to the network structure might be used to operationalise the idea of “female positionings” within narratives. However, I argue that many existing character network studies have developed narrative character network models using network representations which limit the usefulness of such measures.

The reason for this is that narratives are inherently temporal and dynamic phenomena. As narratologists have noted, to talk about narrativity is to talk about time, and most definitions of narrative are based on the notion of the ordering of events. However, existing character network approaches which offer node-level analysis do so using static network representations in which interactions are aggregated, thus removing the temporal element entirely. My contention is that it does not make sense to talk about the positioning of a character within a narrative as a fixed property of a static network, as narrative importance is inherently dynamic and evolves over time. My paper thus aims to develop a more integrated methodological-conceptual approach to the research problem. To this end, I offer some principles by which we might more appropriately capture a character’s dynamic narrative positioning using data about their network activity, offering an example of such a measure based on these principles. This discussion may have implications for node-level measures in other contexts in which networks are based on interactions, where crucial aspects of the network phenomenon in question are lost through aggregation of these interactions into static ties for analytical purposes.

### **Using Ego-Network Analyses to Investigate the Isolation and Insularity of Public Administration as a Field with Journal Citation Metrics**

Glenn McGuigan<sup>1</sup>, Goktug Morcol<sup>2</sup>

<sup>1</sup>Pennsylvania State University, <sup>2</sup>Pennsylvania State University

In this research, we use ego-network analyses to investigate the intellectual environment of public administration with analyses of scholarly journal publishing citation metrics. The purpose of this paper is to investigate whether public administration is an isolated and insular field, particularly in relation to political science and business management. To investigate whether public administration is an isolated field, we used social network analysis on the journal citations in the Web of Science in three years: 2005, 2010, and 2015.

Citation networks can be seen as a flow of links between the nodes of a network. These flows can be analyzed in two ways: “out-degree” flows (the citations going out of a journal to other journals) and an “in-degree” flows (citations of a journal by other journals). The public administration journal citation network is a relational network in which the journals are the nodes, or the actors, and the citations are the flows in and out of the journals. These citations are the edges or the ties. The public administration journals cite journals within the field itself and outside of the field. Journals from outside of the field of public administration cite journals within their own fields and outside the fields, such as public administration. The citations by the journals in other fields (particularly political science and business management) of public administration journals were of particular interest in our study.

An earlier study on journal citations in public administration found that research in public administration is largely isolated from the three disciplines that were believed to be its foundations: law, management, and political science. In this study, we sought to verify this finding and examine the explanations for the levels of isolation and insularity of public administration. We particularly examined the categorical relations between the citations and the characteristics of the ego networks of the public administration journals. Using ego network analyses with the software UCINET, we examined the relative isolation and insularity of the top scholarly journals of public administration, in comparison to the top journals of two related fields: political science and business management. We calculated the citing and cited references based on a categorical classification of citations. We measured the changes in the ego networks of citations over time using the Index of Qualitative Variation. The results of our study confirm Wright's finding that public administration is isolated, but our results provide more detail and nuance to this conclusion.

Why should we examine the citation patterns of scholarly journals using ego-network analyses? We argue that examining the citations between the journals of public administration and those of others, and the citation networks within the field of public administration, will lead to a better understanding of the intellectual traditions and patterns in the field. To our knowledge, there has not been a study that used ego-network analysis or social network analysis to analyze journal level metrics (citations) as we have done in this study.

### **Using Krackhardt Data Over Time to Assess Egonet Dynamics and Accuracy**

Keith O. Hunter<sup>1</sup>

<sup>1</sup>University of San Francisco

There has been some debate over the extent to which egonets support accurate inferences regarding the actual structural features of social networks. The reliance of the egonet method on ego's accurate perception of the local network naturally motivates the examination of differences between what ego perceives and what actually exists. Three decades ago, Krackhardt pioneered the assessment of ego's perception of alters and ties with the contribution of cognitive social structures, henceforth referred to as Krackhardt data. I claim that what has been needed is further examination of Krackhardt data over time, where possible compared with measurement of the actual network structure. This could yield progress for the field in better understanding the stability of both social network perceptions and their accuracy with respect to the actual social landscape. The work presented in this session is an example of just such an effort.

My longitudinal dataset consists of the two relations of friendship and advice measured over a six week period, collected as relationships formed among a group of college juniors working together in a class that included a Prisoner's Dilemma exercise. Notably, this exercise held the potential of significantly affecting not only the group's actual social networks but also the participants' perceptions of each other's' social networks. Augmented by Krackhardt data also collected each week during the same time period, this dataset offers some advantages over the field's most widely analyzed dataset due to Newcomb. Analytical results presented will include longitudinal results for ego distortion, local-global inference error, and feature inference error.

### **Using latent space model to study the impact of formal organizational structure on gossip network formation**

Yuqing Liu<sup>1</sup>

<sup>1</sup>Michigan State University

Gossip, as a special type of communication, serves as a channel for information exchange. Its specialty lies in the fact that the information is an evaluative statement about an absent third

party. Gossip in organization plays an important role in shaping the group membership, the group power structure, and establishing the group norms (Waddington, 2012).

Gossip network can be seen as an essential part of the organizational informal network, which is constrained and developed under the organizational formal structure (Clauset, Moore, & Newman, 2008). Organization functions and operates based on its formal structure, from which the workplace interpersonal relationship grows. Organizational hierarchy signals the power and control individuals have in the organization (Jones, 2013). Similarity in job positions leads to similar work responsibilities, which increases the likelihood of interactions professionally and personally, making gossip a natural scenario. In addition, individuals at lower organizational hierarchy are more locally based, with limited information source compared to the top decision-making level, and consequently are more likely to gossip for information exchange.

Gossip in nature has its network properties of senders gossiping with recipients about an absent third party. The complex triadic relationship originates from three dyads, where the gossip sender, recipient, and target each plays an important role in forming the triadic structure (Wittek & Wielers, 1998). To understand the gossip dynamic, it is important to separately study the mechanisms behind the formation of the dyads. This paper in particular explores the gossip relationship between the sender and recipient with respect to their locations in the formal organizational structure. Limited research on the area of gossip is largely due to the difficulties in data collection and its potential ethical issues. This paper uses the publicly available Enron email dataset for its organizational communication network. Stanford Named Entity Recognition (NER) classifier is used to identify whether the email is a gossip email, i.e. contains people that are neither gossip sender nor recipients. In addition, the job title dataset will be used for the individual level characteristics.

Two hypotheses are formulated. (1) Individuals gossip with those who are within their same organizational hierarchy, due to similar positions in the organization. (2) Individuals in the lower organizational hierarchy are more likely to gossip, due to limited accessibilities to the higher-level organization information. Using latent space model, I estimate the effect of the relative distance in organizational hierarchy between the sender and recipient to explain the frequency of the gossip behavior at the dyadic level, controlling for their frequency of non-gossip communication. In addition, I also study the effect of employee's location in the organizational hierarchy on their tendency to engage in gossip relationship. Cross sectional data of year 2001 will be used, including three separate departments, Enron Americas (EA), Enron Energy service (EES), and Enron Transportation services (ETS), with network size, 66, 61, and 54 correspondingly. Gilbert's (2012) framework of the hierarchy of Enron job titles will be adopted in this paper, where individuals are positioned into six hierarchies based on their job titles.

### **Using Longitudinal Social Network Methods to Evaluate the Impact of eHealth Innovation Ecosystem Development: A Case Study of the EPIC project**

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#### **Background**

Rubens et al (2011) describes 'innovation ecosystems' as inter-organizational, political, economic, environmental, and technological systems of innovation that are conducive to business growth. eHealth or digital health is the use of apps, websites, internet of things, robotics etc. in health and care.

Numerous cities and regions around the world are trying to establish eHealth ecosystems where stakeholders on the demand side (clinicians, patients, carers etc.) can work with providers (SMEs, digital companies, services etc.) and education and research to provide innovation ecosystems in

eHealth (Figure 1.). In order to foster a vibrant ecosystem, it is important to evaluate the extent to which a community of stakeholders currently exists within a region. Facilitating an increase in the connectedness and opportunities for collaboration between e-health stakeholders across the region should help to foster a sustainable environment of e-health innovation for the future.

**Aim**

We are assessing the social network impact of a 3-year intervention to develop an eHealth ecosystem. Results from the first 24 months will be presented.

**Methods**

Setting: EPIC (eHealth Productivity and Innovation in Cornwall and the Isles of Scilly (CloS)) is a European Regional Development Fund project developing an eHealth innovation ecosystem. EPIC was funded in recognition of challenges of delivering high quality and cost effective healthcare in a highly rural area with an increasingly ageing population. EPIC's aim is to stimulate economic growth and create a sustainable eHealth sector in this underdeveloped area. EPIC has held multiple networking activities and events to connect e-health innovators and stakeholders, and aims to establish mechanisms to sustain the developing ecosystem.

Data Collection: Network data comprising awareness and collaboration ties were collected through online surveys at multiple timestamps throughout the project from individuals representing stakeholder groups.

Data analysis: Network data was analysed descriptively in the social network package ORA and modelled in the R package RSiena to explore how the network structures within the ecosystem develops over time.

Tailored interventions: Subsequent network interventions were implemented to connect organisations that were not but which we believed should be connected based on their stage of business development and their field of work.

**Results and Discussion**

Baseline findings showed limited rates of connectivity and collaboration within the ecosystem between technology companies, local clinical commissioners, healthcare organisations and groups representing patients. If not addressed, poor networking may lead to: i) difficulty for technology companies in the region to establish themselves or diversify product lines into the eHealth market; ii) lack of user-led idea generation for new products and an inability for technology companies to conduct usability testing within the region; iii) challenges with getting products commissioned; and iv) potential resistance to adoption and successful implementation of new technology developments.

**Conclusion**

Social network analysis seems a useful way of monitoring and evaluating the impact of network activities and events on developing an innovation ecosystem. By the conference we will present the latest findings on the success or otherwise of EPIC in developing the network.

**Using Mixed Method Social Network Analysis to Evaluate Systems Change Interventions: The Context of Cross-Over Youth**

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<sup>1</sup>Ryerson University

Youth in care of child welfare agencies are disproportionately involved in the youth justice system at alarming rates. Referred to as "cross--over youth," these young people face high risks of poor life outcomes due to institutional failures across multiple systems involved in their care. Policymakers and professionals have indicated that better collaboration between these complex systems is a key priority for improving the outcomes of cross--over youth. Little research,

however, has examined the nature of collaboration between social service systems in such contexts.

The Cross-Over Youth Project (COYP) is a four-year demonstration project that seeks to improve outcomes for cross-over youth in four communities in Ontario, Canada. The COYP engages stakeholders from 9 sectors (i.e., youth, child welfare, group homes, judges, justices of the peace, police, legal services, crown attorney, and probation) in developing locally-adapted systems-level changes to improve outcomes and justice for youth in care.

Social network analysis (SNA) is an innovative research methodology that has significant potential for the study and evaluation of systems change initiatives. In this presentation we will share the development of a participatory, mixed method approach (utilizing participatory mapping, qualitative interviews, and survey) to SNA, conducted as part of an 18-month pre-post evaluation of the COYP in one Ontario community. We will also share preliminary qualitative findings from the first phase of data collection. The presentation will also include reflections on participatory approaches to SNA in program evaluation, and will consider implications for practice, policy, and future research from an anti-oppressive framework. This research is funded by a grant from the Social Sciences and Humanities Research Council.

### **Using social network analysis for policy impact evaluation: cases of Russian education, innovation, and civil society policies**

Nikita Talovsky<sup>1</sup>, Gregory Khvatsky<sup>1</sup>, [Dmitry Zaytsev](#)<sup>1</sup>

<sup>1</sup>NRU HSE International Laboratory for Applied Network Research

The essence of network analysis – the relational association between actors – is paramount to policy analysis. The focus on actors' ties provides an opportunity to evaluate the impact of social actors on policy programs and social changes in general. Impact evaluation is a key topic in different social sciences - public policy, management, economics, sociology - each with its own instruments for impact evaluation. Yet, network analysis is a universal tool across social science disciplines, used both to contribute into impact evaluation for each discipline and be applied across disciplines to determine the common trends.

In this paper, we proposed the use of network analysis to evaluate the impact of policy advice and other drivers of social change in impact evaluation of public policies. Taking the examples of Russian education, innovation, and civil society policies, we develop the model of social influence of network and non-network variables on policy outcomes.

As a result, we draw three lessons important both for the development of policy theories and network methodology. The first lesson relates to the necessity to include additional dimensions to the understanding of politicization process relevant to the authoritarian environment. Here, politicization is manifested not only in the dominance of non-technical argumentation in policy advice, as it does in democratic countries. Also present is the intervention of authoritarian politics into policy, when ideology and private interests of power elites drive policy-making. The second lesson concerns the way in which the politicization can be minimized to reach evidence-based rational policy advice and increase the capacity of policy advisors to impact policy change. The high level of politicization in authoritarian environment is difficult to reduce, but policy advisors can decrease moderate politicization.

The third lesson is that in looking for moderate influence in policy-making and in an attempt to avoid high risks of politicization in the authoritarian environment, external analysts can concentrate on establishing medium to long-term policy steering advice in non-political specialized science-intensive policy fields, as STI policy. They take on the role of coordinators and consultants, supplying the needed technical skills to professionals from academia and the

government, and avoiding making advice about extensive policy change in the field. The effect on policy change in such a situation is hybridized and moderate.

The study focuses on the details of each case that allow us to draw the conclusions above. Focusing on study limitations, we outline key directions for future research, and for policy advisors, provide practical recommendations.

### **Using Social Network Analysis on Classroom Interaction Video Data in Physical Education**

Jennifer Schmitz<sup>1</sup>

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As social interaction is framed fundamentally by its particular contexts, there are specific accompanying requirements as well as opportunities for action. Therefore, the analysis of interaction is supposed to take this contextual framework of interactional behavior into account. Furthermore, relationships to important social partners seem to have a pertinent role in terms of behavioral practice as well. Although few previous studies show that in the particular context of physical education (PE) behavioral engagement is closely related to social structures with important social interaction partners (Kemper, 2015, Munk & Agergaard, 2015; Shen, McCaughtry, Martin, Fahlman & Garn, 2012), the importance of interpersonal affiliation or relatedness among classmates has not been fully recognized in PE research so far (Smith, 2003). Therefore, this study provides a social network approach to investigate the structure of classroom relationships in conjunction with students' interactive behavioral practices, within the context of PE. While network data are collected through questionnaires and serve as a means of identifying groups and striking actors within the network, interaction data are collected by using video recordings. Using PE lessons video data allows for visually explore interaction practices between students on a microphysical level. These data are analyzed qualitatively by sequential analysis based on an inductive-deductive developed code system using MAXQDA (VERBI Software, 2018) as well as quantitatively by using Behavioural Observation Research Interactive Software (BORIS) (Friard & Gamba, 2016). The study is set up in a longitudinal design with two measurements divided over the academic year, which further provides the opportunity to analyze relational network data as well as interactional dynamics by using statistical Models of SIENA (Snijders, Steglich, & Schweinberger, 2007). The major research question concerns the interest in the relation between structure, context and behaviour. Whether and if so, to what degree do relational structures between classmates influence interactional behaviour in the contextual framework of PE? Content-wise, the study aims to explore the dynamic process of context related interaction patterns. Methodologically, it explores how to constructively combine quantitative and qualitative approaches within social network research (Domínguez & Hollstein, 2014). By using a mixed-methods design, the study tries to make a contribution to a better understanding and a deeper insight in the predictive power of relational structures in terms of interactive behavior. At the moment of writing this proposal, the analysis of these data is ongoing. Analyses are expected to be completed by late April and will thus be available in time to be presented at the SUNBELT conference.

### **Using Social Networks to Mitigate Climate Change in Rural Bangladesh**

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In the first century of the new millennium humanity faces many challenges notably political instability, demographic change as populations age and climate change. These are particularly manifest in rural Bangladesh. Many rural Bangladesh are poor, living a subsistence agrarian lifestyle

and as a consequence of successfully reducing the total fertility rate the age profile of Bangladesh has become older. Further as Bangladesh transitions from a rural economy to an urban economy many rural dwellers feel that central government ignores them or at best has forgotten them. Rural Bangladeshi's are clearly a vulnerable population, living on the edge of subsistence and in a society with few young people; not only attributed to low fertility but also to migration to urban areas but often overseas. Yet many rural dwellers face the future with resilience. By understanding the social networks of these resilient self-contained groups one can obtain insight to enable their vulnerability to be reduced. Strong tightly bound and cohesive networks have been found to be robust, especially when compared to fragmented, dispersed and cohesively weak social networks. In this paper this proposition is tested by examining the social networks of Bangladeshi villages who are not in food deficit and compare them to networks of villages who have recently experienced food deficit. It is argued that experience of food deprivation in the population studied is barometer of the inability to adapt to climate change. To investigate this proposition an interviewed based sociometric study was undertaken of those in rural villages. Seven villages were surveyed and more than 700 interviewed. The respondents were asked who they communicated with, how frequently, how they acquired information and how often they experienced food deficit. This SNA was conducted in UCINET 7.1. and exposed the network structure of the different groups. It was found that those who were in more cohesive and dense networks were associated with less experience of food deficient than those whose social networks were more disparate. However, amongst cohesive networks some were found to be centred around actors who maintained traditional ideology meaning that women were denied of power and new ideas were resisted. These networks reported a higher likelihood of experience of deficit when compared to other cohesive networks which were more open to aid and advice from government and NGOs. The knowledge acquired in this study provides information to enable the development of reliable policy, including a communication strategy to be developed to address the impact of climate change in rural areas.

### **Validation Study of a Social Network Analytics Approach to Drug Market Mapping**

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**Background/Goal:** Social network analysis of drug markets provide rare insight into the interactive dynamics of an active drug market, and provide an opportunity to evaluate how to affect the structure and operation of criminal networks. Many drug distribution networks rely on hierarchical network structures where high profile actors are insulated from the majority of the network activity by connecting to only a few individuals (i.e., distributors and manufacturers). This structure serves to protect power brokers within the network and limit the risk of network disruption. However, it also makes the criminal network hubs easier to identify and their removal can yield pronounced disruptive effects on the entire network.

The current research project integrates quantitative law enforcement data sources and qualitative intelligence from field and narcotics officers, investigators, as well as victim and offender testimonies to create and test the practical utility of a data-driven social network topology of the opioid drug market in one urban City in the southeastern United States.

**Theory:** According to the network-created personality perspective, an individual possesses a social personality that stems from occupying a particular position within a social network, and position within a network can be viewed as an indicator of social personality based on the extent to which an individual consistently occupies this specific position within a network across various social conditions or roles. From this perspective, network-related personality can help us better identify high profile actors (leaders) within social and organizational drug market networks. We

hypothesize that when an individual consistently holds a central position within a network over time (e.g., high indegree and low betweenness centrality), such centrality metrics can inform us about this person's social personality as a drug market leader.

**Method:**

Part 1: Monthly criminal incident and drug-related autopsy reports (N=18,434) from one metropolitan area in 2018 are used to identify the social relationships that link drug market leaders. These data are aggregated to create quarterly profiles of the regions opioid network, and analyzed over of year of time (four quarters) to identify the emergence of suspected high profile drug market leaders. Part 2: Drug enforcement agents from across the metro area will provide qualitative field insight into the key players known to engage in drug market leadership behavior (distribution and manufacturing). This qualitative intelligence will be used to contextualize the role of the various drug market actors and to triangulate the role of these nodes in quantitative data analytic techniques commonly used in drug market research to identify network structure indicators of high profile actors within the network.

**Results/Implications:** The qualitative data will be used to validate the social network approach to identifying drug market leaders. Convergence in the identification of leaders will lend credence to using a combined approach for mapping regional drug markets. Findings from this study aim to demonstrate that social network analytics can be used to depict drug market actors' ties to overdose and drug-related homicide victims, and provide insight into pathways for opioid network disruption by aiding narcotics investigations and enforcement operations.

**Venture Capitalists as Organizers of the Biotech industry: The performative capacity of finance**

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The success of entrepreneurial projects presupposes a connection of scientific, industrial and financial networks (Brailly, Éloire, Favre & Piña-Stranger, 2017; Piña-Stranger & Lazega, 2010). In the Biotech industry, for example, a cooperative relationship (Gorman et Sahlman, 1989; Hellmann et Puri, 2002; Sahlman, 1990) between scientific entrepreneurs and venture capitalists (VCs) can be found. While scientific entrepreneurs bring in their knowledge to transfer products into the market, VCs bring not only funding but also non-financial resources, such as a strategic vision, assistance in the management of the company, and a network of opportunities (Gorman et Sahlman, 1989). Given the importance of VCs, in the following research we analyze the impact of their strategies in the configuration of financed biotechnology companies. Thus, the aim of this paper is to show how VCs organize biotech innovation from a social performativity approach of finance (Donald MacKenzie, 2001; Maurer, 2006; Palla, Barabási, & Vicsek, 2007). Two hypothesis concerning the VCs' strategies towards companies are formulated: 1) the size (number of companies) of the VC's portfolio fosters the exchange of advice among the biotech managers of these companies up to a certain point; beyond a certain number there is, on the contrary, a contraction of these exchanges; 2) the level (amount of money) of financing of a shared VC fosters the exchange of advice among executives, but beyond a certain level there is, on the contrary, a reduction of such exchanges. These hypotheses are tested on a sample of 76 biotech companies and their VCs. The strategies of VCs are studied according to 3 dimensions: the size of portfolios (organizational dimension), the size of investments (financial / economical dimension), and the

fact of having a VC as an advisor and/or friend (social dimension). Our initial findings show that VCs do organize the way innovation is carried out in the biotechnology market.

### **Viable Targeted Immunization Strategies for Social Networks: Addressing the Boundary Specification Problem**

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A large body of research suggests that network-based intervention strategies can be effective and cost-efficient approaches to curtailing harmful contagion in myriad settings. Approaches based around breaking or weakening potential infection pathways of structurally important individuals are generally referred to as targeted immunization strategies, but can take many forms including vaccination, treatment, increasing access to risk prevention materials, and more. Theoretical and simulation-based research into these strategies often involves a number of assumptions about the quality of available data which are usually unrealistic when working with social networks. With the results of such research reflecting the efficacy of immunization strategies under these assumptions, practitioners aiming to incorporate targeted immunization in network interventions are left with little guidance on how best to apply these ideal approaches in their real-world settings. One such assumption involves the testing of these strategies on networks considered to be closed systems, whereas social network data is usually collected within some location or organizational context, excluding but acknowledging the edges outgoing from this context. In this project, we examine the effect of the boundary specification problem on the efficacy of targeted immunization strategies. Using both simulated networks and a real-world case study, we expand on a recent method which explores the full-network consequences of immunization strategies developed based on incomplete network samples—adapting the method to networks sampled in ways mimicking how boundaries are traditionally drawn in network research. The simulated network is generated via a metapopulation matrix, connecting multiple realistic local networks. The case study uses data from a mixed-methods research project focused on social networks and risk behaviors among people who inject drugs (PWID) in rural Puerto Rico. Here, location has a strong influence on network composition, but many PWID also have ties with people in nearby localities, and sometimes, as far away as the continental U.S. The efficacy of immunization strategies was benchmarked at multiple levels of boundary specification in terms of simulated final epidemic size, as both a proportion of the entire global network as well as a proportion of the subnetwork which was sampled and partially immunized. Our findings indicate that as boundary specifications shrink the sampled subnetwork relative to the size of the global network, immunization strategies implemented within these specifications fall substantially in efficacy. In terms of protecting the entire network, targeted immunization on subnetworks with small boundary conditions performed only marginally better than random immunization. However, while worse in performance than when used with complete networks, targeted immunization strategies still remained relatively effective when implemented with boundary specifications at most scales except for the smallest, especially in terms of protecting the subnetwork of interest. Thus, continued research and more complete sampling methods are encouraged.

### **Visualizing state and change in human thought, knowledge, and attitude from written texts.**

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Eliciting and tracking human knowledge is an important part of evaluating change and impact in human and technological networks (Jonassen, 2006; Spector, 2008; Strasser, 2010). Our technology was initially built for researchers to objectively and automatically extract knowledge

from text and has been validated and used over time in many different domains and contexts (e.g. Authors, 2006, 2010a,b,c, 2014, 2015a,b, 2016). Text usually contains more than knowledge (e.g., style, macrostructure, typography), but the underlying knowledge is an important part that is often left out for analysis, often due to the amount of manual work. Within our technology, the extracted knowledge is represented by a graph that can also be plotted and visualized. Graphs provide a methodological bridge to automated analysis methods, e.g. to track change over time. Particularly, four structural and three semantic measures based on graph theory and mental model theory have shown to be stable indicators for knowledge over time (Authors, 2010a,b, 2015a, 2016). The graphs can also be visualized on structures that are similar to concept-maps. These artifacts of knowledge can be used in many different ways to confront learners, writers, readers, decision-makers, coaches, instructors with their own or their students' knowledge – as well as the change of it.

We present three different studies that showcase the use of the software for network impact analysis.

The first study (n = 89) is a 10 point time-series design-experiment tracking instructional treatments between two experimental groups and a control. It shows the capabilities of the software to find different progressions in knowledge by different uses of social software between classes at the university level.

The second study is a technological study using a further development of the software that helps to automatically create complex semantic clusters from large text-corpora. When used with all textbook- and learning-material in use on the university level, the technology allows for a reconstruction of the specific domain-model that forms the actual curriculum. Such domain-models can be created automatically and used afterwards to triangulate students writing within the domain. The study is a proof-of-concept best practice that shows the capabilities of the software to create complex domain-models.

The third study shows a similar use for organizations to foster between-expertise understanding. We present a practical application and business use-case for pharmaceutical practice transfer in a heavily regulated and governed industry. In process- and project-related business meetings automatically generated knowledge maps created from the companies' text corpora were used to facilitate communication. The main achievement is to reduce the level of otherwise unnoticed misunderstanding.

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**A Mixed Study on the Construction, Deployment and Operational Devices of an Interdisciplinary Scientific Network in Pediatric Oncology** / Vivre VIE : une étude mixte sur la construction, le déploiement et les dispositifs opérationnels d'un réseau scientifique interdisciplinaire en oncologie pédiatrique

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**Introduction:** In 2017, a major interdisciplinary research aimed at improving the quality of life and preventing the sequelae of pediatric oncology health treatments was launched. The project V.I.E. (LIFE) is conducted at CHU Sainte-Justine by a team of 45 collaborators. The project aims to create new basic scientific knowledge in nutrition, physical education and psycho-oncology. In the short term, the project is focussed on feasibility and in the long term, the overall goal is to produce and transfer new knowledge in clinical settings. One of the main anticipated challenges was the design and implementation of an operational mechanism to bring together heterogeneous disciplinary perspectives in order to produce a coherent and transferable body of knowledge. The ancillary project Vivre V.I.E. (Living LIFE) was therefore designed to respond to these issues. Since September 2017, this study has made it possible to closely follow the team's experience as well as the evolution of internal scientific and cultural ties.

**Objectives:** This first report aims to describe the network set up for the first year of research by portraying the categories of network members, their roles and interactions in four types of activities: coordination, research procedures, teaching, production of outputs.

**Method:** The mixed data on interactions and activities comes from individual interviews, scientometrics, participant observations and document archiving. Statistical analysis allows a graphic presentation of the evolution of the network and its internal interactions. Narrative analysis and collective writing capture the dynamics qualitatively. The descriptive and critical portrait of experience and feasibility is therefore based on the fusion of mixed methods.

**Results:** The main base of the network is the interactions between its members BEFORE the implementation of the device. These relationships are of various types that are mainly based on two temporal dynamics: 1) the history of relationships (previous research projects, current clinical teams, teaching links) and the projection of future relationships (research planning, graduate students' projects) and 2) the anticipation of clinical developments (knowledge transfer, need for resources, interventions and adapted protocols). The main issues are the quality of the internal communication which relies on the identification of the individual provisions in the subgroups (transparency, openness, flexibility, affinity, trust), the fluidity of the information inside the network and at its institutional surface (clinical, teaching and research) and the ongoing training of network members. The concepts of learning community and health cultural capital are useful for reporting the experience and will be mobilized to reflect it to the members during the second year of the project in formalized educational and evaluative feedback.

**Conclusion:** The study of the network and the monitoring of its activities from the moment of project preparation make it possible to document the issues related to its feasibility and to produce regular internal feedbacks that promote fluidity of interactions and productivity.

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**Introduction :** En 2017, une recherche interdisciplinaire visant l'amélioration de la qualité de vie et la prévention de certaines séquelles de traitements en oncologie pédiatrique a été lancée. L'enquête VIE est menée au CHU Sainte-Justine par une équipe de 45 collaborateurs. Le projet vise à produire des connaissances scientifiques inédites en sciences fondamentales, nutrition, éducation physique et psycho-oncologie. À court terme, le projet est axé sur la faisabilité et à long

terme, l'objectif général est de produire et de transférer de nouvelles connaissances en milieu clinique. L'un des principaux défis anticipés était la conception et la mise en place d'un dispositif opérationnel permettant de réunir des perspectives disciplinaires hétérogènes de manière à produire un corpus de savoirs cohérent et transférable. Le projet ancillaire *Vivre VIE* a donc été conçu pour répondre à ces enjeux. Depuis septembre 2017, cette étude a permis de suivre au plus près l'expérience de l'équipe ainsi que l'évolution des liens entre ses membres.

**Objectifs :** Ce premier rapport vise à décrire le réseau mis en place pour la première année de recherche en réalisant un portrait des catégories de membres du réseau, leurs rôles ainsi que les interactions dans quatre types d'activités : coordination, procédures de recherche, enseignement, production d'extraits.

**Méthode :** Les données mixtes sur les interactions et les activités proviennent d'entretiens individuels, de banques scientométriques, d'observations participantes et d'archives du projet. L'analyse statistique permet de réaliser une présentation graphique de l'évolution du réseau et de ses interactions internes. L'analyse narrative et la rédaction collective permettent de saisir les dynamiques qualitativement. Le portrait descriptif et critique de l'expérience et de la faisabilité repose donc sur la convergence de méthodes mixtes.

**Résultats :** La base principale du réseau est constituée des relations interindividuelles de ses membres AVANT la mise en place du dispositif. Ces relations sont de types variés qui reposent principalement sur deux dynamiques temporelles : 1) l'ancienneté des relations (projets de recherche antérieurs, équipes cliniques actuelles, liens d'enseignement) et sur la projection de relations futures (planification de la recherche, projets d'étudiants aux cycles supérieurs) et 2) l'anticipation de développements cliniques (transfert des connaissances, besoin de ressources, interventions et protocoles adaptés). Les principaux enjeux sont la qualité de la communication interne qui repose sur la mise au jour des dispositions individuelles dans les sous-groupes (transparence, ouverture, souplesse, affinités, confiance), la fluidité de l'information à l'intérieur du réseau et à sa surface institutionnelle (clinique, enseignement et recherche) et la formation continue des membres du réseau. Les concepts de communauté apprenante et de capital culturel de santé sont utiles pour rendre compte de l'expérience et seront mobilisés pour la refléter aux membres pendant la deuxième année du projet dans des feedback formalisés de nature pédagogique et évaluative.

**Conclusion :** L'étude du réseau et la veille sur ses activités dès le moment de la préparation du projet permettent de documenter les enjeux liés à sa faisabilité et de produire des rétroactions internes régulières qui favorisent la fluidité des interactions et la productivité.

### **What can we learn about social and environmental network relationships through the internet?**

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"I once participated in one of those social network analysis surveys," an environmental decision maker told me. "It was the worst experience of my life." Let's face it, listing all your collaborators can be mind-numbingly boring. We may be lucky to get 50% survey response rates in many

settings where environmental managers have competing interests for their time. And mental recall has limitations: Can you remember all the people you discussed with last year? How often? What policy issues or projects you worked on? Where you did them? And all this during your 30-minute lunch break? The task is no simpler for the researcher. Contacting hundreds of urban stewardship groups or municipal water managers in a 30,000 km<sup>2</sup> watershed is time consuming at best, logistically impossible at worst. Alternatively, in many social-ecological systems, in places and cultures where digital resources and records are actively used, electronic data and web-based tools can potentially create new opportunities for understanding networks. Network data may be collected at short and repeated time intervals, or rapidly following major policy changes or natural disasters. Such a transition is not just methodological. There are higher order questions to be asked about what we can learn of environmental governance networks through the internet.

To help answer these questions, we conduct a comparative analysis of an urban environmental stewardship network analyzed through a traditional survey and a newly developed web tool. The tool scrapes hyperlinks from organizations' web pages and builds networks based on Google search algorithms. We compare data gathered by the web tool to recent survey data (2017) collected in New York City by the United States Forest Service as part of their stewardship mapping, or "StewMap," project. StewMap documents local stewardship organizations, their information sharing and funding networks, the type of environmental work they do, and where they do it. StewMap contains social network data as well as two-mode data linking people to places and projects, providing a useful comparison to understand what we can learn about environmental governance patterns from the internet. Using data derived from the two methods, traditional survey and web tool, we compare total and ego network metrics for information sharing and funding. We also compare qualitative ego network analysis to understand relationships between organization and environmental projects or places. Our analysis compares classical survey and internet-based approaches to learning, revealing what and how we can learn about environmental governance through the internet. This research may improve how we study large social-ecological systems, enable short interval time series data collection, and allow rapid monitoring of networks after significant social and environmental events.

### **What do the Dutch mean by 'friend'?**

Vera Landa Buijs<sup>1</sup>, Gert Stulp<sup>1</sup>

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Rapid social changes in the previous century have caused personal networks to shift from dense networks with many family members to more sparse networks including many friends. And indeed, friends play an important role in people's lives. Despite this importance, the concept of "friend" is hard to pin down. Here we revisit a classic study by Fischer (1982) and ask: what do we mean by 'friend'?

In this exploratory study among a sample of Dutch women, we examine the use of the word "friend" to describe alters in the networks. We address four questions that allow us to get a better grip on the concept of "friend": i) which individuals in a personal network (e.g., colleagues, family members, neighbors, acquaintances) are most strongly associated with being considered a "friend"; ii) to what extent are "closeness" and "contact frequency" associated with being considered a "friend"; iii) are there individual differences (e.g., in age, education) in the use of "friend"; iv) how does network composition differ based on friendship, contact frequency, closeness, and relatedness (family).

Using a novel tool (GENSI) to collect large personal networks while decreasing respondent burden, we collected personal networks of 25 alters for a representative sample of 724 Dutch women between the ages of 18 and 40. Several questions were asked about the relationship between the

respondent and the alter, including how the respondent and alter knew one another (e.g., family, from work, from studies) and whether the alter was a friend. Closeness and frequency of contact were measured on a five-point scale.

Our first results show that the 724 respondents listed 7486 friends in total. On average, respondents listed 10 friends (SD = 5). Some listed no friends, while others considered all 25 alters as friends. People met during study, primary school, or high school were most likely to be considered a friend. Partners were more often considered a friend than not. Siblings, other kin, and parents were also considered “friends” in quite some cases. “In-laws” were least like to be listed as friends, yet still had a 13% chance.

Closeness was most strongly associated with being considered a friend. Very close relationships were friends half of the time, while relationships considered not at all close were friends 5% of the time. Both face-to-face and other forms of contact were associated with being considered a friend, although this effect was much more pronounced for the latter. Daily non-face-to-face contact was twice as likely for friends than for other relationships.

In our talk, we will further discuss how individual demographic differences are associated with how people use “friend” as a category to describe their relationships. We further assess in what fundamental ways networks differ when selecting alters on friendship status, closeness, or frequency of contact. We discuss how these results are important for network researchers in light of different name generators explicitly involving the word “friend”. We mirror Fischer’s conclusion nearly 40 years ago, that “friend” might not be a robust term for describing particular social relationships.

### **What Is(n't) a Friend? Dimensions of the Friendship Concept Among Adolescents**

James Kitts<sup>1</sup>, Diego Leal<sup>2</sup>

<sup>1</sup>University of Massachusetts, <sup>2</sup>University of South Carolina

Most work in network analysis of adolescent friendships assumes that a friendship nomination on a survey represents *directed-liking* (and an absent nomination represents directed non-liking or disliking). By modeling diffusion of ideas or viruses on paths of friendships, many further assume that friendship nominations measure *directed-social-interaction* (and non-friendship prohibits interaction). Underlying these usages is an assumption that liking, interaction, and attributions of friendship are described well by a single dimension, which can be captured by asking a survey respondent to nominate her friends. Lastly, the analytical leverage of social network analysis typically entails strong assumptions of *equivalence*: Ties are interchangeable and non-ties are interchangeable; that is, only the structure matters.

We investigate an argument by Kitts (2014) that friendship is generally construed by survey respondents as a *role relation*, especially as a *mutual* obligation to abide by a set of *relational norms*. Investigating this claim, we challenge all of the interwoven assumptions above -- friendship as directed-liking, friendship as directed-interaction, and friendship as a one-dimensional concept. Further, we will demonstrate that friendship measures in heterogeneous populations are likely to violate the equivalence assumption in systematic ways: Friendship as a socially constructed role relation may mean very different things to different people, especially as relational norms may differ across cultures or genders.

A mixed-methods study of a diverse population of adolescents in 6 school grades tests the argument that friendship is construed foremost as a role relation, against the conventional assumptions above. Focus groups, interviews, and surveys suggest that students regard friendship as a complex multidimensional concept, best summarized as a mutual role relation embodying relational norms as well as (undirected) sentiments. Qualitative findings are inconsistent with the conventional definition of friendship as directed liking and interaction. To pursue this further, we

derive a set of 11 exemplary defining features of friendships from the focus group responses. Follow-up surveys allow participants ( $N=441$ ) to rank those 11 features. Dimensionality assessment of these 11 ranked features reveals that friendship is not described well by one dimension, and that directed liking and interaction are not aligned with each other or with the primary dimension underlying the friendship concept. Respondents see friendship primarily as an agreement to obey relational norms. Liking is not relatively important to defining friendship (even so, *likes-me* is surprisingly more important than *I-like*), nor is the volume of time spent together. Friendship can even imply structural properties such as reciprocity [*calls me his/her friend*], closure [*friends with my other friends (part of my group)*], and even homophily [*has much in common with me*] by definition. Lastly, although boys and girls agree that relational norms for role-related behavior are most important to defining friendship, they differ systematically in which norms or features they see as defining friendship. Given that such heterogeneity is problematic for the assumption of equivalence, network analysis based on direct measures of sentiments and interaction may be more interpretable than analysis based on measures of friendship nominations.

### **What makes a good story plot? From a social network perspective**

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The movie industry has been a key driver of the U.S. economy with a total box office revenue reaching \$11.89 billion in North America market in 2018. Identifying factors influencing movie popularity and box office performance has been an important research topic in both the movie industry and the academia. To date, much research has proposed that story plots, such as the relationships/conflicts among characters, influence the quality of movies and their performance in the market. For example, many researchers believe that the story plots of great movies should start with a background, move on to incidents and mental struggles, and end with a climax and resolution (Edson 2011 and Hennig-Thurau et. al 2001). However, empirical evidence supporting the above proposition is generally based on qualitative analysis. In our research, we aim to quantify the story plots of movies with network analysis. Although recent research on movies and networks has proposed some algorithms to identify characters in networks (Do et al, 2018), our paper is the first to quantify the relationships among characters and their dynamic changes with network analysis.

We crawled movie scripts from the Internet Movie Script Database (IMSDb) and selected top ten most popular movies (based on IMDB ranking) to conduct the analysis. First, text mining was used to identify characters in the script. Then, with nodes representing the characters and edges representing the characters' co-occurrence in the same scene, the character network was constructed using dialogs to extract variables related to relationships between characters and story plots. Lastly, each script was split into ten sequential segments and macro and micro indices were computed for each segment. The macro indices focus on the society-wide view of networks in terms of degree distribution, density, assortativity, community structure, average distance, and networkdiameter. The micro indices capture the local properties of a given character such as closeness, betweenness, centrality, and tie strength. We show that those indices as well as their dynamic patterns are correlated with the development of the story plots and can depict the relationships and conflicts among characters. For example, the network indices, such as degree and centrality measures, tend to increase over the timeline of the movie and reach their peaks in latter segments (segments 8, 9, or 10). This pattern provides empirical evidence for existing theories regarding the standards of great story plots.

Our research contributes to literature on the impact of story plots on movie performance by providing an innovative way to quantify these story plots. Our research also contributes to literature on text mining and network analysis by applying them to the analysis of movie scripts.

### **What's the Difference? Accounting for Cross-Country and Cross-Immigrant Group Variations in Interethnic Social Relationships**

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Social relationships with natives are considered particularly advantageous for immigrants' integration process. However, they remain rare compared to random chance. At the same time, previous studies repeatedly observed that social tie homogeneity varies slightly across countries and immigrant groups. The question arises why interethnic friendships are more frequent in some countries than in others? And why are some immigrant groups more likely to develop these ties than others? Although the development of interethnic relationships has been the focus of numerous studies, comparative studies on immigrants' social integration are still rare, especially on multiple immigrant groups in multiple receiving countries. Only a few studies have made a first step toward understanding differences in immigrants' interethnic relationships across immigrant groups and countries.

To account for cross-country and cross-group variations in interethnic relationships, this study applies a theory of preferences, opportunities, and third parties. While opportunities comprise of the structural possibilities for ego to encounter alter, preferences refer to the mutual satisfaction obtained through the interactions constituting the social tie. In addition, third parties influence the formation of social ties by approval or disapproval, by sanctioning undesirable contacts and by shaping preferences through group norms. Arguably, these mechanisms themselves do not differ across immigrant groups and countries, but instead characteristics related to preferences, opportunities, and third parties differ across countries and groups. This study differentiates eight potential characteristics which arguably predict these variations, such as host language proficiency, social relationships with co-ethnics, and ethnic segregation.

Data from the two-wave panel study 'Socio-Cultural Integration Processes among New Immigrants in Europe project (SCIP)' on Poles and Turks in England, Germany, Ireland, and the Netherlands are reported. The study differentiates between friendships and the frequency of contacts with natives as dependent variables, thereby improving on previous research largely focusing on weak or strong ties. Methodologically, linear and logistic regressions on social relationships with natives at the time of the first interview are applied. These models include an indicator for respondents ethnic group membership and host country combinations and further predictors representing the hypothesized causes for cross-country and cross-group variations. The latter are introduced into the models in a stepwise manner, thereby identifying how much of the cross-country and cross-group variations are due to any of the eight differentiated characteristics.

The analysis shows that social relationships with co-ethnics and migrants of other ethnic groups in particular account for cross-immigrant group and cross-country variations in interethnic relationships. In addition, host language proficiency and the ethnicity of the partner are important predictors. The results for weak and strong interethnic ties are virtually identical, albeit a higher remaining unexplained variance between countries and groups in the friendship models. The study highlights that cross-country and cross-group variations in interethnic relationships are mainly due to migrants' embeddedness in social relationships with co-ethnics as well as members of other ethnic groups - whenever these relationships are less frequent, interethnic relationships become more likely.

**When being member of a minority group is advantageous: the role of the school identity**

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While diversity can have positive effects on the conviviality between different social groups in classrooms, it also entails the risk of social exclusion of minority groups, for example in terms of nationality. In this respect, an interesting case to study are international schools, which are mainly oriented towards students who are not the local majority. Sometimes in these schools, natives from the country of residence still form the majority group in the school, and children with the same national identity as the school are the minority (i.e., Swiss students in a Swiss school abroad). In this specific context, it is interesting to study to what extent the school environment enhances the inclusiveness of minority groups. To address this question, we collected data on the friendship networks, the self-ascribed national identities as well as the national identities perceived by peers of 377 students (53% girls; 73% natives, 23% Swiss, 4% other nationalities) in 18 classrooms of grades one through eight in a Swiss school in Spain. A stochastic actor-based model implemented in R-Siena was run to identify selection effects in the classroom networks. Changes of friendship ties from t1 through t3 (average Jaccard coefficient .51) were analysed in relation to gender, self-ascribed national identity (native and Swiss), and national identity perceived by peers (native and Swiss). The results revealed on one hand that students with a self-ascribed national identity matching the school (Swiss) were more likely to nominate friends. Identifying with the national majority (native) had less impact on how friendships were formed. On the other hand, while being identified by peers as Swiss (minority group) did not influence the friendship networks, being identified by peers as a native (majority group) was positively linked to nominating friends and negatively linked to being nominated as friend. As expected, gender homophily was related to the friendship networks. Interestingly, homophily related to national identity was not found. In conclusion, it seems that in this context that is positively focused on the minority, identifying with the school national identity has a positive impact on the social activity of students, and it does not have a negative (nor positive) impact on their popularity.

**When digital methods meet social network analysis: what ethics?**

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In this communication we want to discuss the methodological and ethical questions induced by a research project at the intersection of digital methods and social network analysis. We emphasize that digital research must constantly adapt to the dominance of platforms in order to respect certain ethical foundations such as the anonymity of the subjects observed. This adaptation requires both a reinterpretation of certain categories specific to social networks analysis and the implementation of mixed methods and specific processes.

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Dans cet article, nous décrivons les ajustements méthodologiques induits par l'application d'une politique éthique lors d'un projet de recherche à l'intersection des méthodes numériques et de l'analyse des réseaux sociaux. Nous soulignons que la recherche sur les réseaux sociaux en ligne doit constamment s'adapter à la domination des plateformes afin de respecter certains fondements éthiques tels que l'anonymat des sujets observés. Cette adaptation, que nous décrivons à travers les résultats de recherches menées sur le financement participatif en France, nécessite à la fois une réinterprétation de certaines catégories d'analyses et la mise en œuvre de méthodes mixtes et de processus spécifiques.

**When social position and isolation hurt: Can social ties protect the mental health of migrants?**

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Mental health is unequally distributed among ethnic groups in the Western industrialized world, such that ethnic minority groups report poorer mental health than majority groups. Previous research points to two explanations for this unequal distribution: psychosocial stress and socioeconomic disparities.

In this paper, we explore to what extent several aspects of personal networks are able to buffer against the adverse effects linked to psychosocial stress and socioeconomic disparities. Personal networks have been shown to play an important role in buffering against mental health problems and they have the potential to decrease or facilitate socioeconomic inequalities. According to psychosocial explanations of ethnic health differences, ethnic minority members experience elevated stress-levels due to discrimination or marginalization, which harms their mental health. We investigate the protective role of personal network size, co-ethnic ties, and social ties in the residential area. We also consider the role of co-ethnic concentration in respondents' residential areas to test whether indirect exposure to ethnically similar residents is sufficiently beneficial for mental health or whether actual ties need to be realized.

According to socioeconomic explanations, ethnic minorities are overrepresented in more disadvantaged socioeconomic strata, which is associated with factors predictive of poorer health. Linking this perspective to personal networks, we test for the protective role of resources controlled by alters (i.e., social capital) and contact frequency (i.e., mobilization of support). Finally, we also consider interdependencies of psychosocial and socioeconomic explanations by exploring whether the negative association between socioeconomic status and health is more pronounced for ethnic minority members who have smaller networks and/or less co-ethnic exposure.

To test our predictions, we analyzed Dutch data from the Longitudinal Internet Studies for the Social sciences (LISS) Immigrant panel (2011-2013). The LISS Immigrant panel contains detailed information on respondents' health, as well as their personal networks in and outside of their residential areas. We link these individual-level data to residential composition data from Statistics Netherlands.

We found a negative relationship between mental health and socioeconomic status, and a quadratic relationship between mental health and co-ethnic exposure in respondents' residential areas. Mental health was lowest at very low and at very high levels of co-ethnic concentration, suggesting that both extreme isolation and extreme segregation are detrimental. Isolation was especially detrimental for migrants below the poverty line. More inter-ethnic ties, more diversity in social capital and higher contact frequency were all positively associated with mental health. We did not find evidence that co-ethnic exposure and personal networks substituted one another. We therefore conclude that co-ethnic exposure and relevant aspects of personal networks independently exert protective effects.

**Where Does Innovation Come From? Examining the Impact of Network Diversity on the Novelty and Quality of Social Innovation**

Jiawei Sophia Fu<sup>1</sup>

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Confronted with persistent wicked problems, scholars have highlighted the urgency to creating and implementing novel solutions (i.e., social innovation) to tackle grand challenges of our era, such as environment degradation, poverty, gender inequality, and social exclusion. Similar to the

argument that innovation is the most important determinant of competitive advantage of business firms, scholars contend that social innovation is the basis of effective social change. Notably, cross-sector partnerships (CSSPs)—collaborative arrangements among organizations in the business, nonprofit, and public sectors—are crucial for the development and implementation of social innovation. The central tenet of this line of research posits that CSSPs allow organizations from different sectors to share unique knowledge and resources, complementary capabilities, and distinctive expertise, which are critical for interactive learning and collective development of social innovations. However, research has also revealed that CSSPs often fail to innovate. Given the significance of social innovation for addressing grand challenges, it is imperative for researchers to understand the conditions under which CSSPs facilitate the creation of social innovation.

Drawing on research on organizational innovation and CSSPs which considers diverse networks as the locus of innovation, this research examines the impact of three dimensions of interorganizational network diversity—*duration*, *tie strength*, and *collaboration type*—on the social innovations organizations develop at the meso-level. To that end, I surveyed 319 nascent nonprofit organizations, social enterprises, and benefit corporations in the United States and used the name generator approach to examine their ego networks. I also invited program officers to evaluate the *novelty* and *quality* of each organization's social innovation. Structural equation modeling (SEM) results suggested that diversity in partnerships with nonprofit and business partners influenced the *novelty* and *quality* of social innovation. However, diversity in partnerships with government agencies did not influence the novelty or quality of social innovation. Instead, the size of partnerships with government agencies influenced social innovation. Moreover, findings suggested that tie strength and collaboration type diversity generally helped organizations improve social innovation. However, duration diversity had opposite effects on social innovation, depending on whether organizations were partnering with nonprofits or businesses.

This research makes four contributions to the study of CSSPs, interorganizational networks, and organizational innovation. First, in contrast to prior organization studies that primarily focus on the determinants of business innovation, this research contributes to our limited knowledge of the determinants of social innovation. Second, this research sheds light on the determinants of two interrelated but distinct dimensions of innovation, highlighting the necessity of understanding organizational innovation as a multidimensional outcome. Third, this research answers the call to more vigorously understand the impact of different dimensions of network diversity on innovation. Hence, it contributes to a more nuanced understanding of the link between interorganizational networks and organizational innovation. Finally, this research reveals the conditions under which CSSPs facilitate organizational innovation, contributing to a contingency theory of collaborative value creation via CSSPs. The findings of this research also have important practical implications for organizations to strategically configure their network ties for optimal social innovation.

**Where you are, what you want, and what you can do: The role of master statuses, personality traits, and social cognition in shaping ego network size, structure, and composition**

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Individuals are embedded within groups of people, and significant effort has been expended in understanding the predictors of the size, structure, and composition of our local social environments. These “ego networks” are thought to be influenced by the opportunities provided to associate with others (shaped by our master statuses such as race or sex), by the preferences

individuals possess for interaction (given by our personality traits, such as extroversion or neuroticism), and by their capacity to manage interactions on an ongoing basis (determined by our cognitive ability to manage network information), but prior research has been unable to examine all three classes of predictors at the same time. We rectify this deficiency in the literature by using a novel dataset of nearly one thousand respondents collected using controlled laboratory designs to simultaneously examine the impact of master statuses, personality traits, and social cognitive competencies on ego network size, structure (i.e., density), and composition (i.e., diversity). We find that all classes of predictors exert important influences, though in different ways, and point to new avenues of research into human sociability.

### **Who is Dropped and Why? Methodological and Substantive Accounts for Network Loss**

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A long-lasting concern in the analysis of egocentric networks is the frequently-observed “churn”: high levels of turnover in network alters that occur even in brief periods between surveys. We use two waves of the UCNets panel—about 1,000 respondents in two age cohorts (50–70 and 21–30) living the San Francisco Bay Area—to examine how many alters are dropped within about a year and why they are dropped. Seven name-eliciting questions yielded an average of about 10 names (SD=4) per respondent in each wave. Yet, almost half of the names respondents listed in wave 1 did not appear in respondents’ wave 2 lists. This is consistent with the experience of other egocentric network studies.

We asked the respondents why they did not re-list the missing alters from the previous year. For about 40 percent of the unlisted cases the respondents answered that they had forgotten to name the alter. This finding suggests that the true drop rate was about 25 percent, not the conventional 50 percent. Other explanations, such as “there has not been any occasion... to be in touch,” also suggest that the alters are available and that the true attrition rate is much less than previous estimates. We discuss the methodological explanations and implications of this finding.

We also pursue the question of who was really dropped—neither re-listed *nor* forgotten—and by whom. Respondents explained drops by a range of “soft” to “hard” reasons—from “no occasion” and “we drifted apart” to we had disputes and the alter died. Using an HLM model that nested alters within respondents (and setting aside nonkin roommates who had high rates of turnover), we found that alters were highly likely to be dropped if they were *not* immediate kin, if they were coworkers, romantic partners, or acquaintances, if they were *not* named on several questions indicating that they provided support to ego, or if they were “difficult” people who were not immediate kin. (Other attributes were also significant predictors.) The major distinction among *respondents* for who dropped many ties was having moved outside the region between waves.

### **Who is using prevention messages on social media?: A social network analysis**

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Social media presents a unique opportunity for communication about and discussion of intimate partner violence (IPV) issues. One way that IPV awareness and prevention programs seek to track online discussion is by encouraging the use of specific hashtags to promote a core message or phrase associated with a campaign. However, little empirical work has evaluated the use of hashtags in relation to IPV prevention outcomes for a community.

In this study we examine Twitter conversations about IPV. We use two hashtags to limit our inclusion parameters, a smaller prevention program’s hashtag (#livethegreendot) and a larger

national movement's hashtag (#ItsOnUs). We coded user profiles to examine who is using the hashtags, i.e. who is a part of the conversation. We also examine the unique nature of the types of connections expressed through social media, which may reflect differential levels of engagement with the prevention messages within each of the campaigns (original tweets, re-tweets, mentions, and replies). Analyses were performed using NodeXL Pro 1.0.1.394.

Our findings indicate that although a wide array of different users may be using a hashtag in a given context, often the most far-reaching users (possessing the most followers, etc.) are typically passive participants. Conversation connections tend to be one-way for the smaller prevention program, limiting the audience for the prevention messages. However, the engagement within the larger national movement tended to be retweets rather than direct interactions and original posts, which suggests that engagement may be more surface level even if more widespread. We offer several implications and suggestions both for 1) research methods utilizing hashtag delineated networks on Twitter, and 2) recommendations for programs that use social media campaigns as an awareness tool.

### **Who talks to whom in lake basin management: comparing communication networks of water resource partners of five Columbia River headwaters lake basins**

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Water basins are complex social-ecological systems, spanning political, legal, jurisdictional, socio-economic, geographic and biophysical boundaries. Water resource managers in a single basin are faced with multi-jurisdictional structure, as well as challenges of meeting the place-based needs of water users with sustainable plans. Collective action and adaptive management approaches are required to govern such complex systems, and to solve the "perpetual crisis," of water policy. Network-weaving, or reaching out to others in networks of relationships, is fundamental to the communications necessary if collaborations in adaptive management are to be sustainable and responsive to change.

Social network analysis has been valuable in identifying and describing communication patterns among actors in water management groups. Few studies, however, have examined communications linkages at the intersection of networks for developing policy or regulations, and collaborative networks for managing resources within those regulatory structures. Few direct comparisons have been made across multiple communities, so little can currently be said about whether consistent patterns exist across water management scenarios. This research advances understanding about the features of communication networks the stakeholders create to facilitate management activities, and provides insight into types of network structures that promote positive change in the watersheds.

In the Columbia River headwaters basin, Washington, Idaho, Montana, and British Columbia are each impacted by their neighbors' water management decisions. Water resource managers have an important place in the co-managed social and ecological landscape of the region. Management partners must be able to rapidly adapt their management plans to dynamically changing conditions, especially with effects of climate change already regionally evidenced. Knowledge of the features of the network structure can reveal the dynamics and drivers of inter-organizational interactions. Understanding the communication networks dynamics of lake basin management partnerships and the impacts of network interactions can help establish a position of regional water resource management leadership, and has implications for national and international collaborations in lake management.

In this paper, our goal is to determine the communication network among water resource managers and to explain their motivations driving the observed network structures in the context

of Columbia River headwaters lake basins. Two separate networks are identified in each of the following Columbia River headwaters lake basins: Chelan, Roosevelt, Pend Oreille, Kootenai, and Flathead. One network in each basin is focused on water quality management, and another network in managing fisheries, resulting in a total of 10 individual networks across the five basins, two for each basin.

The primary method of data collection in this study is an online survey using Qualtrics™ as the survey tool. Surveys will be administered from mid-March to mid-May 2019. Respondents include regulatory agencies on federal, state, and regional levels, Indigenous tribes, regional and government and businesses entities, research and education institutions, and non-profit organizations. We will use network visualization and exponential random graph model to explain the network of communication ties among water resource managers for both water quality management and fisheries management communication networks in each of the five basins, as well as across all five basins.

### **Who's Influencing Who: Does Adolescent Peer Group Sex Composition, Drinking, & Homophobia Predict Violent Behavior?**

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Research consistently shows the alarmingly high rates and deleterious consequences of dating violence, sexual assault, and harassment for victims, particularly among adolescents (Black et al., 2011; Gruber & Fineran, 2008; Niolon et al., 2015). Across cultures, men and boys are often the perpetrators of these acts of gender-based violence (GBV), so interventions to prevent these behaviors are often designed with men as the target audience (Barker, Ricardo, & Nascimento, 2007; Jewkes, Flood, & Lang, 2015). Understanding the antecedents of GBV among adolescents needs to inform prevention efforts however, as time with middle and high school students can be limited. Examining the influence of peer-group and the behaviors of close friends may be particularly important to predicting GBV behaviors among this age group; there is evidence that close peers' behaviors are important predictors of general adolescent delinquency behaviors such as drinking, smoking, stealing, or skipping school (Andrews, Hanish, & Santos, 2017; Molloy, Gest, Feinberg, & Osgood, 2014; Williams, Knight, & Wills, 2015). However, studies of delinquent behavior and egocentric network influence typically do not include GBV items or use only cross-sectional data, leaving a gap in our understanding of adolescent behavior as to whether there is a link, and in what direction goes the relation (Mumford, Okamoto, Taylor, & Stein, 2013).

The present study is a longitudinal examination of individual and social network predictors of GBV perpetration among a sample of 2,539 middle and high school students from 8 schools in South Dakota collected over a 2-year period. The sample is 52.9% female with a mean age of 13.7 years old ranging from 12-18 years old. The majority of the sample is White (71.8%), with the remaining students identifying as Native or Indian American (20.8%), or Multiracial/Other (7.5%). Individual-level characteristics include drinking behavior, homophobic teasing behaviors, and sex. Social network characteristics include peer network size, percent same-sex, mean alters' alcohol use, mean alters' homophobic teasing, and mean alters' GBV perpetration.

Analyses will be conducted using SIENA to fit longitudinal stochastic actor-based models (Snijders, van de Bunt, & Steglich, 2010). This analysis strategy models evolution of friendship network characteristics (sex-composition, peer drinking, homophobic behaviors, and GBV perpetration) simultaneously with evolution of individual GBV perpetration across the three measurement points, while accounting for additional individual characteristics (sex, drinking, and homophobic behaviors).

Findings from this study will inform GBV prevention and intervention efforts by supporting peer-based and social norms correction programming. Middle and high school policies may also be informed by these findings, particularly related to student conduct practices by suggesting response emphasis on peer groups in addition to responding to individual students. This study also hopes to connect predictors of adolescent GBV behavior with the rich literature on predictors of other unhealthy and harmful behaviors for which adolescents may be at risk to enhance our holistic understanding of youth behavior across domains.

### **Whose voices rise? Gaining, maintaining, and losing position in community networks of justice discourse after police-involved deaths.**

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Social media discourse can help frame major societal issues, and enable community formation, social change, and activism. Engagement on social media provides opportunities to gain and share knowledge and to form ties with others around an issue, topic, or cause. Prior work on social movements, collective action, civic engagement, protest, and related topics has suggested a number of dimensions that correlate with an individual becoming and staying engaged, including social embeddedness (network position) and identity (Klandermans, 1996). With the rise of social media, there appears to be an evolution or shift in the nature of engagement, with digital elements and affordances reshaping the landscape of participation and tie formation (Bennet and Segerberg 2012, Svensen 2015, Theocharis, 2015, etc.). This work examines the networks of justice-related discourse as expressed in Twitter data in the context of events in which highly controversial police actions triggered the deaths of citizens and the network implications of these events. In the face of an onslaught of social media activity in the community and an explosion in network size, this work explores whether and how newcomers to the discourse community can attain central, influential positions in the network, and who among the formerly influential are displaced.

### **Women in Gangs: Life-course Events & Ego-Networks, Women**

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U.S. Department of Justice funded a mixed-methods field research study gathered data on adolescent women's ego networks in Champaign, IL, from 2000-02 as part of a comprehensive study of gang suppression, prevention, and intervention. Eight key informants nominated friends providing descriptive data about each. The study's informants sat for a multiple domain interview. Domains included education, criminal offending, sexual behavior, dating, birth control, drug use, employment, and criminal conduct. First round interviewers nominated 89 friends, subjects of the second-round interviews. Third round interviews gathered data about them. Life events had direct effects on ego networks. The first major life event, gang affiliation, occurred between ages 13 to 15. Women said they gradually pulled away from their natal households. This period was a time for "*hanging out a lot*" with friends, and was termed, "*active gang affiliation*." Active gang affiliation does not warrant violence (fights with other gangs) and non-violent crime (drug selling). The study found popular gang apocrypha baseless. Prospective male gang members need not commit a violent act or withstand a beating or, females need not engage in forced group sex acts. Even the idea of a woman allowing herself to be "*sexed in*" was repugnant and came with an often-heard pronouncement: "*They try that, I'd kill the m...fers*." Multiplex friendship networks formed, enabling social, emotional, and household support, and if necessary engendered physical protection. Pregnancy led women to withdraw from hanging out a lot- "*inactive gang affiliation*."

She sheds weak ties friends. Best friends assist her during pregnancy, and as she establishes her own household. These adolescent women mature into the neighborhood's next generation of female heads of stable households. Male and female adults, from their 20s to beyond 60s, retain their gang attribute. Contrary to law enforcement and criminological descriptions of bounded gang networks, data show a high number of outgoing and incoming arcs between gang networks create many friendship networks, forming a complex web of relations supporting residents in this poor neighborhood.

**Women in science. Research collaboration in Italian Academia from a gender perspective.**

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The paper analyses and compares the networks of scientific collaborations of male and female scientists in the local system of public funding in Italian Academia. In specific, we look at 10 years (2001 – 2010) of the Italian Ministry of University and Research funding of Projects of National Interest (Prin) in all disciplines. In this dataset we observe the percentage of men and women funded in each discipline (over the total number of male and female appointed in Italian Universities), their academic ranks (full professor, associate professor, researcher), and their geographical location (North, Centre, South of Italy). We then select the top funded men and women across all disciplines and compare their collaboration networks, to see if women adopt different network strategies to their male counterparts. Previous studies suggest that women should have more constrained and hierarchical networks than men, while men are supposed to be more efficient and homophilous. Results show that while there is no significant difference in the structure of collaboration networks between male and female, men significantly prefer to work with other men in all the disciplines under analysis. Together with the finding that women are still under-represented in Italian Academia, that they occupy less prestigious roles and overall receive less money than male scientists, our results pose serious questions to the structure and organization of Italian academic system, where gender barriers are still very much in place, and men exclude women from scientific research either deliberately for strategic reasons, or unconsciously for stereotyped biases.

**Worth the Weight: Conceptualizing and Measuring Homophily in Weighted Social Networks**

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Homophily, or the tendency for social contact to occur among those who are similar, plays a crucial role in structuring our social networks. However, empirical research that tests for homophily almost always assumes it is an unvarying process that operates similarly for all social ties, regardless of their strength or level of intimacy. As data on weighted networks, or networks where ties are assigned quantitative measures of strength, become increasingly available, network researchers need to consider whether homophily processes operate differently for ties with varying weights. Here, I take this approach by first defining two variants of homophily that can arise in weighted networks: (1) *strong tie homophily*, or the tendency for ties with high values to cluster together similar peers, and (2) *weak tie homophily*, or the tendency for ties with low edge weights to connect same-attribute actors. I develop new parameters that can be included in valued exponential random graph models (ERGMs) to differentiate between strong and weak tie homophily. Then, I use simulated data to empirically demonstrate the utility in distinguishing between the two variants. I find that, in most networks, there are observable differences in the magnitude of strong versus weak tie homophily. Additionally, when there are low levels of

clustering on the attribute of interest, distinguishing between strong and weak tie homophily often reveals that these processes operate in opposite directions. For instance, in some networks, the formation of strong ties is guided by a tendency towards homophily, while the formation of weak ties is guided by a tendency towards heterophily. Using standard measures of homophily in both binary and valued ERGMs does not allow the researcher to uncover these patterns of variation. Since strong and weak ties carry substantively different implications, I argue that differentiating between the two homophily variants can uncover novel insights for a variety of social processes.