



5th annual Australian Social Network Analysis Conference

ASNAC2020

November 25th-27th

Perth, Western Australia

Conference sponsors:



CYBER SECURITY
COOPERATIVE
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CENTRE

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Security Research Institute



Conference organisers:

Dr Kirsten Martinus, University of Western Australia

Dr Roberto Musotto, Edith Cowan University

Dr Jordan Tchilingirian, University of Western Australia

We would like to extend a warm welcome to ASNAC 2020 – our first ever fully virtual conference.

We would like to acknowledge and celebrate the first Australians on whose traditional lands we meet, and pay our respect to the elders' past, present and emerging.

This is the 5th Australian Social Network Analysis Conference, and it follows in the traditions of previous conferences. The inaugural ASNAC in Melbourne in 2016, and later in Sydney, Canberra and Adelaide. ASNAC represents a unique opportunity for the Australian social network community to present and discuss research across a diversity of fields, with a common theme coalescing around the method - social network analysis. This year is particularly special.

We had originally planned an in-person conference in Perth, but COVID-19 unfortunately hit so we made the decision to go virtual. We are proud therefore to welcome presenters and participants from across Australia and the world to this virtual conference. We hope you join in an exciting two days of plenary discussion, presentations, and social opportunities, to discuss research and advances in the field. Conference participants are academics, students, and industry partners, interested in a range of theory, method, and application contexts ranging from cyber-security, health, the environment, innovation, social media and policy.

We are pleased this year to welcome keynotes from experts within our Australian, as well as from our wider international SNA communities. Before the conference, we will hold three introductory and three advanced pre-conference workshops which are also fully virtual. They are excellent tasters for anyone interested in SNA. We will also be announcing the inaugural Patterson Award – and exciting recognition for excellence in Australian SNA research.

We are excited to share this program with you, and look forward to the insights and perspectives that emerge throughout the conference. We hope to learn from colleagues, and that the exchanges during the conference strengthen and grow Australian SNA research networks.

We wish to thank the members of the ASNAC 2020 organising committee and to our conference funding supporters – AustCyber, Cyber Security Cooperative Research Centre, Edith Cowan University Security Research Institute and The University of Western Australia. Their support facilitated several pre-conference meet-ups in Perth, with the aim of strengthen the Western Australian SNA cohort.

We also thank our colleagues in the organising committee for the Australian Network for Social Network Analysis. Finally, I also want to thank our keynote speakers, Dr Lucia Falzon and Professor Emmanuel Lazega.

Dr Kirsten Martinus
Department of Geography and Planning
University of Western Australia

WELCOME TO #ASNAC2020

This conference marks the 5th national meeting in Australia for Social Network Analysis (SNA) researchers and practitioners. The Australian Network for Social Network Analysis (ANSNA) aims to build greater coordination and collaboration among social network researchers and practitioners in Australia and overseas. It also seeks to raise the profile of Australian social network research nationally and internationally.

It is the national focal point for SNA in Australia, providing information about resources, connections, training in SNA, conferences, and more.

ANSNA is endorsed by the International Network for Social Network Analysis (INSNA).

ANSNA Committee Members

President: Associate Professor David Bright (Flinders University)

Vice President: Dr Kirsten Martinus (University of Western Australia)

Committee Member: Dr Peng Wang (Swinburne University of Technology)

E: info@ansna.org.au

W: <https://www.ansna.org.au>

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Plenary Speaker

Lucia Falzon

is a Senior Fellow of the Defence Science and Technology (DST) Group in the Australian Department of Defence. Since joining DSTO in 1990 and up to her retirement in 2019, she was involved in various endeavours, ranging from the development of techniques for performance analysis of communications systems to the research and development of modelling and analysis tools to support operational planning and, more recently, leading an initiative in mathematical modelling of social phenomena and dynamic social network analysis. A Chief Defence Scientist Fellowship (2015-2018) enabled her to focus on the mechanisms of diffusion over social media networks, laying foundations for an integrated capability for data analysis from open online networks. Her current research is on methods for temporal analysis of interaction networks and the formal characterisation of social media as a system for spreading information and social attitudes. She is an Honorary Fellow at the School of Psychological Sciences, University of Melbourne, and a Visiting Fellow at The Centre for Defence Communications and Information Networking at the University of Adelaide.



Keynote title

On Sequence and Timing: Mapping the Trajectory of SNA research at DST(O)

Cyberspace is a contested environment for defence and national security. Information competitors, malicious actors, and proponents of violent action are aptly utilising the space with considerable impact on the political, economic, and social dimensions. The increased focus on the information environment has seen the use of SNA as it applies to questions in defence evolve from the early days of link analysis of covert networks to the development of a capability to further an understanding of online interactions and their role in promoting the spread of ideas, organized group activities and social action. However, the dynamic nature of cyberspace quickly highlighted the different nature of online networks and the limitations of the available SNA methods and techniques that were specifically developed for static or long-term relations. Critical research questions on the network features of online interactions and their relationship to actual social structure stressed the need for a different approach to social network analysis that also accounts for the timing and order of interactions, one that could leverage the vast quantities of time-stamped data from blogs, online interactions, and social networks sites. This presentation describes the research undertaken at DST over the last decade or so to investigate the potential of social network analysis methods to provide insight into such phenomena. Along the way it discusses the scientific challenges encountered and the steps taken to address them, including the development of an algebraic framework that allows us to define dynamic relational structures and an associated class of temporal network measures.

Plenary Speaker

Emmanuel Lazega

is Professor of Sociology at the Institut d'Etudes Politiques de Paris (Sciences Po), a membre of the Centre de Sociologie des Organisations (CNRS) and a senior member of the Institut Universitaire de France. His current research projects focus on the role of multilevel relational infrastructures in the navigation of generic social processes such as solidarity, control, regulation and learning. Emmanuel is co-editor, with Tom Snijders and Rafael Wittek, of a new book series, called Social Networks in Organizations and Markets, at Edward Elgar Publishers. He has most recently published a book entitled: *Bureaucracy, Collegiality and Social Change – Redefining Organizations with Multilevel Relational Infrastructures*. His publications can be downloaded from <http://www.elazega.fr>



Keynote title

Judges, lawyers, priests and scientists: Lessons from a sociological approach to comparing social networks

The current literature on comparisons of networks is often based on a broad network science perspective, with the assumption that general local mechanisms drive, on their own, the emergence of global patterns. I propose an alternative sociological and neo-structural approach based on finding variations in similar social processes of collective agency across different contexts. To illustrate, I look at "seeking advice downwards" in four different organizational settings: among judges, among lawyers, among priests and among scientists. Analyses reveal various strategic uses of homophily across these settings, skillfully mitigating the divisive effects of rigid status differences in the construction of common knowledge. Making sense of these variations teaches a lesson. Between relational work at the local level and morphological structure at the global level, recursive transformations require multilevel positioning, contested norms and politicized strategies. Multifaceted structure, problematic culture and changing agency combine in these transformations. Very little can be technocratically routinized in the navigation of social processes.

ASNAC 2020 workshop schedule

Wed 25 November 2020

Location: All workshops will be delivered on-line. *Times are Australian Western Standard Time (Perth GMT +8).*

Workshop 1: 11:30pm-1pm AWST (2:30pm-4:00pm AEST)

Introduction to Social Network Research

Malcolm Alexander (Griffith University), **Petr Matous** (University of Sydney), **Daniel Chamberlain** (La Trobe University)

This workshop surveys the range of research approaches coming from long-standing social science work on Social Network Analysis (SNA). It provides guidance for social researchers interested in the substantive questions around social networks by looking at the type of findings produced by SNA research built on survey and (ego-centric) egonet methods, (socio-centric) whole network analysis, and affiliation (2-mode) data. We briefly review the modelling and simulation of 'complex networks' and probabilistic network models such as exponential random graph modelling or stochastic actor-oriented modelling.

This workshop will cover the fundamental concepts of the three social network research streams and help you choose the strategy of network research best suited to your goals and data availability. We will also outline the variety of software available for handling network data, visualising networks, SNA analytics and network modelling.

- 1: Introduction and stocktake of participants' research needs.
- 2: Survey research and ego-centric (egonet) studies: Their contribution to network thinking.
- 3: SNA's socio-centric 'whole network' approaches: Examples.
- 4: The road toward statistical and 'complex' network modelling.
- 5: Where do I start? Data collection and management, Software packages.

Workshop 2: 11:30pm-1pm AWST (2:30pm-4:00pm AEST)

Hands-on introduction to SAOMs for newbies

Johan Koskinen (University of Melbourne, Social Networks Laboratory)

This is a 90 minute workshop that will give you hands-on experience in fitting a stochastic actor-oriented model to longitudinal networks using RSiena in R. The workshop is based around simple example of longitudinal network and aims to illustrate how to calibrate (estimate) the SAOM so that the simulation model reproduces the second network starting in the first. No prior experience of R is required and the

workshop will walk you through pre-prepared code that will be provided. Basic knowledge about SNA and a laptop with R and the packages RSiena, sna, and network (instructions for installation are provided here http://www.stats.ox.ac.uk/~snijders/siena/siena_r.htm). More background material will be provided on the website.

Workshop 3: 11:30pm-1pm AWST (2:30pm-4:00pm AEST)

Introduction to ERGMs for beginners

Peng Wang, Colin Gallagher, James Coutinho, Maedeh Aboutalebi Karkavandi, Dean Lusher (Swinburne University, MelNet Social Network Research Group)

This 90 minute workshop will provide you with practical experience in fitting an exponential random graph model (ERGM) to cross-sectional network data using MPNet. The workshop is based around simple example of an undirected network. It aims to demonstrate how to calibrate (estimate) the ERGM so that the simulation model reproduces the observed network data based on the set of actors (nodes) and their individual attributes (characteristics). The workshop will walk you through the basic rationale behind ERGM framework, formatting data, and using the MPNet program. No programming knowledge is required. Basic knowledge about SNA and a Windows laptop are needed. More background material will be provided on the website.

Workshop 4: 1pm-2:30pm AWST (4:00pm-5.30pm AEST)

VOSON Lab Tools for Collecting and Analysing Online Networks

A/Prof Robert Ackland (Virtual Observatory for the Study of Online Networks (VOSON - <http://vosonlab.net>) Lab & School of Sociology, Australian National University)

This workshop will introduce participants to two open source R packages for online network collection and analysis:

- vosonSML (<https://github.com/vosonlab/vosonSML>) - an R package providing a suite of tools for collecting and constructing networks from social media data. It provides easy-to-use functions for collecting data across popular platforms (Twitter, Reddit and YouTube) and generating different types of networks for analysis.
- VOSON Dashboard (<https://github.com/vosonlab/VOSONDash>) - an R/Shiny application providing a graphical user interface for collecting and analysing online networks and associated text data. It builds on a number of R packages, in particular igraph (for network analysis) and vosonSML.

Participants will be shown how to install vosonSML and VOSON Dashboard, and the basic operation of these tools. Workshop materials will include notes on analysis of online networks, and examples of research.

Workshop 5: 1pm-2:30pm AWST (4:00pm-5.30pm AEST)

A review of advanced use of SAOM

Johan Koskinen (University of Melbourne, Social Networks Laboratory)

This is a 90 minute workshop with brief examples of extensions to stochastic actor-oriented model to longitudinal networks. It is assumed that you have some basic experience of using the standard selection and influence models, including running standard diagnostics. We will cover some recent extensions, such as analysis of multiplex ties, the joint evolution of one-mode and two-mode networks, influence models for continuous outcomes, and multilevel analysis using multigroup and sienaBayes. A focus will be put on data formats and some key interpretative issues in working with the output. Example code will be provided and a laptop with R and the packages RSiena, sna, and network is required for following the workshop.

Workshop 6: 1pm-2:30pm AWST (4:00pm-5.30pm AEST)

An overview of advanced uses of ERGMs

Peng Wang, Colin Gallagher, James Coutinho, Maedeh Aboutalebi Karkavandi, Dean Lusher (Swinburne University, MelNet Social Network Research Group)

This is a 90 minute workshop with brief examples of extensions to exponential random graph models. The focus of this course will be on more advanced forms of cross-sectional network data, including directed, bipartite, and multilevel network data. It is assumed that you have some basic experience of using the standard selection models (e.g., ERGMS). Example datasets will be provided. A focus will be put on data formats, common trouble shooting, and some key interpretative issues. A Windows laptop is required for following the workshop.

Conference Schedule

All times are: **Australian Western Standard Times (AWST, Perth Australia)**

Thursday, November 26 th , 2020	
8:00 - Welcome	Kirsten Martinus
8:15 – 9:30 - Plenary Address	Introduction – Garry Robins (University of Melbourne and Swinburne University of Technology) Lucia Falzon (Defence Science and Technology, Australia; University of Melbourne) On Sequence and Timing: Mapping the Trajectory of SNA research at DST(O)
9:30 – 11:00 Session 1: Social Relationships and Cultural Networks Chair - Yoshihisa Kashima	<p>9:30-9:45 - Triad Census and mental models Charles Kirschbaum (Inspere, Brasil)</p> <p>9:45-10:00 - Positive relationships, energising and wellbeing in social enterprise Rachel Taylor (Swinburne University of Technology)</p> <p>10:00-10:15 - Overcoming choice homophily under wealth disparities in dynamic social networks Jiayu Chen, Tasuku Igarashi (Nagoya University)</p> <p>10:15-10:30 - Taboo ties: how social structure constrains and enables ties of friendship and romance Michael Genkin, Johan Koskinen (University of Melbourne)</p> <p>10:30-10:45 - Social network analysis and visualisation tools within a ceramic art studio Graham Hay (Curtin University)</p> <p>10:45-11:00 - Ideology, Communication, and Polarisation Yoshihisa Kashima, Andrew Perfors, Vanessa Ferdinand, Elle Pattenden (University of Melbourne)</p>
11:00-11:15	Coffee break – bring a snack to the Social Room

<p>11:15 – 12:45</p> <p>Session 2:</p> <p>Crime, Violence and Illicit Use Networks</p> <p>Chair – Roberto Musotto</p>	<p>11:15 – 11:30 – Inside Mafia networks</p> <p>Roberto Musotto (Edith Cowan University)</p> <p>11:30 – 11:45 - A preliminary investigation of organised violence in virtual markets in comparison to illicit markets</p> <p>Robert Fleet (Australian National University)</p> <p>11:45 – 12:00 – Pulping Pelalawan: the political economy of corrupt forestry networks in Riau, Indonesia</p> <p>Jacqui Baker (Murdoch University)</p> <p>12:00 – 12:15 – Revealing social bot communities through coordination detection during the 2020 US Democratic and Republican National Conventions</p> <p>Derek Weber^{1,2}, Mehwish Nasim^{3,4,5}, Lucia Falzon^{2,6}, Lewis Mitchell^{1,5} (¹University of Adelaide; ²Defence Science and Technology, Australia; ³Data61, CSIRO; ⁴Cyber Security Cooperative Research Centre; ⁵ARC Centre of Excellence for Mathematical and Statistical Frontiers, Adelaide; ⁶University of Melbourne)</p> <p>12:15 – 12:30 - A novel network-based approach to detecting and analysing coordinated inauthentic behaviour on Twitter</p> <p>Timothy Graham¹, Robert Ackland², Lewis Mitchell³ (¹Queensland University of Technology; ²Australian National University; ³University of Adelaide) https://pypi.org/project/coordination-network-toolkit/</p>
<p>12:30 – 12:45</p>	<p>Conference break</p>
<p>12:45 – 13:45</p>	<p>Bring your lunch and meet colleagues in the Social Room</p> <p>Come see poster presentations:</p> <p>1) Hien Thi Nguyen (University of Western Australia)</p> <p>A depiction of social support networks in facilitating Vietnam-born parent visitors' social well-being in Australia</p> <p>2) Robert Ackland, Francisca Borquez, Bryan Gertzel (Australian National University)</p> <p>Analysing Dynamic Online Networks with VOSON R Tools</p>

<p>13:45 – 15:15</p> <p>Session 3: Analysing Networks</p> <p>Chair – Pavel Krivitsky</p>	<p>13:45 – 14:00 - Relational ambivalence in domestic violence: a mixed methods social network approach </p> <p style="text-align: right;">Elisa Bellotti (University of Manchester)</p> <p>14:00 – 14:15 - Locating power in social network analysis</p> <p style="text-align: right;">Dan Chamberlain (La Trobe University)</p> <p>14:15 – 14:30 - It's models all the way down: operator terms and other building blocks for specifying increasingly complex network models</p> <p style="text-align: right;">Pavel N. Krivitsky (University of New South Wales)</p> <p>14:45 – 15:00 - Bayesian variational inference for exponential random graph models</p> <p style="text-align: right;">Tan Siew Li Linda (National University of Singapore)</p> <p>14:30 – 14:45 - Analysing networks of networks</p> <p style="text-align: right;">Johan Koskinen¹, Pete Jones¹, Darkhan Medeuov², Artem Antonyuk², Kseniia Puzyrev², Nikita Basov² (¹University of Melbourne, ²St Petersburg University, Russia)</p> <p>15:00 – 15:15 - Modelling ensembles of networks via infinite mixtures of exponential random graph models</p> <p style="text-align: right;">Sa Ren (University of Kent, UK)</p>
<p>15:15 – 15:30</p>	<p>Conference break – bring a coffee to the Social Room</p>
<p>15:30 – 17:00</p> <p>Session 4: Corporate Urban, Industry and Organisational Networks</p>	<p>15:30 – 15:45 - Reconsideration of role of professional networks of tourist agents during COVID-19 pandemic</p> <p style="text-align: right;">Deniza Alieva (Management Development Institute of Singapore in Tashkent, Uzbekistan)</p> <p>15:45 – 16:00 - City network and industrial interdependence via interlocking directorates: the case of Australia</p> <p style="text-align: right;">Bo Guo¹, Kirsten Martinus¹, Thomas Sigler² (¹University of Western Australia, ²University of Queensland)</p> <p>16:00 – 16:15 - Multilevel trust in a global advanced manufacturing organization</p> <p style="text-align: right;">James A. Coutinho¹, Seong Won Yang², Peng Wang¹, Dean Lusher¹, Joe Labianca² (¹Swinburne University of Technology, ²University of Kentucky)</p>

 **Overflow presentation from Session 2: Crime, Violence and Illicit Use Networks**

Chair - Julia Loginova	<p>16:15 – 16:30 - Global city networks of firms: the emergence of multiplex ties from multiple network layers Julia Loginova¹, Thomas Sigler¹, Kirsten Martinus² (¹University of Queensland, ²University of Western Australia)</p> <p>16:30 – 16:45 – Networks structures and dynamics in the internationalisation of Australian junior mining firms in Latin America: copper and lithium Adriana Nunez¹, Kirsten Martinus¹, Thomas Sigler² (¹University of Western Australia, ²University of Queensland)</p> <p>16:45 – 17:00 - The network structure of success: evidence from an empirical study of European patents Alex Stivala, Alessandro Lomi (Università della Svizzera Italiana)</p>
17:00 Close of day 1	

Friday, November 27th, 2020

Friday, November 27th, 2020	
<p>8:15 – 9:30</p> <p>Session 5: Health Care Networks</p>	<p>8:15 – 8:30- Using SNA to examine a network’s capacity to address cancer- and tobacco-related disparities among Asian American, Native Hawaiian, and Pacific Islander populations in the United States Linda M. Bosma¹, Rod Lew² (¹Bosma Consulting, USA; ²Asian Pacific Partners for Empowerment Advocacy and Leadership, USA)</p> <p>8:30 – 8:45 – The use of mixed-methods to study social networks: a scoping review Jovana Sibaliija, Carri Hand, Colleen McGrath, Gail Teachman, Marianne Larsen (Western University, London, Canada)</p> <p>8:45 – 9:00 – Optimising Isolation, quarantine and distancing for COVID-19: the role of networks Dean Lusher¹, Margaret Hellard^{2,3}, Katherine Gibney⁴, Alisa Pedrana³, Mark Stoové³, Nick Scott^{2,3}, Rachel Sacks-Davis^{2,3}, Anna Bowring³, Anna Wilkinson^{2,3}, Johan Koskinen⁴, Garry Robins⁴, Colin Gallagher¹, Peng Wang¹, Maedeh Aboutalebi Karkavandi¹, Bopha Roden¹, Giovanni Sadewo Radhitio Putra¹, Petr Matous⁵, Chiara Broccatelli⁶ (¹Swinburne University of Technology; ²Monash University; ³Burnet Institute; ⁴University of Melbourne; ⁵University of Sydney; ⁶University of Queensland)</p>

<p>Chair - Peng Wang</p>	<p>9:00 – 9:15 - Dementia risk education: teaching some and reaching more Hannah Fair, Kathleen Doherty, Claire Eccleston, Shannon Klekociuk, Maree Farrow (University of Tasmania)</p> <p>9:15 – 9:30 - Evaluating the social ties in recruitment of doctors into the rural workforce in remote WA Bek Ledingham¹, Denese Playford¹, Yulia Shiikha¹ (¹Rural Clinical School of Western Australia)</p>
<p>9:30-10:00</p>	<p>Coffee break – bring a snack to the Social Room</p>
<p>10:00 – 11:30</p> <p>Session 6: Social Media Networks</p> <p>Chair - Mehwish Nasim</p>	<p>10:00 -10:15 - Using semantic network analysis to identify meaning structures on Twitter Robert Ackland (Australian National University)</p> <p>10:15 -10:30 - Examining the temporal dynamics of an online social movement Martin Wood¹, Lucia Falzon^{1,2}, John Dunn¹, Bradley Donnelly¹, Danielle Iannella¹, & Trevor Tao¹ (¹Defence Science and Technology, Australia; ²University of Melbourne)</p> <p>10:30 -10:45 - Discussion networks and deliberation on Twitter: how did climate strikes change deliberation about climate change? Yuanyuan Shang, Joan Leach, Robert Ackland, Will Grant (Australian National University)</p> <p>10:45-11:00 - #ArsonEmergency and Australia’s “Black Summer”: a study of polarisation and its broader effect on the online discussion Derek Weber^{1,2}, Mehwish Nasim^{3,4,5}, Lucia Falzon^{2,6}, Lewis Mitchell^{1,5} (¹University of Adelaide; ²Defence Science and Technology, Australia; ³Data61, CSIRO; ⁴Cyber Security Cooperative Research Centre; ⁵ARC Centre of Excellence for Mathematical and Statistical Frontiers, Adelaide; ⁶University of Melbourne)</p> <p>11:00 – 11:15 – An empirical study to evaluate the persistence of polarised communities in social networks Mehwish Nasim^{1,2,3}, Derek Weber^{4,5}, Lucia Falzon^{5,6}, Lewis Mitchell^{3,4} (¹Data61, CSIRO; ²Cyber Security Cooperative Research Centre; ³ARC Centre of Excellence for Mathematical and Statistical Frontiers, Adelaide; ⁴University of Adelaide; ⁵Defence Science and Technology, Australia; ⁶University of Melbourne)</p> <p>11:15 – 11:30 - Understanding the impact of technology in the time of crisis for building human connections Bibhu Kalyan Nayak¹, Pushkala Rajan¹, Majdi Faleh² (¹Manipal University Jaipur, India; ²University of Western Australia)</p>

11:30 – 11:45	<i>Presentation of Inaugural Pip Pattison Award</i> Announcement of Winner by: Pip Pattison Deputy Vice Chancellor, The University of Sydney
11:45 – 12:45	Bring your lunch and meet colleagues in the Social Room
12:45 – 14:15 Session 7: Multi-Stakeholder Networks and Collaborations Chair - Bopha Roden	<p>12:45 – 13:00 - The interplay between trust and collaboration among scientists engaged in the commercialisation of public research Bopha Roden, Dean Lusher, Peng Wang, Tom Spurling, Greg Simpson (Swinburne University of Technology)</p> <p>13:00 – 13:15 - University-industry collaboration: network dynamics of research contracts and grants in an Australian university Colin Gallagher¹, Dean Lusher¹, Johan Koskinen², Peng Wang¹, Aaron Gosling², Anastasios Polyzos², Martina Stenzel³, Sarah Hegarty¹, Tom Spurling¹ (¹Swinburne University of Technology, ²University of Melbourne, ³University of New South Wales)</p> <p>13:15 – 13:30 - Capturing the voice of community stakeholders in infrastructure projects Vivian Pao (University of Sydney)</p> <p>13:30– 13:45 - Networking for gender-equitable climate-smart agriculture Steven Crimp¹, Rachel Friedman¹, Ellis Mackenzie², Tom Sloan², Nicole Sweaney² (¹Australian National University, ²Sustineo Pty Limited)</p> <p>13:45 – 14:00 - Migration and knowledge networks in peripheral farming villages in Sumatra Indonesia Ayu Pratiwi¹, Petr Matous², Kirsten Martinus³ (¹University of Turku, ²University of Sydney, ³University of Western Australia)</p> <p>14:00 – 14:15 - Co-evolution of a multilevel scientific network: extended features for goodness of fit in complex networks Alejandro Espinosa-Rada¹, Elisa Bellotti¹, Martin Everett¹, Christoph Stadtfeld² (¹University of Manchester, ²ETH Zürich)</p>
14:15 – 14:30	Conference break – bring a coffee to the Social Room
14:30 – 15:45 Plenary Address	Introduction – Kirsten Martinus (University of Western Australia) Emmanuel Lazega (Sciences Po) Judges, lawyers, priests and scientists: Lessons from a sociological approach to comparing social networks

<p>15:45 – 17:15</p> <p>Session 8: Policy and Governance Networks</p> <p>Chair - Jordan Tchilingirian</p>	<p>15:45 – 16:00 - <u>Centralization of communication networks in communities of smallholder farmers and fertilizer use†</u> Petr Matous¹, Orjan Bodin² (University of Sydney¹, Stockholm Resilience Centre²)</p> <p>16:00 – 16:15 - <u>Who speaks for social impact bonds? An analysis of co-authorship networks of policy intellectuals</u> Jacob Broom, Jordan Tchilingirian (University of Western Australia)</p> <p>16:15 – 16:30 - <u>Speaking the same language: how successful lobbyists leverage social capital and messaging to gain access</u> Jon MacKay (University of Auckland)</p> <p>16:30 – 16:45 - <u>Towards a theory of conflict and cooperation in network governance: positive, negative and “induced” ties in social ecological networks</u> Garry Robins¹, Örjan Bodin², Maria Mancilla Garcia² (¹University of Melbourne and Swinburne University of Technology, Stockholm Resilience Centre²)</p> <p>16:45 – 17:00 - <u>Who funds them?: A mixed method social network analysis of disclosed funding relationships within the British tanks tank community</u> Jordan Tchilingirian (University of Western Australia)</p> <p>17:00 – 17:15 - <u>Explaining the Persistence of “decentralisation” of education in Egypt</u> Dina Abdelazeem (based on PhD, University College London, independent researcher)</p>
<p>17:15 Closing Remarks</p>	<p>Closing Remarks – Kirsten Martinus, Roberto Musotto, Jordan Tchilingirian</p> <p>Hand over to Sunbelt 2022 as the next meeting of ASNAC – Dean Lusher</p>

† Overflow presentation from Session 7: Multi-Stakeholder Networks and Collaborations

Poster Presentations

1. A depiction of social support networks in facilitating Vietnam-born parent visitors' social well-being in Australia

Hien Thi Nguyen (University of Western Australia)

Social support networks established by the engagement of family members, friends, and significant others are crucial to the well-being of people by providing diverse forms of care, including emotional (cared about), instrumental (financial & physical), and informational support. These social support networks become particularly critical in the context of international migration, including the transnational mobility of older people, for example, the growing phenomenon of grandparent visits. In the past when information and communication technologies (ICTs) and new media were limited, migrants largely relied mostly on new local social support networks to facilitate their transition, adaptation and settlement. Today, the polymedia environments created by ICTs and new media blur geographical boundaries and facilitate the development of distant and virtual social support networks¹. As a result, distant members of support networks also participate in the process of migrants' transition, adaptation, and settlement in the host country².

Based on the PhD project "*Growing older overseas: how older Vietnam-born people are experiencing ageing and aged care in Australia*", this poster highlights the importance of virtual and distant social support networks in facilitating Vietnam-born grandparent visitors' social well-being in Australia. Applying a social network analysis approach to analyse 10 ethnographic interviews, this research depicts how Vietnam-born long-term grandparent visitors rely on different virtual and distant forms of care exchange to support their social well-being. Social well-being in this context is defined at the individual level, as comprising their perceptions of the quality of the relationships established and maintained within social networks of family, friends and significant others such as neighbours and (former) colleagues³. Using an interviewee Ms Dang's example, this research shows that Vietnam-born grandparent visitors rely heavily upon their strong ties with distant network members back in their home country to support their social well-being in the host country through virtual and distant care. It can be seen that three-fifths of Ms Dang's strong ties are based in Viet Nam. Although Ms Dang has also formed two new social ties with some Vietnam-born friends in Australia, she practises daily internet-based interactions (video calls and online chats) to sustain her distant and virtual networks with families and friends in Viet Nam. Hence, the majority of Ms Dang's social support networks are distant and virtual. Like Ms Dang, 9 other grandparent visitors in the research sample receive significant social support and care online, building and sustaining their social and kin ties in the digital world. Two significant factors, including poor English and driving capacities, are the main barriers limiting grandparent visitors' development of new social ties in the host country. Thus, Vietnam-born grandparent visitors tend to prefer nurturing their social bonds and kinship with existing ties already formed in their home country. This plays a significant part in ensuring their social well-being during their extended visits in Australia.

¹MADIANOU, M. & MILLER, D. 2012. Polymedia: Towards a new theory of digital media in interpersonal communication. *International journal of cultural studies*, 16, 169-187.

²BALDASSAR, L., WILDING, R., BOCCAGNI, P. & MERLA, L. 2017. Aging in place in a mobile world: New media and older people's support networks. *A Social Work Journal*, 7, 2-9.

³CANTY-MITCHELL, J. & ZIMET, G. D. 2000. Psychometric Properties of the Multidimensional Scale of Perceived Social Support in Urban Adolescents. *American Journal of Community Psychology*, 28, 391-400.

2. Analysing Dynamic Online Networks with VOSON R Tools

Robert Ackland, Francisca Borquez, Bryan Gertzel (Australian National University)

The VOSON R tool suite consist of two packages available on GitHub and CRAN: vosonSML and VOSON Dashboard. vosonSML is an R package for collecting and constructing networks from social media data (currently Twitter, YouTube and Reddit) and generating different types of networks for analysis. VOSONDash is an interactive R Shiny web application for the collection (via vosonSML), visualisation and analysis of social media network data. The networks collected via vosonSML are dynamic – in Twitter networks, for example, the reply/mention/retweet edges have an attribute for the timestamp of the tweet. However, at present, VOSON Dashboard only allows visualisation and analysis of static networks. This poster presentation focuses on the use of line graphs (e.g. Moody 2009) as a way of providing static representations of dynamic large-scale social media network data. We evaluate various R packages such as tsna that can be used to incorporate dynamic line graphs into VOSON Dashboard, with an application to a large-scale dataset covering one year of Twitter activity focusing on Australian politics.

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Conference Sessions

Session 1: Social Relationships and Cultural Networks (6)

1. Triad Census and Mental Models

Charles Kirschbaum (Inspere, Brazil)

Sociology of culture has proposed diverse models to formalize culture (e.g. Fuhse et al, 2019; Mohr et 2020). In this paper, I propose inferring individual culture from individuals' perception of potential ties. Specifically, I interviewed 35 rappers in São Paulo and showed a fixed roster of consecrated Brazilian rappers. For each rapper in the list, interviewees had to nominate other musicians in the roster to 'whom that musician could open the concert for'. Hence, the potential ties are potential 'acts of deference' ties, akin to network status. As a consequence, I obtained 35 networks. These different networks are compared in their propensity of forming triad configurations (Faust, 2010; Skvoretz et al 2004). Individual differences reveal varying tolerance to intransitive structures, which are compared to other relevant individual characteristics.

2. Positive relationships, energising and wellbeing in social enterprise

Rachel Taylor (Swinburne University of Technology)

Social enterprises are organisational entities that trade to improve the quality of life in the communities they serve. As social enterprises typically operate under significant resource constraints, optimising human capital is key to sustaining the organisation and achieving social outcomes. However, little is known about the lived experience of working in social enterprise, in particular, the nature of work relationships and the wellbeing of social enterprise staff. Research to date examining the wellbeing outcomes for social enterprise beneficiaries suggests that psychosocial factors (e.g., increased confidence, sense of purpose, sense of worth, empowerment, reduced marginalisation, social capital) play key roles, however, these factors have not been examined in an integrated way and have not been examined for employees.

This paper presents preliminary findings from a case study of two Australian work-integrated social enterprises. The study applies a mixed methods approach, incorporating social network analysis, wellbeing measurement, and in-depth interviews to explore the structure and determinants of key relational networks in a social enterprise context. A particular focus is given to energising relationships, which can be described as interactions or ties that provide a heightened sense of psychological resourcefulness or capacity. Findings reveal high levels of wellbeing, and dense energising, trust and support networks, along with the key attributes of energising individuals. An exploration of factors that contribute to the relational structures include organisational and relational practices that are need-satisfying by supporting worker's sense of stability, safety, belonging, identity, and meaning, and buffer against marginalisation. The study provides insights into the ways in which social enterprises contribute to their social mission by providing workers and beneficiaries with stable, meaningful and fulfilling work.

Keywords: social enterprise, wellbeing, relational energy, work—relational aspects

3. Overcoming choice homophily under wealth disparities in dynamic social networks

Jiayu Chen and Tasuku Igarashi (Nagoya University)

How people can overcome choice homophily based on initial wealth disparities, which aggravates inequality and segregation in social networks (DiMaggio & Garip, 2012; Nishi et al., 2015), is one of the central questions to be resolved in the world. The current research examined whether information about partner's cooperativeness is more critical in partner selection than the similarity of the amount of resources between the self and partners. We conducted an iterated public goods game (PGG) in which participants were assigned to a rich group and privileged to choose rich or poor partners (programmed bots) at each round. When partners' cooperativeness was not presented, participants showed a strong preference for the choice of rich partners. However, when both initial endowments and last round contribution ratio of potential partners (cooperative or selfish) were presented, participants tended to choose partners based more on their cooperativeness than on their initial endowments. Also, participants who chose the cooperative poor and shared their resources with them in advance of PGG increased the amount of investment in the main PGG. The current findings suggest possible ways to promote the formation of productive rich-poor ties by letting people know about the goodness of potential partners and by implementing the micro-investment system to produce better outcomes in future joint activities.

4. Taboo Ties: How Social Structure Constrains and Enables Ties of Friendship and Romance

Michael Genkin, Johan Koskinen (University of Melbourne)

This study seeks to investigate how two basic types of network ties – friendship and romance – relate to one another over time at the network level. It is hypothesized that specific taboo and eligibility norms influence the co-evolution of the two networks by systematically constraining which new friendship ties may form given a person's past/existing romantic ties and which romantic ties may form given a person's past/existing friendship ties. We further compare how the norm mechanism works differently when friendship interacts with romantic ties as contrasted to when friendship interacts with (non-romantic) sexual ties. Alternative explanations such as propinquity and homophily are also considered and tested. The study uses the Romantic Pairs Add Health Data for the longitudinal romantic/sexual ties network and the Restricted Add Health Data for the longitudinal friendship ties network. Data are analyzed using stochastic actor-oriented models (SAOM) where constraints are construed as conditional, multiplex propensities for tie-formation and deletion.

5. Social Network Analysis and Visualisation tools within a ceramic art studio

Graham Hay (Curtin University)

Social network analysis of artists focussed on established practitioners working within formally organised events or organisations. Network analysis and visualisation research have been undertaken on professional classical music composers (1), a contemporary music group (2), artists' collectives (3), art organisations (4, 5, 6,7), and serious leisure groups (8). Analysis of emerging artists, within less formal structures, is less prevalent.

Network analysis of emerging visual artists is particularly challenging for some art forms. It is difficult to identify significant networks where emerging visual artists work in social isolation and predominately exhibit in small events, within short-lived venues. It is challenging to even find emerging professional visual artists in some disciplines such as ceramics. Specialist training for the ceramic arts profession is no longer provided in Australian universities and is rapidly disappearing from TAFE colleges. This is despite escalating demand for community-level recreational ceramic class and teachers on a global scale.

All these challenges necessitate a practice-led auto-ethnographical research method. This mixed-method investigation of ceramic art networks uses both sculptural and social network analysis as visualisation tools. The former method uses continuous creative hand building in clay and other medium, ongoing evaluation of the realised 3D concepts, and self-reflection on subjective network experiences. The latter method visualises five years of unstructured attendance by 330 adults within studio-based ceramic art classes, as an aid to visualise students' networks.

The mixed-method research generates data that will assist in assessing and stimulating discussion on the role and value of artists' networks. Particularly networks within and around artists' studio-based classes. The findings test the hypothesis that professional artists now emerge from amateur ceramic art networks, as had occurred fifty years ago before ceramics was absorbed by the formal education system (9). Limitations and implications of the research are discussed.

Key words: artists, social network analysis, visualisation, ceramics, sculpture, andragogy

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6. Ideology, Communication, and Polarisation

Yoshihisa Kashima, Andrew Perfors, Vanessa Ferdinand, Elie Pattenden (University of Melbourne)

Ideologically committed minds form the basis of political polarisation, but ideologically guided communication can further entrench and exacerbate polarisation depending on the structures of ideologies and social network dynamics on which cognition and communication operate. Combining a well-established connectionist model of cognition and Friedkin and his colleagues' (2016) computational model of social influence dynamics on social networks, we develop a new model of ideological cognition and communication on dynamic social networks and explore its implications for ideological political discourse. In particular, we explicitly model ideologically filtered interpretation of social information, ideological commitment to initial opinion, and communication on dynamically evolving social networks, and examine how these factors combine to generate ideologically divergent and polarised political discourse. The results show that ideological interpretation and commitment are foundational to polarised discourse. Nonetheless, communication and social network dynamics tend to accelerate and amplify polarisation. Furthermore, when agents can sever social ties with those that disagree with them (i.e., structure their social networks by avoiding heterophily), even non-ideological agents may form an echo-chamber and form a cluster of opinions that resemble an ideological group. In all, our simulations suggest ideological cognition and social network dynamics interact under different social-technological circumstances to generate different types of consensualization-polarization in public opinion dynamics.

Session 2: Crime, Violent and Illicit Use of Networks (6)

1. Inside Mafia Networks

Roberto Musotto (Edith Cowan University)

The Sicilian Mafia (Cosa Nostra) has a pervasive control in its territory. Far from the rustic chivalry of its origins, it is a criminal organisation that has managed to evolve and adapt over the decades through violence and powerful connections. Finding insights about its structure is more crucial than ever in the constant fight into its annihilation.

This book suggests an economic analysis of the internal structure of the Sicilian Mafia. It does so by applying social and spatial network analysis to an original dataset of a large group of Cosa Nostra members, built from judicial sources on the investigation named *Operazione Perseo*, a recent anti-mafia operation that resulted in the arrest of a large number of *mafiosi*.

The novel aspect of the analysis is the geo-localization of the members of Cosa Nostra identified by the police operation in the territory of the city and province of Palermo (Sicily), together with the identification of the links among them. This allows an empirical estimate of how space, in terms of the geographical localization of the Cosa Nostra members, affects the organization and evolution of this network of criminals.

The role of space in shaping the network structure of the Sicilian Mafia has not so far been considered in the literature, although space is a fundamental aspect for its functioning and the success of the criminal organisation.

Results challenge classic ideas of a vertical hierarchical organisation in favour of a more horizontal structure, where multiple families are intertwined one to the other in an ever constant race to the top and competing in the control and exercise of power in the town of Palermo, Italy.

2. A Preliminary Investigation of Organised Violence in Virtual Markets in Comparison to Illicit Markets

Robert Fleet (Australian National University)

Building on Fleet & Nummikko-Fuller (2019) which investigated 11 hours of data gathered from the MMO *Eve Online*, this paper aims to demonstrate that there are similar patterns of behaviour that are observed between the virtual world and the physical world. Given the virtual world's potential for larger sample sizes and increased observation of activities the paper will demonstrate that the virtual world holds insights into the characterisation of organised groups who use violence. Additionally, the activities of the in-game police force may uncover patterns of interest to the study of both lone wolf and group-motivated suicide attacks. This paper extends the investigation to look at 1% of the total data gathered (500 files of 50000). However, 1% of the data does contain the actions of 117014 individuals (nodes) and 1472082 violent contacts (edges) between these individuals. The data represents roughly 2 months of actions (24/05/2012 – 30/07/2012). Also captured is the actions of an in-game "Police Force" (CONCORD) which responds to transgressions of the game's rules around allowable violence (accounting for 0.12% of all edges). The investigation will look at patterns of behaviour at a macro scale (all nodes and edges) as well as breaking the larger graph down in to some meso- and micro- level interactions for clarity. This will be done by identifying the top 5 individuals, corporations (smaller groups of collaborating individuals) and alliances (larger collectives of corporations) by out-degree and describing the patterns and graph metrics observed. The paper will also look at other factors such as the top 5 locations, times and ships used (ships being an approximate measure of the level of violence/force used in the encounter). A brief discussion of some of the limitations of working with, interpreting and visualising larger datasets encountered in the analysis will be presented. Results will be discussed firstly in the context of the game mechanics to highlight the way in which the players themselves utilise violence. Subsequently, drawing on the current organised crime and gang literature a comparison between the patterns observed in the virtual world and physical world will be made.

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3. Pulping Pelalawan: The political economy of corrupt forestry networks in Riau, Indonesia

Jacqui Baker (Murdoch University)

The burgeoning analysis of corrupt network approaches corruption as if it were a subset of criminal networks. As such, the study of these illegal networks revolves around the core question of how network structures are shaped and reshaped within a hostile environment of law enforcement. In this paper, I present an analysis of a corrupt network of over 200 forestry actors operating in Pelalawan, Riau whose illegal actions ultimately led to the pulping of thousands of hectares of pristine lowland forest for pulp and paper industry. I present the main descriptive statistics of this corrupt network, highlighting its social composition, its main organizational structures, its enablers and how resources flowed through it. Ultimately, I show how the structure of this network demonstrates the real and perceived impunity that its actors enjoyed. I argue that the study of corrupt networks needs to combine network analysis with a deep and critical understanding of underlying political economy dynamics. This paper has been supported by the Indonesian Anti-Corruption Commission, U4 Anti-Corruption Resource Centre and the German Development Fund.

4. Revealing social bot communities through coordination detection during the 2020 US Democratic and Republican National Conventions

Derek Weber^{1,2}, Mehwish Nasim^{3,4,5}, Lucia Falzon^{2,6}, Lewis Mitchell^{1,5} (¹University of Adelaide; ²Defence Science and Technology, Australia; ³Data61, CSIRO; ⁴Cyber Security Cooperative Research Centre; ⁵ARC Centre of Excellence for Mathematical and Statistical Frontiers, Adelaide; ⁶University of Melbourne)

Efforts to influence public opinion online, especially during times of political relevance, such as election campaigns, have grown since first observed in 2010, and are feared to be a particular threat to the upcoming US Presidential election. A significant component of such efforts has consisted of the use of *social bots* to quickly disseminate vast amounts of polarizing information, propaganda and biased opinion. As social bots are intended to mimic humans on social media, it is often difficult for other humans to identify them easily, but as there are also legitimate uses for online automation, the social media platforms also struggle to contain them, especially with the vast number of users they manage. Previous research has developed methods to detect influence campaigns in general, as well as specifically focusing on identifying social bots, including examining how they interact with other accounts and influence the broader political discussion.

In this talk, we discuss preliminary results from analysis of Twitter activity over the recent 2020 Democratic and Republican National Conventions, at which the parties formally nominated their candidates for President and Vice President. Each convention ran for four days, during which we collected 3m tweets. In particular, we apply techniques for discovering highly coordinating communities based on potentially coordinated behaviours: co-retweeting, co-mentioning of hashtags, and URL sharing. In doing so, we reveal groups of accounts engaging in potentially inauthentic behaviour, and identify classes of participating accounts, including social bots, campaign accounts, news accounts, and regular Twitter users. A variety of analyses of content and temporal patterns exhibited by the communities provide qualitative and quantitative validation, along with discussion of different behaviour patterns observed between the conventions. The ultimate aim is to distinguish between legitimate use of online influence activities (e.g., by political parties and grass roots campaigns) from covert malicious ones.

5. A novel network-based approach to detecting and analysing coordinated inauthentic behaviour on Twitter

Timothy Graham¹, Robert Ackland², Lewis Mitchell³ (¹Queensland University of Technology; ²Australian National University; ³University of Adelaide)

Online disinformation is a global problem that requires urgent attention. Defined as the spreading of information that is false and deliberately created to harm a person, social group, organization or country (Wardle & Derakhshan, 2017, p. 20), disinformation is difficult to identify and prevent. Coordinated disinformation operations are now occurring in at least 48 countries (Howard et al., 2018). In 2019 alone, the European External Action Service exposed over 1,000 cases of disinformation within the European Union (European Commission, 2019). This problem is so widespread that even Facebook have acknowledged it and introduced the term *coordinated inauthentic behaviour* (herein CIB) to encompass their efforts to address it (Facebook, 2018).

There is an urgent imperative to distinguish between genuine organic and CIB. To date, machine learning based approaches have been primarily used to detect inauthentic actors and content such as bots (Varol et al., 2017), trolls (Galán-García et al., 2016), and misleading and false content (Shao et al., 2016). However, these approaches have been criticised for their validity (e.g. misclassifying people as bots) and their inability to detect *coordinated* patterns of behaviour between them, given the focus on individual actors and content items.

Network-based approaches have therefore been recently proposed, which respecify the problem as a relational one – i.e. how can networks reveal the structural patterns of coordination that underpin CIB? In this paper, we report on cutting-edge network methods to construct coordinated message networks using Twitter data. We illustrate these methods through a case study of CIB during the 2020 US Presidential election, and highlight problems and opportunities for future work.

<https://pypi.org/project/coordination-network-toolkit/>

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6. Relational ambivalence in domestic violence. A mixed methods social network approach

Elisa Bellotti (University of Manchester)

Domestic violence is a relational dynamic that does not only involve a victim and a perpetrator, but the whole social environment around them. This environment plays a crucial role in the dynamics of the abusive relationship, especially in the victim's decision to report the abuse. While current literature looks at personal network as a source of support, this paper proposes the theoretical concept of relational ambivalence. Ambivalent relationships are ties that the victim would expect to be a source of support, but that fail in offering it. I argue that relational ambivalence does not depend on the type of relationship or its strength, but on the relational dynamics between the victim and her social environment.

This theoretical conceptualization of relational ambivalence is explored and tested in a mixed method study that collected 19 in-depth interviews of women who filed a report to the police for domestic abuse. Victims also reconstruct their personal networks before and after they decided to report the violence to the police. The qualitative thematic analysis identifies the reasons why the victims perceive some of her personal relationships as ambivalent, while descriptive statistics identify the relational dynamics of such ties (their resilience or disappearance over time). Multilevel logistic regression analysis is then used to test which characteristics may explain the ambivalence of a tie, and its relational dynamics.

Results clearly indicate that ambivalent ties are not explained by any categorical aspect (being family, relatives, etc., or being female, or being strong or weak at time 1): their nature fully depends on the interactional dynamics within the victim, in the fact that they fail in recognising the relationship with the

perpetrator as abusive and in acknowledging the need of support of the victim. Likewise, ties maintenance and disappearance over time are only explained by their ambivalence nature.

Keywords: Domestic violence, social networks, mixed methods, egonets, ambivalent relationships, constructive relationships, network dynamics.

Session 3: Analysing Networks (5)

1. Locating power in social network analysis

Dan Chamberlain (La Trobe University)

Power is fundamental to understanding social processes, but the number of ways it's conceptualised and used make it difficult to pin down. Many conceptions of power state that power is an inherently relational property, i.e. that the power of actor A is proportional to the power of actor B. There are obvious applications for social network research, where relationships between actors is a central concern for the analysis.

However, power in social network research is rarely explicitly discussed or linked to analysis. Power is predominantly linked to individual position in terms of centrality, and situated in either social influence models or network exchange models. There are a small number of metrics explicitly theorised as related to power: eigenvector, Kreb's centrality power score, Bonacich's beta centrality; there are other measures that are also important to social influence measures, such as betweenness centrality.

The limited discussion of power has two significant and related issues. First, there are other analytical measures which should be linked to discussions of power, including core-periphery models, cliques, and factions, for example. These analyses focus on groups and their relation to others in the network; conceptualisations of power could be extended to explore how the power of groups of actors is proportional to other groups. Second, existing discussions of power are framed in terms of actor A's power over actor B, building upon Weberian conceptualisations. However, there are other ways to frame power including Arendt's formulation of power arising out of the concerted activities of a plurality of actors, or feminist theories in which power is embodied within systems.

This paper will discuss these limitations and the potential to develop a network theory of power – one in which the power of actors and groups is interdependent with each other, and affected by overall network structure.

2. It's Models all the Way Down: Operator Terms and other Building Blocks for Specifying Increasingly Complex Network Models

Pavel N. Krivitsky (University of New South Wales)

Popular frameworks for modelling network data and processes—whether Exponential-Family Random Graph Models (ERGMs), Stochastic Actor-Oriented Models (SAOMs), Relational Event Models (REMs), Dynamic Network Actor Models (DyNAMs), or others—are distinguished by their ability to represent a wide variety of social forces and structural properties of networks and interactions between them. These include exogenous effects of immutable actor and dyadic features and endogenous effects such as historical, degree, triadic, and other structures and effects of mutable actor features; and these can in turn be parametrised and combined in a variety of ways. The interactions of these exogenous and endogenous effects, along with other features of increasingly complex network data, such as valued relations, multiplicity of modes, multiplicity of layers, and multiplicity of levels, create a combinatorial explosion of substantively meaningful model formulations.

This is a challenge for all segments of network modelling. The applied researchers need to be able to formulate models for increasingly complex phenomena on increasingly complex network data. Network analysis software developers need to produce tools that are both increasingly flexible and highly computationally efficient. At their intersection of the two, languages and user interfaces to specify these increasingly complex models are needed.

In this work we apply to ERGM specifications the mathematical concept of *operators*—functions that operate on other functions. Using this language to interact, combine, filter, transform, and reparametrise

ERGM effects, enables network researchers to parsimoniously specify models with multiple forms and levels of complexity. At the same time, it enables implementations efficient in both programmer and computer time. We describe a variety of effects that can be integrated in this manner and demonstrate applications to complex network data.

3. Bayesian Variational Inference for Exponential Random Graph Models

Tan Siew Li Linda (National University of Singapore)

Deriving Bayesian inference for exponential random graph models (ERGMs) is a challenging “doubly intractable” problem as the normalizing constants of the likelihood and posterior density are both intractable. Markov chain Monte Carlo (MCMC) methods which yield Bayesian inference for ERGMs are asymptotically exact but computationally intensive. We develop a variety of variational methods for Gaussian approximation of the posterior density and model selection. These include nonconjugate variational message passing based on an adjusted pseudolikelihood and stochastic variational inference. To overcome the computational hurdle of drawing a network from the likelihood at each iteration, we propose stochastic gradient ascent with biased but consistent gradient estimates computed using adaptive self-normalized importance sampling. These methods provide attractive fast alternatives to MCMC for posterior approximation. We illustrate the variational methods using real networks and compare their accuracy with results obtained via MCMC and Laplace approximation.

4. Modelling Ensembles of Networks via Infinite Mixtures of Exponential Random Graph Models

Sa Ren (University of Kent, UK)

Ensembles of networks can be found in various fields where multiple independent networks are observed on the same kind of nodes, like a collection of friendship networks for different schools. In this context, the interesting information is the homogeneity and heterogeneity of the whole ensemble. Mixture models provide a natural framework to model a population. Exponential random graph models (ERGMs) represent the generating process of networks using network sufficient statistics through exponential distributions, which is a good choice for base distribution in mixture models. In this talk, we propose to model the ensembles of networks using infinite mixtures of exponential random graph models with Dirichlet Process prior, which allows both the cluster memberships and the ERGM parameters to be estimated at the same time. Here, we also develop a Metropolis-within-Slice Sampling algorithm to perform Bayesian inference for the proposed model, where an importance sampling estimation is used to facilitate the inference as ERGM contains intractable normalising constant. We demonstrate the performance of the proposed method with both simulated datasets and real datasets. Simulation results show that the proposed infinite mixture of ERGMs is capable of representing transitivity, homophily and clustering simultaneously without knowing the number of clusters in advance.

Keywords: Infinite mixture models; Exponential random graph models (ERGMs); Dirichlet process; Slice sampling; Metropolis algorithms

5. Analysing Networks of Networks

Johan Koskinen¹, Pete Jones¹, Darkhan Medeuov², Artem Antonyuk², Kseniia Puzyrev², Nikita Basov²
(¹University of Melbourne, ²St Petersburg University, Russia)

We consider data with multiple observations or reports on a network in the case when these networks themselves are connected through some form of network ties. We could take the example of a cognitive social structure where there is another type of tie connecting the actors that provide the reports; or the study of interpersonal spillover effects from one cultural domain to another facilitated by the social ties. Another example is when the individual semantic structures are represented as semantic networks of a group of actors and connected through these actors' social ties to constitute knowledge of a social group. How to jointly represent the two types of networks is not trivial as the layers and not the nodes of the layers of the reported networks are coupled through a network on the reports. We propose to transform the different multiple networks using line graphs, where actors are affiliated with ties represented as nodes, and represent the totality of the different types of ties as a multilevel network. This affords studying the associations between the social network and the reports as well as the alignment of

the reports to a criterion graph. We illustrate how the procedure can be applied to studying the social construction of knowledge in local flood management groups. Here we use multilevel exponential random graph models but the representation also lends itself to stochastic actor-oriented models, multilevel blockmodels, and any model capable of handling multilevel networks.

Keywords: Multiplex, Multilevel networks, Sociosemantic networks, Multigraphs

Session 4: Corporate Urban, Industry and Organisational Networks (6)

1. Reconsideration of role of professional networks of tourist agents during COVID-19 pandemic

Deniza Alieva (Management Development Institute of Singapore in Tashkent, Uzbekistan)

Networking in any professional field can bring positive results to the members of the network by providing them opportunity to track all the changes happening in environment, follow the trends and become aware of the news that may influence on the way they perform their work. In this sense communication and collaboration between companies in organizational and individual level can be crucial for such dynamic industries like tourism. Current situation with COVID-19 pandemic hit the industry heavily, leading to unemployment level increase, economic losses, and negative emotional and psychological consequences for industry workers.

The present research analyses the dynamics of professional social networks of tourist agents from Moscow and the region of Moscow (Russia). The data on networks were collected in three instances: twice before the pandemic and the last one – during pandemic crisis. Using longitudinal approach we could have seen how professional networks were changing throughout time, and analyze how these changes influenced on work performance and/or economic well-being of our egos. In the third period of data collection in addition online interviews were conducted, where we analyzed the perception of the networks from ego's perspective. In particular, we determined if they have used their networks to get new job and/or opportunity to gain money during pandemic, if the networks were used for helping organization in general to pass the crisis, etc.

The results have shown that networks help tourist agents in several ways, both in individual and organizational levels. On the one hand, they get support, contacts and opportunities for self-development, on the other – the agencies where they work obtain more possibilities to collaborate with each other and, consequently, create new tourist products and offer them to consumers.

2. City Network and Industrial Interdependence via Interlocking Directorates: The Case of Australia

Bo Guo¹, Kirsten Martinus¹, Thomas Sigler² (¹University of Western Australia, ²University of Queensland)

Largely drawn on social network analysis, two distinct but interrelated networks have been mapped and studied in regional economics and economic geography, namely, world city network and interlocking corporate directorates. By integrating two analytic frameworks, this paper aims to explore the relative importance of urban agglomeration externalities (intra-city corporate networks) *vis-à-vis* network externalities (inter-city corporate networks) in order to better understand city networks as a whole. Using the context of Australia as an example, this paper adopts board interlocks as a proxy quantifying corporate flows between firms, and applies social network analysis to investigate the interaction of publicly traded firms from all industrial sectors within Australian urban system. Focusing on the five largest Australian Greater Capital City Statistical Areas, we find the relative importance of intra-city and inter-city corporate networks varies significantly moving from city to city. While Perth being the only internally orientated city that has the largest intra-city corporate network, Sydney, Melbourne, Brisbane and Adelaide are all found to be externally orientated. By examining the industrial interdependence within and between cities, the results show that cities with a more diversified sectoral base tend to have a higher external connectivity. Despite the fact that the resulted city network can be partially explained by

geographic distance between cities, urbanisation economies (diversity) and localisation economies (specialisation) may also play an important role in explaining cities' connectivities and their networks. The findings of this paper contribute to the understanding of the interrelation between urban agglomerations and networks, and how they are spatially articulated.

3. Multilevel Trust in a Global Advanced Manufacturing Organization

James A. Coutinho¹, Seong Won Yang², Peng Wang¹, Dean Lusher¹ & Joe Labianca² (¹Swinburne University of Technology, ²University of Kentucky)

Trust is a psychological state which has been defined as the willingness to be vulnerable to the actions of another party, and can be treated as a characteristic of a relationship between two actors (a dyad). Trust is related to the willingness to assume risk, and consequent risk-taking behaviours. Collaboration in knowledge-intensive work involves a range of risks, such as willingness to rely on knowledge provided by others, willingness to admit ignorance, or willingness to take responsibility for others' actions. Therefore trust promotes effective work coordination by reducing risk perceptions in work relationships and allowing people with diverse skills to collaborate. Consequently, the emergence of trust is an important topic of enquiry for organizational scholars.

Network studies of organizational trust have focused on trust at the interpersonal level. However, organizations are multilevel social systems, with persons nested in groups such as departments, teams or sites; and relational dependencies among both persons and groups. Organizational trust is not only about interpersonal trust, but also involves perceptions of the trustworthiness of groups. This study uses a multilevel network perspective to understand how employees' perceptions of the trustworthiness of organizational departments are related to the structure of interpersonal trust networks among department members. We use data from an advanced design and manufacturing firm, where employees from 27 departments at 3 global sites work together to produce public artworks. We collected data on interpersonal trust, and on perceptions of the trustworthiness and performance of departments. In this presentation we report early results from analysis of our data which demonstrate the value of a multilevel network approach to organizational trust.

4. Global city networks of firms: the emergence of multiplex ties from multiple network layers

Julia Loginova¹, Thomas Sigler¹, Kirsten Martinus² (¹University of Queensland, ²University of Western Australia)

Empirical studies on interurban firm networks tend to analyse their spatial organisation by examining functional linkages between cities. Growing literature points out that these linkages are multiplex phenomena as urban networks can take many different forms. This paper will provide a novel approach to the analysis of multiplexity in the global city networks by creating and combining multiple network layers that correspond to regional, socio-cultural, hierarchical, functional, and 'command-and-control' functions of urban connectivity. Based on all possible combinations of layers, multiple ties can be obtained for each individual city. This approach has been empirically applied to a dataset of more than one million corporate relations connecting 5,287 cities in 169 countries and territories. Based on the analysis, cities were categorised into a typology according to commonalities and differences in their multiplex network relations using hierarchical cluster analysis. We find that cities with similar levels of network embeddedness derive their connectivity from similar multilayer profiles.

5. Networks structures and dynamics in the internationalisation of Australian junior mining firms in Latin America: copper and lithium

Adriana Nunez¹, Dr Kirsten Martinus¹, Dr Thomas Sigler² (¹The University of Western Australia, ²The University of Queensland)

Since 1990s, numerous Australian junior firms have internationalised, setting operations in many nations across the world, and creating active economic links between Australia and multiple sites of operation overseas. Literature in economic geography and international business describe firm internationalisation processes as both embedded and shaped by social networks. However, the treatment of social networks

in this literature is mostly metaphorical, referring to webs of social connections without incorporating structural or positional network attributes in empirical analysis, and in the mining industry remains largely unexplored. We address this gap by using Social Network Analysis (SNA) to explore how the network structure, composition and interactions of junior mining firms evolve throughout the internationalisation processes. We do this in a comparative case study of firms operating in a developed and emergent mining industry in Latin America, copper and lithium respectively, to assess the impact of industry development in the networks. Data was derived from in-depth elite interviews with Australian junior firms operating in Latin America, governments and other relevant actors. Findings demonstrate that the network structure, composition and interaction of junior mining firms varies depending upon their stage of internationalisation, firm needs of knowledge, social and financial capital, social and governmental approval. Along with periods of expansion and contraction roughly aligned with commodity price fluctuations, junior mining firm networks were highly influenced by the level of industry development, especially in initial internationalisation stages. Understanding network differentiation is especially relevant in green technology development, where there is continuous exploration of minerals in both developed and emerging industries often by junior mining firms.

6. The network structure of success: Evidence from an empirical study of European patents

Alex Stivala, Alessandro Lomi (Università della Svizzera Italiana)

Patents are often used as a source of data to study innovation, and one measure of the "success" of a patent is the number of citations it receives from other patents, which is its in-degree in the patent citation network. The combination of different knowledge is the basis for innovation, which, almost by definition, entails the combination of knowledge in novel ways. But not all possible combinations of knowledge are equally likely to succeed. What factors contribute to the success of a patent? In this work we use the ideas of categorical contrast and niche width to help try to answer this question.

The contrast of a category (such as a patent technology class) captures the idea of sharp versus broad or "fuzzy" category boundaries. If a technology class is one that is seldom assigned together with other classes, then it has high contrast. A low contrast technology class is one that is frequently found together with other classes. Niche width is a measure of the diversity of technology classes combined by a patent.

We will use these ideas to examine the effects of diversity and contrast on the success of a patent, using a data set of nearly two million European patents. We will use both conventional regression modelling, as well as exponential random graph modelling (ERGM) to model the patent citation network. The latter allows modelling of the patent citation network having to treat the network structure as exogenous.

Session 5: Health Care Networks (5)

1. Using SNA to Examine a Network's Capacity to Address Cancer- and Tobacco-Related Disparities among Asian American, Native Hawaiian, and Pacific Islander Populations in the United States

Linda M. Bosma¹, Rod Lew² (¹Bosma Consulting, USA; ²Asian Pacific Partners for Empowerment Advocacy and Leadership, USA)

To examine the dissemination of training and technical assistance (TAT) in a community health collaborative, we used social network analysis to examine the reach of TAT by content area by organizations participating in the RAISE Network from 2014-2019. We collected data annually to assess trends in TAT provision and reach; findings were shared with Partner organizations annually to inform their efforts. RAISE (Reaching Asian Americans Pacific Islanders through Innovative Strategies to Achieve Equity in Tobacco Control and Cancer Prevention) is a network of 11 core national and local organizations in the United States that collaborate to prevent and reduce tobacco use and other cancer-related disparities in the diverse Asian Americans, Native Hawaiian, and Pacific Islander (AANHPI) communities in the U.S. RAISE was coordinated by Asian Pacific Partners for Empowerment, Advocacy, and Leadership (APPEAL) and funded by the Office on Smoking and Health and the Division of Cancer

Prevention and Control at the Centers for Disease Control and Prevention. RAISE partner organizations expand culturally competent and evidence-based strategies through collaborative initiatives, campaigns, and providing training and technical assistance (TAT) to AANHPI communities in tobacco control, cessation, cancer survivorship, cervical cancer, hepatitis B, community outreach, and healthy eating/active living (HEAL). Findings show 1) the number of organizations reached with TAT increased each year, 2) expertise is diffused throughout the network, and 3) each RAISE partner organization brings both specialized expertise and unique connections to organizations that serve AANHPI communities. RAISE was especially successful at diffusing community outreach strategies that are necessary to connecting AANHPI communities to services to reduce cancer and tobacco-related health disparities. SNA was useful for examining trends, partner roles, and areas of focus to evaluate the RAISE Network; feedback from the evaluation helped RAISE Partners focus their efforts and identify areas of need.

2. The use of mixed-methods to study social networks: A scoping review

Jovana Sibaliija, Carri Hand, Colleen McGrath, Gail Teachman, Marianne Larsen (Western University, London, Canada)

There has been a recent push to study social networks using mixed-methods, as networks consist both of structure and social processes, necessitating the application of both quantitative and qualitative methods. To support research in this area, a scoping review was conducted to examine how mixed-methods were being used to study network structure and the ties among network members. Systematic searches of four databases (CINAHL, Scopus, PsycINFO, Sociological Abstracts) identified 46 articles that met the review criteria. We extracted and summarized information on the quantitative and qualitative methods used and when the methods were integrated within the studies. Questionnaires were used frequently to collect quantitative data related to network structure. Within questionnaires, name generators were used most often. Qualitative data was generated primarily through interviews and concentrated on understanding the ties among network members. Over half of the studies employed social network analysis and thematic analysis to analyse the quantitative and qualitative data respectively. Detailed description of the qualitative methods was lacking in the majority of studies reviewed. The integration of the methods primarily happened at the method and reporting/interpretation levels. The use of mixed-methods enriched understanding of social networks by simultaneously examining structure and identifying important contextual information such as how members interacted with each other.

3. Optimising Isolation, Quarantine and Distancing for COVID-19: The role of networks

Dean Lusher¹, Margaret Hellard^{2,3}, Katherine Gibney⁴, Alisa Pedrana³, Mark Stoové³, Nick Scott^{2,3}, Rachel Sacks-Davis^{2,3}, Anna Bowring³, Anna Wilkinson^{2,3}, Johan Koskinen⁴, Gary Robins⁴, Colin Gallagher¹, Peng Wang¹, Maedeh Aboutalebi Karkavandi¹, Bopha Roden¹, Giovanni Sadewo Radhitio Putra¹, Petr Matous⁵, Chiara Broccatelli⁶ (¹Swinburne University of Technology; ²Monash University; ³Burnet Institute; ⁴University of Melbourne; ⁵University of Sydney; ⁶University of Queensland)

Since its emergence in late 2019 and into 2020 the number of cases of novel coronavirus (COVID-19) has grown exponentially globally. In Australia, for a range of reasons Victoria has experienced a significant second wave of cases that has required a return to lockdown restrictions. While this second intervention has been effective, saving many thousands of lives, it comes at a huge economic, social and non-COVID-19 health cost that makes it impractical to sustain indefinitely.

This project monitors and evaluates the effectiveness of these key interventions on disease transmission and individual wellbeing; including understanding compliance with isolation, quarantine and physical distancing measures among the population over time, and its impact on disease transmission. This is to help Australia enable a responsive decision support system which can incorporate social, political, and ethical considerations into the decision-making process, and quantify the effectiveness of individual components of the Australian Government's current disease control strategies to inform the appropriate triggers to transition to the release and then restore phases.

The 12-month project uses snowball sampling and applies a range of network analysis techniques to follow approximately 1,000 participants and their contacts every week over a 12-month period. It examines the important social contact networks by which disease is spread but also social support

networks, with attitudes towards physical distancing, attitudes to government responses, as well as COVID-19 symptoms and virus status.

In this presentation we use social network analysis to observe the impact of networks on compliance to isolation, quarantine and physical distancing recommendations. We present contact data on COVID-19 disease spread as well as social support networks and their relation to individual wellbeing.

4. Dementia risk education: teaching some and reaching more

Hannah Fair, Kathleen Doherty, Claire Eccleston, Shannon Klekociuk, Maree Farrow (University of Tasmania)

Dementia is a growing global public health concern, currently affecting over 50 million people. Evidence suggests that individuals can reduce their dementia risk by addressing a series of physical, psychological, and social health and lifestyle factors. Community knowledge of these risk factors remains low: to increase dementia risk knowledge and promote risk-reducing behaviour, the Wicking Centre developed a free online course – the Preventing Dementia MOOC. We hypothesised that information diffusion through course participants' social networks would increase and broaden the reach of this dementia risk education. We characterised the diffusion of dementia risk information through the close contact networks of 37 Preventing Dementia MOOC participants using sociogram-aided interviewing. The name generator "Who do you feel very close or somewhat close to?" was used alongside prompts to consider family, friends, colleagues and contacts from social groups and organisations. Participants' close contact networks ranged in size from 8 to 42, with an average size of 19.81. Participants reported discussing dementia risk reduction with 54.16% of their close contacts - 397 of 733 alters. Participants were more likely to share dementia risk information with contacts they felt closer to ($p < 0.001$), contacts whose health they admired ($p < 0.001$) and contacts who admired their health ($p < 0.001$). Participants were also more likely to share this information with older people ($p < 0.01$) and with people who have higher levels of education ($p < 0.01$). 27 participants were asked about additional people with whom they discussed dementia risk – these participants reported sharing dementia risk information through an additional 32 weaker connections. Overall, diffusion through social networks increased the reach of dementia risk information 11-fold. We aim to further characterise the alters reached with this information to determine if diffusion also increased the diversity of people with access to dementia risk reduction information.

5. Evaluating the social ties in recruitment of doctors into the rural workforce in remote WA

Bek Ledingham¹, Denese Playford¹, Yulia Shiikha¹ (¹Rural Clinical School of Western Australia)

Difficulties in rural medical recruitment are an international issue. Amongst many known positive and negative the role of social relationships in the recruitment of doctors to rural locations is yet to be systematically investigated. Social Network analysis (SNA) as an ideal methodology to quantitate the role of relationships in recruitment of doctors to a remote setting in Western Australia.

Methods: Four recently recruited doctors who live in Broome were comprised our bounded set. They were asked to name the five persons most important to their recruitment. A relationship matrix (*adjacency matrix*) was constructed for all possible relationships in this bounded set. The matrix was imported into UCINET. UCINET's NetDraw function was used for graphical presentation, and the UCINET editor was used to obtain measures of centrality for the matrix.

Results: The graphical presentation showed two strongly centralised nodes, with one the clear lead. The eigenvector measure of centrality for the most connected node was 0.54, whose nIn -degree and $nOut$ -degree measures were 0.526 and 0.348 respectively. This centralised node served as a "bridge".

Discussion: The most connected node in our sociogram is locally known as a hero for recruitment. He is a long term GP with strong University connections, involved in teaching medical students, early career doctors and vocational trainees. Our analysis, appropriately identifies the central role of relationship for the remote medical workforce in Australia.

Keywords: Social network analysis, rural clinical school, junior doctors, medical, connections

Session 6: Social Media Networks (6)

1. Using Semantic Network Analysis to Identify Meaning Structures on Twitter

Robert Ackland (The Australian National University)

Twitter has become a major online platform for political discussion and deliberation, with hashtags being particularly effective for raising issues, promoting concerns and mobilising action (see e.g. O'Neil and Ackland, 2018). While the relatively easy access to Twitter data via APIs and advances in text and network analysis would seemingly be a boon for researchers wanting to study the social construction and dynamics of issues, there are still major methodological challenges. This presentation outlines progress towards operationalising Twitter data for researching issues, with particular focus on how dynamic semantic network analysis of hashtags can be used to identify "meaning structures" on Twitter, and track their change over time. While this presentation is primarily focused on methods and data, there will also be discussion of an application to analysing the potential impact of foreign information operations on the Australian political Twittersphere (Ackland, Jensen & O'Neil, 2020).

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2. Examining the Temporal Dynamics of an Online Social Movement

Martin Wood¹, Lucia Falzon^{1,2}, John Dunn¹, Bradley Donnelly¹, Danielle Iannella¹, & Trevor Tao¹
(¹Defence Science and Technology, Australia, ²University of Melbourne)

Social media platforms can play a crucial role in the organisation and coordination of social movements (Tufekci & Wilson, 2012). The interaction networks derived from these platforms also provide a unique opportunity to examine the network processes contributing to emergent social phenomena. For instance, insights have been garnered into the growth of social movements (Banos, Borge-Holthoefer, & Moreno, 2013), their community structure (Gonzalez-Bailon & Wang, 2016), and the identification of prominent information spreaders or sinks (Borge-Holthoefer et al., 2011). However, most network analyses of online social movements treat the interaction network as a static structure, collapsing a multitude of relational events together to generate a single cross-section of the network. Albeit informative, this type of aggregation removes the temporal dependencies (i.e., sequence and timing) between relational events. Without preserving the sequence and timing of relational events among movement participants, we lose critical insights into the behavioural dynamics of social movements, such as people's unique patterns of engagement and the process of brokerage they enact. To address this gap, we directly model and analyse the sequences of relational events occurring among people engaged in the Gilets Jaunes movement on Twitter. More specifically, we use the time stamps of tweets to construct an interaction network of people engaged in the online social movement. A matrix algebra specifically developed for temporal networks (Kontoleon et al., 2013; Falzon et al., 2018) is then used to calculate a suite of individual based temporal measures (e.g., reachability, centrality, and brokerage) that explicitly take sequence into account. To demonstrate the utility of this approach, we compare the results of these temporal analyses with static network metrics and discuss their implications. Overall, we argue that a temporal network perspective affords insights into emergent social phenomena not otherwise captured by traditional network approaches.

Keywords: Network Methods, Social Movements, Social Media, Temporal Networks

3. Discussion networks and deliberation on Twitter: How did climate strikes change deliberation about climate change?

Yuanyuan Shang, Joan Leach, Robert Ackland, Will Grant (Australian National University)

A deliberative system refers to 'a talk-based approach to political conflict and problem-solving through arguing, demonstrating, expressing, and persuading' (Mansbridge et al., 2012, p.4). Online discussion networks provide citizens an opportunity to develop opinions and assess conflicting ideas. This paper uses social network analysis (SNA) in an attempt to quantify the extent to which discussions on Twitter about climate change are deliberative, adapting Schneider (1997)'s rationality of dimensions (reciprocity, equality, diversity, and quality) of ideal public sphere. In addition to providing a general empirical framework for assessing whether Twitter discussions are deliberative, this paper also examines the impact on deliberation of the Climate Strike global environmental movement. Led by Swedish school student Greta Thunberg, the "school strike for climate" has been attracting attention since 2018, inspiring worldwide environmental movements. But did the climate strike affect the deliberation of online climate change communication? There is no study that has answered this question yet. This paper seeks to answer this by using SNA to examine how the climate strike movement affected three key measures of deliberation in discussion - reciprocity, equality, and diversity.

The first contribution of this research is advancing approaches for testing whether online discussion networks are deliberative and how particular events or movements can affect deliberation. Second, it applies social network analysis to unearth structural features of online climate change communication, which is a new but valuable contribution for scholars in climate change communication. More generally, this paper contributes to on-going debates between cyber-optimists and cyber-pessimists, regarding whether social media can have a positive effect on political deliberation. Although there is no simple answer to whether we should be optimistic or pessimistic towards the impact of the Internet or social media on deliberation, this paper shows that discussions of climate strikes changed the nature of deliberation about climate change on Twitter.

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4. #ArsonEmergency and Australia's "Black Summer": A study of polarisation and its broader effect on the online discussion

Derek Weber^{1,2}, Mehwish Nasim^{3,4,5}, Lucia Falzon^{2,6}, Lewis Mitchell^{1,5} (¹University of Adelaide; ²Defence Science and Technology, Australia; ³Data61, CSIRO; ⁴Cyber Security Cooperative Research Centre; ⁵ARC Centre of Excellence for Mathematical and Statistical Frontiers, Adelaide; ⁶University of Melbourne)

Australia suffered some of its worst bushfires on record during the summer of 2019-20, which have been widely regarded as connected to climate change. In online discussions, emerging from Australia and elsewhere, a narrative gained traction, in which arson and a lack of forest management were the predominant causes of the bushfires. This was particularly prevalent on the #ArsonEmergency hashtag on Twitter. A brief study in early January concluded that this hashtag and the associated narrative were being boosted by bot-like accounts.

This talk discusses a follow-up study covering the original study's duration plus the following ten days, during which the original study reached the mainstream news, correlating with a significant change in the online discussion. In the retweet network of the online discussion, two polarised communities were observed and their contribution to the online discussion is presented. The Supporter community actively engaged with others to spread the arson narrative, while the other community, the Opposers, engaged less but retweeted more, referring to fact-checks and statements from authorities debunking misinformation using reputable news sources. Using a phased approach, the effect of the Opposer community on the broader community is visible through the distribution of URLs shared. Follow-up bot analysis fails to confirm the widespread presence of bots, though aggressive language is present in both communities, and active trolling behaviour appears amongst the Supporters.

Further social communities are identified using networks based on retweets, replies and URL sharing and their overlap with the polarised communities is considered. Taking advantage of previous studies in polarisation in the Australian online ecosystem, we highlight communities that appear to persist over time, adopting similar ideological standpoints on different issues, lending weight to the existence of long-standing echo chambers, under certain circumstances.

5. An empirical study to evaluate the persistence of polarised communities in social networks

Mehwish Nasim^{1,2,3}, Derek Weber^{4,5}, Lucia Falzon^{5,6}, Lewis Mitchell^{3,4} (¹Data61, CSIRO; ²Cyber Security Cooperative Research Centre; ³ARC Centre of Excellence for Mathematical and Statistical Frontiers, Adelaide; ⁴University of Adelaide; ⁵Defence Science and Technology, Australia; ⁶University of Melbourne)

Online social media platforms have become an important forum for public debate, yet their precise role in elections, changing the discourse of political discussions and influencing people to change their opinions remains difficult to characterise.

It has been argued that users typically interact with like-minded people – *the echo chamber effect* – and are exposed to selective news and pages that already reinforce their existing opinions – *the filter bubble effect*. However, the presence of echo chambers is still under controversy.

In our previous studies we looked at controversial topics such as the marriage equality debate, Australian bushfires, and COVID-19 related data. We found polarised communities in each of those datasets.

In 2017, we collected an original dataset from Twitter, comprising tweets related to the same-sex marriage survey conducted in Australia between September and November 2017.

In a longitudinal setting, we analysed the social relations (interactions and friendships), network structures, and diversity of discussion topics (hashtags) in the tweets.

The results show that the discussions in Twitter space on marriage equality survey were highly polarised, with little interaction between opposing groups. Later in 2020, we collected data on hashtags related to the Australian bushfires. We found two polarised communities, one strongly supporting the hashtag *ArsonEmergency* - attributing arson being the cause of bushfires and the other community opposing this theory.

Here, we expand on our previous studies to analyse whether such communities persist, and if not, then what happens to those communities when they are analysed over time. To this end, using various network analysis methods we matched the polarised communities in the same sex marriage data with several other datasets that we had collected recently, including the *ArsonEmergency* data, Covid-19 data, and AFL data. We found some intriguing results. If the echo chambers effect is strong then we would expect the communities to persist. Our results show that not all communities strongly persist over different controversial topics. The communities persist in the *ArsonEmergency* and Covid-19 datasets. However, the effect is less pronounced in the AFL datasets.

This opens up various research questions, including how people decide their position in a social space when encountered with contesting opinions (about various controversial topics), and what are the reasons that could make an echo chamber transient or persistent.

6. Understanding the impact of technology in the time of crisis for building human connections

Bibhu Kalyan Nayak¹, Pushkala Rajan¹, Majdi Faleh² (¹Manipal University Jaipur, India; ²University of Western Australia)

After the 2nd world war, while working towards the formation of the United Nations, Winston Churchill said, "Never let a good crisis go to waste." If we ignore the political correctness of this statement in this time of COVID-19 pandemic, it seems to have found a new meaning. This global crisis has made a few critical revelations about the capacity of the human to survive and thrive. This paper is going to assess two critical hypotheses using a mixed-mode research methodology.

1. Crisis nudges people more towards collaboration than conflict, despite physical, social, cultural and economic barriers.
2. Technology reinforces the human network to make collaboration possible, despite its use to influence public opinion.

The first hypothesis enquires, how crisis brings motivations to people even miles apart from each other. It sheds some light on the factors influencing such decisions among the people. It also intends to understand the "why" behind every decision to cooperate or fight. The second part look for the quality of impact technology (information technology & internet) has on individual lives, without discounting the ill-effects of it. However, neither of them are going to ignore the responses that contradict. In many cases,

anomalies will be investigated thoroughly. The study involves samples from various part (mostly urban areas) of the world including South Asia, Australia, Middle East, North America and many others. Purposely the sample is collected randomly through interviews and polls from social media platforms. This research sample is only limited to people who has an access to the internet and have some sort of verifiable online presence. The study has also taken the existing literature and experts' opinion into consideration while deriving its conclusions for this paper.

Keyword: urban and city networks, social media, technology for collaboration.

Session 7: Multi-Stakeholder Networks and Collaborations **(7)**

1. The interplay between trust and collaboration among scientists engaged in the commercialisation of public research

Bopha Roden, Dean Lusher, Peng Wang, Tom Spurling, Greg Simpson (Swinburne University of Technology)

In recent times, as well as focusing on education and research, universities are encouraged to engage in knowledge transfer. There is an increasing effort from governments to enable and steer universities towards a more active role in the commercialisation of academic knowledge. Even though increased collaboration with industry partners is the intended outcome of policies that have been introduced around the world, it is widely acknowledged that collaboration between universities and industry can be fraught with potential problems. These problems are often the results of differing institutional backgrounds, purposes, reward structures, cultures and norms.

Collaboration is about social relations and processes that take place when individuals come together to achieve something new. Much is written about collaboration and knowledge transfer, but the focus has been on university-industry (U-I) collaborations. However, recent publication and patent application data indicate that there is an emergence of another way for universities to conduct knowledge transfer, namely with other public research organisations (University-University).

This research investigates the interplay between trust, widely accepted as being critical for relationship success, and collaboration in a global community of scientists in universities and other public research organisations (PROs). The common link between these scientists is the application of Controlled Radical Polymerisation (CRP), a platform technology in the field of polymer chemistry, in product innovation.

Using Exponential Random Graph Models (ERGMs), we seek to understand the structural effects of the trust, the collaboration networks and the multiplex relationship and interplay between these two networks among the scientists. Results and implications are discussed with the view to better understanding the social processes that drive or hinder collaboration in the public system. This will add to our understanding of how knowledge transfer between public research organisations can be improved in order to maximise commercialisation of scientific innovation.

2. Co-evolution of a Multilevel Scientific Network: Extended Features for Goodness of Fit in Complex Networks

Alejandro Espinosa-Rada¹, Elisa Bellotti¹, Martin Everett¹, Christoph Stadtfeld² (¹University of Manchester, ²ETH Zürich)

In the following presentation we explore how researchers consider the co-evolutionary interdependency of scientists and entities of different levels when they cite other researchers in a scientific group. To achieve this, we explore the relevance of the closure by affiliation and closures by association mechanisms, and we expand some diagnostics to distinguish the contribution of the cross-level effects in the representation of relevant features in a complex three-mode multilevel and multiplex network. Also, we use the stochastic actor oriented model for one-mode and bipartite networks to linkage micro-macro processes using a dataset of a scientific community from 2013 to 2015. We use new and already available measures for diagnostics used for statistical models for social networks to identify how micro-mechanisms

trigger different structures at the macro level. Our results suggest that social relationships based on scientific collaboration and space proximity based on institutional affiliation are more accurate to understand the co-evolution of the networks in a scientific network, in comparison with cognitive-based networks such as the journal network.

3. University-Industry Collaboration: Network dynamics of research contracts and grants in an Australian University

Colin Gallagher¹, Dean Lusher¹, Johan Koskinen², Peng Wang¹, Aaron Gosling², Anastasios Polyzos², Martina Stenzel³, Sarah Hegarty¹, Tom Spurling¹ (¹Swinburne University of Technology, ²University of Melbourne, ³University of New South Wales)

University-Industry (U-I) collaboration takes on many forms, ranging from the provision of research services, to teaching and training, to curiosity-led research. These diverse forms of collaboration are especially important in the Chemical Industries, where academic chemists are called upon to generate new knowledge, address novel problems faced by industry, and train the future workforce in cutting-edge methods. Forming and maintaining strong collaborative U-I links is especially important to the chemical industries sector in Australia, where its educational and research sector are a key asset in the face of increased international competition.

Social networks are a natural means by which to measure and analyse collaboration. Yet, network research on U-I collaboration has generally been limited to the analysis of co-patenting and co-publishing networks. However, previous studies pose two general issues. First, publications and patents constitute just a portion of potential collaboration activities, and may not provide an accurate picture of all forms of collaboration, or when that work occurred. Second, these analyses typically rely on one-mode projections of two-mode data introducing various data artefacts.

A little used but potentially significant form of collaboration data is that of research contracts and grants, as they are formed between academic and industry partners. In this study, we examine U-I collaboration between academic chemists and industrial partners over a six-year period within a research-intensive Australian university, as observed in a database of university contracts and grants. Preserving the two-mode nature of the network (partner-to-contract), we estimate a stochastic actor-oriented model of academic and industry partners contracts, looking at their dynamic tendencies over a four-year period. In particular, we focus on patterns of homophily among industry partners, with a focus on biomedical and health partners. We likewise focus on recurring partnerships over time. Overall, the analysis aims to uncover network patterns of trust. Substantive results will be presented, along with recommendations for administrative data collection for university research offices and industry.

4. Capturing the Voice of Community Stakeholders in Infrastructure Projects

Vivian Pao (University of Sydney)

Project stakeholder management is critical to project success, and yet, most work in the field has been impeded by limiting assumptions and inefficient methods of analysis. Many traditional stakeholder analysis frameworks underrepresent lay community members and ignore the dynamic network between stakeholders. Modern studies collect data using surveys and interviews which are unsuitable methods for repeated application in big projects due to their time, cost and labour intensiveness. Furthermore, social media platforms have grown in prevalence and reduced the cost of sharing information and forming and maintaining connections to other people. In this way, social media has boosted stakeholder potential for collaboration and mobilisation, shifting the power distribution between stakeholders and the firm. This study employs social network theory to analyse the evolution and activity patterns of an online stakeholder network on Twitter. By developing a software tool in Python to scrape Twitter feeds from community members regarding infrastructure projects, we were able to generate sociograms that depict community sentiment toward the project. Our domain of study is the government-led project Western Sydney International Airport (WSIA) which is currently in development and has faced decades of opposition from several communities. By observing the network in various time windows, we can identify spikes in network activity in the months when announcements surrounding the project emerged. In these networks, high centrality stakeholders highlight communities that have large numbers of anti-project residents. Manually reading the tweets from these users allows us to understand their reasons for opposition (for WSIA, most concerns were environmental or related to residents' quality of life). We conclude that this social network analytic framework provides project managers with a relatively quick

and cost-effective method of identifying an initial point of contact for further community stakeholder interventions and negotiations to ensure project success.

5. Migration and knowledge networks in peripheral farming villages in Sumatra Indonesia

Ayu Pratiwi¹, Petr Matous², Kirsten Martinus³ ((University of Turku¹, University of Sydney², University of Western Australia³)

The migration of people from core areas of the world to the peripheries is a long-established subject of research enquiry, with one particular focus being the study on transmigration. Transmigrations often occur via government-supported programs intended for redistribution of resources and solving the uneven socio-economic development. However, there is still limited understanding on how transmigrants structurally position themselves in community knowledge networks and on their roles in shaping the information networks in the context of agriculture-dominated rural peripheries. This paper examines how transmigrants from the national cores manage to shape their communities' social structures in the rural peripheries. We study the extent of migration experience between Java (the political centre of Indonesia) and a peripheral area on an "outer island" (Sumatra) that influenced the composition of the majority and minority ethnic groups, and examine whether their majority/minority status in their respective communities determines the degree of influence in the knowledge networks via social-core position in local villages. For this study, we investigated 16 randomly selected farming communities in rural Lampung, which used to be the main destination of government-backed transmigration programs from the national core more than 30 years ago. We then analyzed the linkage between their majority/minority status upon their core/periphery position and social networks centrality measures within their community. We found that being part of the major ethnomigration group makes one likely a part of the social core of the village by all kinds of centrality measures and the core-periphery measure, indicating that the transmigrants and its descendants became the dominant ethnic-migration group in the periphery. The results indicate that the government-backed transmigration program may help shape the knowledge systems in the peripheries to advance the peripheral regions via the changing structural systems of their communities.

6. Networking for gender-equitable climate-smart agriculture

Steven Crimp¹, Rachel Friedman¹, Ellis Mackenzie², Tom Sloan², Nicole Sweaney² (1Australian National University, 2Sustineo Pty Limited)

Climate change presents a grave threat to the productivity and resilience of smallholder farming systems, impacts on which are already being felt in Pacific Island nations. One of the keys to helping farmers adapt their practices in response to climate change is access to climate information; seasonal climate forecasts often offer this information in an accessible form for farmers. To better understand the channels through which such forecasts could be disseminated to address different farming needs, we examined information networks in communities in three of Papua New Guinea's provinces. Data on ties between farmers and information sources (e.g. community groups, extension agents) and the barriers to utilising seasonal climate forecasts was collected from 1,284 respondents in Morobe, Eastern Highlands, and East New Britain provinces during 2018 and 2019. We constructed separate networks for male and female farmers, and calculated network centrality measures to determine pathways of greatest influence.

The results highlighted key differences in how men and women share information, and the perceived barriers each faces. Women demonstrated stronger information connectivity with family and friends compared to men, capitalising on informal networks. Conversely, men showed stronger connections with media and community groups, suggesting greater engagement with more formal institutions compared to women. Men were more likely to report not having access to information or that it was not locally relevant, whereas women were more likely to question its quality and trustworthiness. That said, farmers generally had a low level of engagement with agricultural extension and government, which are major sources of climate forecasts. In order to ensure the equitable distribution and effective use of information to help both men and women adapt their farming, more emphasis must be placed on tailoring climate forecasts for the needs and constraints within these different networks.

7. Centralization of communication networks in communities of smallholder farmers and fertilizer use

Petr Matous¹, Orjan Bodin² (University of Sydney¹, Stockholm Resilience Centre²)

Around half of the world's food calories are produced by smallholder farmers and their decisions on fertilizer use have profound implications for food security, biodiversity, as well as their own livelihoods. In this study, we investigated information exchange networks and fertilizer use in 31 villages in Indonesia. Our results show that farmers' use of both organic and inorganic fertilizers is strongly related to the structures of these village-based social networks. More precisely, we demonstrate that in highly centralized villages, where one farmer holds a very prominent position in information-sharing network of the village, the community as a whole, including this influential individual, tends to grow their produce with almost no fertilizer. This pattern is contrasted in less centralized networks where communication links are more evenly distributed and fertilizer use can differ widely. The findings are consistent with an asymmetric effect of network centralization on fertilizer adoption. Until a certain threshold (around 40% of maximum possible centralization), the effect of village network centralization on fertilizer ratio is either weakly negative or on par with multifinality. Centralization levels above this threshold are unanimously associated with low fertilizer adoption. Our findings have implications for design and delivery of programs in remote agrarian communities.

Session 8: Policy and Governance Networks (5)

1. Who speaks for social impact bonds? An analysis of co-authorship networks of policy intellectuals

Jacob Broom and Jordan Tchilingirian (University of Western Australia)

Social impact bonds (SIBs) are an 'experimental', outcomes-based social policy intervention financed by private investment. Originating in the UK in 2010, SIBs have since been enacted in 33 countries. The research on SIBs tends to focus on a) evaluating their effectiveness, b) theorising their origins in national political economies and welfare regimes, and c) understanding how social outcomes are made commensurate with financial value. Little is known about movement of SIBs as a policy idea or the policy intellectuals who develop and promote SIBs as a policy solution. In response, we use social network analysis to understand the structure of the policy intellectual community who research and advocate for SIBs across the globe. Focusing on co-authorship networks in the SIB policy intellectual space, we examine who writes with whom, whether distinct epistemic communities have emerged, how geography impacts these communities, and who has only fleeting contact with the intellectual world of SIBs.

2. Towards a theory of conflict and cooperation in network governance: Positive, negative and "induced" ties in social ecological networks

Garry Robins¹, Örjan Bodin², Maria Mancilla Garcia² (¹University of Melbourne and Swinburne University of Technology, Stockholm Resilience Centre²)

Environmental problems typically entail conflicts of interest. Sometimes, but not always, different actors and opposing coalitions cooperate in solving these problems. So, processes of conflict and cooperation often present in tandem, although much past research tends to study these processes separately. In understanding the governance of social ecological systems, we may be missing the point if we ignore the possibility of negative ties.

In unconstrained social systems, a simple strategy to evade negative tie difficulties is to avoid the alter. But social ecological networks are not unconstrained: the ecosystem provides a strong context against avoidance and so facilitates the emergence of negative ties and open conflict. The presence of environmental resources engenders competition by actors who wish to harvest the resource, and withdrawal from the competition is not the preferred or even possible option.

Based on recently published work (Bodin, Garcia and Robins, 2020), we present three basic elements towards the development of a more comprehensive theory on conflict and cooperation in social ecological systems. First, we see networks from a process-oriented, rather than exclusively structural, perspective, thereby permitting causal insights. Secondly, we represent a social-ecological system as a bi-level system comprising both social and ecological nodes and three levels of interdependencies; and within this system there are both positive and negative ties. So, the system is both multilevel and multiplex. Thirdly, we propose the new concept of an "induced" tie where the structure of the ecological and cross-level ties "induces" the preconditions for conflict in the social system. Understanding the structure of induced ties enables identification of regions of the network where cooperation may need to be strengthened.

With these elements in place, we call for the development of more comprehensive and empirically informed theories on why in social ecological systems stakeholders sometimes engage in conflict, sometimes in cooperation, and sometimes in both, and what social and environmental consequences these different actions bring about.

3. Speaking the Same Language: How Successful Lobbyists Leverage Social Capital and Messaging to Gain Access

Jon MacKay (University of Auckland)

Corporations lobby governments to voice their interests and to gain insights into a government's priorities. Successful lobbyists help their corporate clients to become trusted sources of information used to make policy decisions, or to become partners in government program delivery. This raises the question: Why are some organizations that lobby the government ultimately listened to while others are not? The conventional wisdom of the lobbying process is that it involves powerful politicians and business leaders making deals in back rooms. I argue that successful lobbyists know gaining access to government decision makers requires more than policy expertise or political connections – they need to speak the same language. To explore this hypothesis, I examine proposals sent from lobbyists to policy makers in Canada between 2008 and 2019 across multiple terms of two major political parties. I define gaining political access based on whether a corporate lobbyist manages to successfully present to the Prime Minister's Office. To determine whether a lobbyist's proposal speaks to government concerns, I develop topic models of the lobbying proposals sent to government departments on behalf of corporations each year. I use these topic models to generate semantic networks relating proposals and topics and then examine how successful proposals differ from other proposals. I use multiple brokerage-inspired measures to capture the degree to which a proposal speaks to multiple concerns of the sitting government. Preliminary results indicate that lobbyists are more likely to gain access to top decision makers when they produce proposals that cover a diverse range of topics important to the government.

4. Who funds them? A mixed method social network analysis of disclosed funding relationships within the British tanks tank community

Jordan Tchilingirian (University of Western Australia)

The research and advocacy organisations known as 'think tanks' are often at the centre of controversies about the role and influence of funders over policy research and policy making. For some, think tanks are the intellectual shock troops of elite policy planning cliques. For others they are simply ideologues for hire, or intellectual smokescreens for corporate interests. Social and political scientists have employed mixed method social network analysis in an attempt to uncover how think tanks might be enrolled into covert cooperate and political lobbying. However, there has yet to be any detailed studies of relationships between think tanks and their *disclosed* funders or how funding relationships are governed. In response, this presentation draws on an ongoing mixed method social and personal network analysis of the funding relationships of British think-tanks. Quantitative network analysis is used to: (a) profile the sectoral and professional backgrounds of funders; (b) identify prominent funding bodies; and, (c) explore the structure of shared funding networks of British think tanks from across the organisational and ideological spectrum. I find that private sector funders the most numerous funding bodies, but do not hold central network positions, and that the network ideological polarised. Findings from qualitative personal network interviews are used to elucidate how think-tanks actively regulate the

potential influence of funders. I suggest think-tanks employ several 'purification strategies', which arise from the personal and organisational networks that span the policy-knowledge nexus. Exploiting opportunities presented from their structural marginality between the fields of academia, business, politics, and the media; think-tanks attempt to neutralise the symbolic and direct influence of funders by enrolling a diverse network of allies.

5. Explaining the Persistence of “Decentralisation” of Education in Egypt

Dina Abdelazeem (based on PhD, University College London, Independent researcher)

The study examines how and why decentralisation remained central to education reform in Egypt over the period 1990-2016 despite the mixed outcome at both the national and international levels. The study contributes to the literature on politics of education policymaking and policy transfer in developing countries. Three decentralisation models were examined: community schools, public-private partnerships and school-based management. Social network analysis was combined with a process-tracing approach to identify the key actors involved and the mechanisms causing policy persistence. A two-mode network approach was used to map the actors involved over five periods using international organisations and governments' documents, academic literature and online resources. Centrality measures were used to identify the key actors and select interviewees. Next interviews, government and international agencies' documents were used to trace the mechanisms causing policy persistence. The analysis revealed an increase in the number and diversity of involved actors over time paralleling the international development trends. Nonetheless, the network structure was hierarchical with international agencies, the Ministry of Education (MOE) and senior officials from international agencies and MOE occupying the core and top central positions. Decision and policymaking remained hierarchical. The state remained the key actor, and international agencies continued to play a crucial role throughout the various stages of policy evolution. Three necessary mechanisms led to policy persistence. International agencies used *coercion* through funding pilots and *persuasion* by framing the models to match the interests of political sponsors and guard against bureaucratic resistance. These sponsors were interested in a limited form of administrative decentralisation to raise financial resources to expand access to education; improve education quality and governance; improve their electoral position and respond to international pressures for democratisation and rights protection. There was also *bounded-rational learning* by national officials from international experts and models and several complementary mechanisms with minor influence.