Statistical Analysis of Networks

Mini-Presentations

Does diversity in collaboration network lead to higher research productivity?

An examination of Academic Scientists in the US

Jinghuan Ma

Introduction

- **Research question**
  - Do more diverse collaboration networks contribute to higher research productivity?
- **Motivation**
  - The social network theory of creativity suggests that interaction with a broader spectrum of other individuals enhances creativity, as it enables the use of a wider array of perspectives and a more extensive pool of domain-specific knowledge (Shalley and Gilson 2004; Perry-Smith 2006).
  - Scholarly publications, as products of creativity, is important for scientists' career advancement and scientific reputation. It is also important for knowledge and development, technological innovation and social development.
  - What is the relationship between compositional heterogeneity of scientists' collaboration networks and their research productivity (as measuered by scholarly publication)?

Literature review

▶ Previous research found that heterogeneity in both research fields and disciplines of scientists has positive relationships with research productivity (Seibert et al. 2017; Hayat, Dimitrova, and Wellman 2023). Research on the effect of diversity in universities and nations yields mixed results. While collaboration with researchers in more distant geography or institutional setting (as opposed to those around them) tends to have larger grant(Bozeman and Corley 2004), multi-university collaboration may lead to less project outcomes as it requires higher coordination cost (Cummings and Kiesler 2007).

▶ In order to understand the relationship between compositional attributes of gender, region and institution of scientists' collaboration networks and research producvity. Moreover, it would be interesting to compare if the effects vary across different kinds of collaboration networks.

▶ The network approach is appropriate for this study as the theoretical framework I use is rooted in network research.

Research question (refined)

- **Research purpose**
  - This study aims to understand whether and how member diversity across different dimensions of academic scientists' collaboration network contributes to their research productivity.
- **Research questions**
  - What are the gender, regional and institutional composition of scientists' diffferent collaboration networks, co-authorships, grant proposal collaboration, patent collaboration, and material exchange collaboration?
  - What are their relationships with research productivity?

Data

- ▶ 2016 Survey data
  - ▶ National sample of 3,933 academic scientists in three disciplines–marine biology, entomology, and ecology–from R1 and R2 universities in the US
  - ▶ Response rate: 37.1% (AAPOR RR2)
  - ▶ Individual and ego-centric network data
    - ▶ Respondents were asked to specify the people they (1) published one or more articles together; 2) worked on one or more grant proposals; (3) produced patent, patent application, or disclosure; and (4) either requested or was requested biological materials or genetic data in the past two academic years.
    - ▶ For each of the person they named, they were also asked the region and institution the person works at, as well as whether the person is female.
- ▶ Bibliometric data retrieved from the Scopus database using the R package bibliometrix in March 2023
- ▶ Merge the two databases together by author
- ▶ The final data set consists of 451 eligible respondents and 1,653 relationships.

Variables

▶ Dependent variable: Number of Publications, the sum of peer-reviewed journal articles from 2017 to 2022

▶ Independent variables
  - ▶ gender diversity measured by ratio of female to male
  - ▶ regional diversity measured by the ratio of people in the collaboration network from other regions to people from the same region
  - ▶ institutional diversity measured by the ratio of researchers from other institutions to those from the same institution

▶ Control variables:
  - ▶ individual characteristics: gender; age; proportion of time spent on research, teaching and services; total amount of fund received; discipline; sum of grant money; network positional attributes
  - ▶ institutional characteristics: whether working in a R1 university

Analysis

▶ Zero-Truncatded negative binomial model
▶ What is the relationship between network diversity and research prodoctivity?
▶ Does this relationship vary across different network structure?

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Homophily and Use of Force Network Dynamics Among Outlier Police Officers:
A Cohort Comparison

By: Matthew Duran

Overview

- A minority of police officers account for a disproportionate number of use of force incidents (Brandl & Stroshine, 2013).

- While officer- and situational-level characteristics have been able to explain this inequity, research has yet to investigate the potential of <u>network-level influences</u> on officers with high incidents of use of force.

Literature Review

The policing literature has begun to incorporate network science approaches to understanding the relationship between officer peer structures and use of force outcomes.

- Police misconduct among certain peer networks (Jain, Senclair, Papachristos, 2022)

- Use of force interactions as conduits of police culture (Zhao & Papachristos, 2024)

- The spill-over effect among police cohorts (Holtz et al., 2019)

Research Questions

➢How does police cohort class homophily influence the likelihood of use of force incidents among outlier officers?
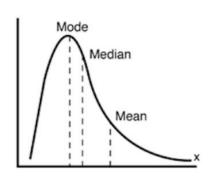
Data

- Use of force data from a mid-sized police department
  - Two police cohorts that graduated in 2019
  - Total use of force incidents for each officer in the year 2022

Cohort 1 (N = 50 officers)		Cohort 2 (N = 62 officers)	
Min.	1 incident	Min.	2 incidents
Max.	26 incidents	Max.	49 incidents
Mean	8.77 incidents	Mean	10.65 incidents

Analyses

- Exponential Random Graph Models (ERGMs)

- Outlier officer identification
  - Q3 + (1.5 * IQR)

Key References

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Project Overview

Through this project I will look at the structure of prison family networks of incarcerated women. The project will analyze how certain individual characteristics correlate with network structure and how network characteristics correlate with particular outcomes.

The purpose of this project is to better understand how socialization and peer influence impact behavioral outcomes, such as engaging in programming and engaging in misconduct.

Literature Review

This project is supported by bodies of literature focused on peer influence and socialization/social networks in prison.

<u>What we know</u> -

We know that prison is inherently a unique and complex social context and therefore the related social structures are often dynamic with unique elements (Crewe, 2009; Chong, 2013; Kreager et al., 2019; Schaefer et al., 2017)

<u>What we do not know</u> -

We know very little about prison family structures and the ways in which specific elements of such networks may impact behavioral and structural outcomes for individuals and the institution itself (Kreager & Kruttschnitt, 2018)

Why Networks?

A network approach allows us to visualize and quantify an individual's place in the prison family structure to better understand how that positionality (and related elements) impacts particular outcomes.

Research Questions

This project investigates -

- Does age impact an individual's socialization and engagement in prison?
  - Does age correlate with an individual's influence in the network structure?
  - Does age correlate with an individual's engagement in programming? In misconduct?
  - Does age correlate with the degree to which an individual reports engaging with their network regularly?
- Does an individual's centrality in the prison family network impact their engagement in prison?
  - Do individuals who are more socially integrated report engaging with their network to a higher degree regularly?
  - Do individuals who are more socially integrated report higher engagement in programming? In misconduct?

Data

The Women's Prison Inmate Network Study (WO-PINS)

- Prison family network developed from the question *"who in the unit is in your prison family?"*
- Responses to *"When not at work or locked in, how do you typically spend your free time?"* - (1) Mostly with one group of women (2) With one or two unit residents (3) With many different unit residents but not one group (4) Mostly alone

WO-PINS administrative data

Measures

Age

Degree centrality (indegree/outdegree) → social integration / degree of influence

Amount of people regularly engaged with → degree of social engagement

Count of misconducts → engaging in misconduct (negative outcome)

Count of programs enrolled in → engaging in programming (positive outcome)

Conceptualization of Analyses

This project will conduct analyses to determine -

- Correlation between age and…
  - Degree centrality
  - Misconduct
  - Programming
  - Amount of people regularly engaged with

- Correlation between degree centrality and…
  - Misconduct
  - Programming
  - Amount of people regularly engaged with

Who Am I Supposed to Trust? A Proposed Network Analysis of Women in Policing Navigating their Male-Dominated Profession

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Stephanie Geoghan
Zeina McCabe

Overview

Seeking to conduct a network analysis
of women working in law enforcement

- Who do they trust?
- Why do they seek advice from?
- Who do they go to for
  guidance/mentorship?
- Why? How much/often?

Overview: Motivation for Project

Women in law enforcement have been severely underrepresented for the last two decades

- Ranging from 10%-12% [1]

[1]Belknap, 2020, p. 350

Overview: Motivation for Project

Due to working in a male-dominated field, women have expressed feeling:

- Isolated[1]

- In need of mentorship[2]

- A lack of respect and acceptance from male counterparts[3]
  - (e.g. sexual harassment[4], unwelcoming environment)

[1]Archbold & Schulz, 2008; [2]Lavender & Todak, 2022; [3]Rabe-Hemp, 2008; [4]Belknap, 2020, p. 342

Overview: Motivation for Project

To overcome these obstacles, women have:

- Tried to "fit in" by being masculine[1]
- Tried to "prove themselves" by being a hero[1]
- Achieved higher rank[1]

[1]Rabe-Hemp, 2008

Overview: Motivation for Project

Important to Understand:

- Women are experiencing these obstacles **on top of** the everyday difficulties of being a police officer

Overview: Motivation for Project

Need to assess how these individuals build their support system and navigate the difficulties of being the minority in their profession

Why This Matters: Literature Review

What we know is that women in policing are:

- Less likely to use force when compared to male counterparts[1]
- More likely to de-escalate potentially violent encounters[2]
- More likely to be perceived as trustworthy by citizens[3]

[1]Rabe-Hemp, 2008a; [2]Rabe-Hemp, 2008b; [3]Salerno and Sanchez, 2020

Why This Matters: Literature Review

To address low representation:

- Departments participating in 30 x 30 Initiative
  - Addressing recruitment and retention concerns

[1]Rabe-Hemp, 2008a; [2]Rabe-Hemp, 2008b; [3]Salerno and Sanchez, 2020

Why This Matters: Literature Review

What is Missing:

- How do people who identify as women find a support system (e.g. people they can trust, go to advice, or seek mentorship from) within a male-dominated profession?

[1]Rabe-Hemp, 2008a; [2]Rabe-Hemp, 2008b; [3]Salerno and Sanchez, 2020

Why This Matters: Continued

Why a network approach is needed:

- Researchers, administrative authorities, and practitioners can understand how people who identify as women create their support system
  - Inform retention practices
  - Inform department policies
- Can understand how and why female officers pick certain individuals to trust and confide in
  - Gossip Culture in Law Enforcement
  - Lack of Personal Space

Research Questions

In a profession dominated by males, we seek to understand how women in policing create their own social networks in regards to trust, advice-seeking, and mentorship.

- Who do you trust within the department?
  - How much do you trust them?
- Within the department, who do you go to for advice?
- Within the department, who do you go to for mentorship?

Data

- Individuals who identify themselves as women who are employed by the City of Peoria Police Department
  - Includes both sworn and civilian
- Data will be collected through a survey
  - Qualtrics or hand-delivered paper
  - Distributed by researcher and trusted employee
- Measuring levels of trust, advice-seeking, & mentorship

Analyses

- Multiple Gplots
  - Network of TRUST
  - Network of ADVICE-SEEKING
  - Network of MENTORSHIP
- Understanding node centrality, closeness, and betweenness in each plot
- Understand the differences between each plot and note similarities
  - Do we see the same individuals across the board?
  - Do women prefer to speak to other women or men?

Questions?

Thank You!