Introduction to Social Network Analysis in Public Health

Tyler Prochnow
Meg Patterson

October 25, 2020

bit.ly/snaworkshop

Introductions

This is a “network” workshop, after all!

Tell us your name, affiliation, and if we were visiting where you live, what would be one thing we would need to SEE, DO, or EAT?

To show this poll

1

Install the app from
pollev.com/app

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Start the presentation

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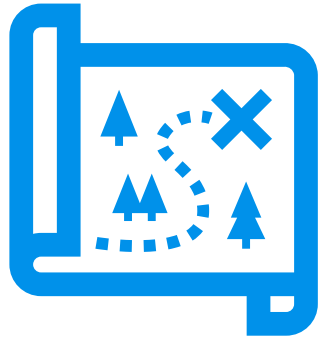
or
Open poll in your web browser

What's in store?

Purpose: Providing a primer for social network analysis in public health fields to better prepare participants to read, understand, and use social network theories, methods, and data.

Agenda

- SNA Background, Terms, and Theory
- Measures
- Data Collection and Management
- Group Case Study
- Wrap up



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Social Network Analysis: *a theory and set of methods focused on the meaning of connections and social structure.*

The point of SNA

- Relationships, and how we connect with one another, matter!
  - More so than individual traits or characteristics*
- The way networks are patterned and structured also matters
  - Air travel vs. Highway travel

SNA data is different!

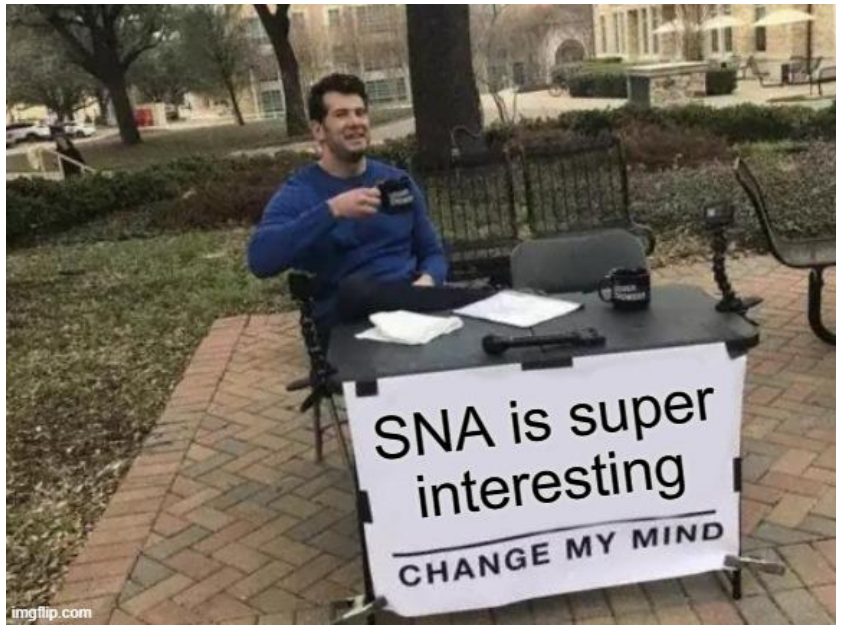
- Independence is NOT assumed
  - Actually, that's an irresponsible way to think, according to network theory
- "The whole is more than the sum of its parts"
  - Nonlinearity
  - Inputs and outputs
  - Variance explained

Why Might We Need SNA?

- Dissatisfaction with attribute theories of behavior
- “Qualintative”
- More realistic modeling of human behavior
  - Behaviors and diseases spread through social contacts, so model that!
- Develop better programs/interventions!

Why Might We Need SNA?

- It’s SUPER interesting!!
- The field is growing and continues to be “written”
- Applies across physical, biological, and social sciences



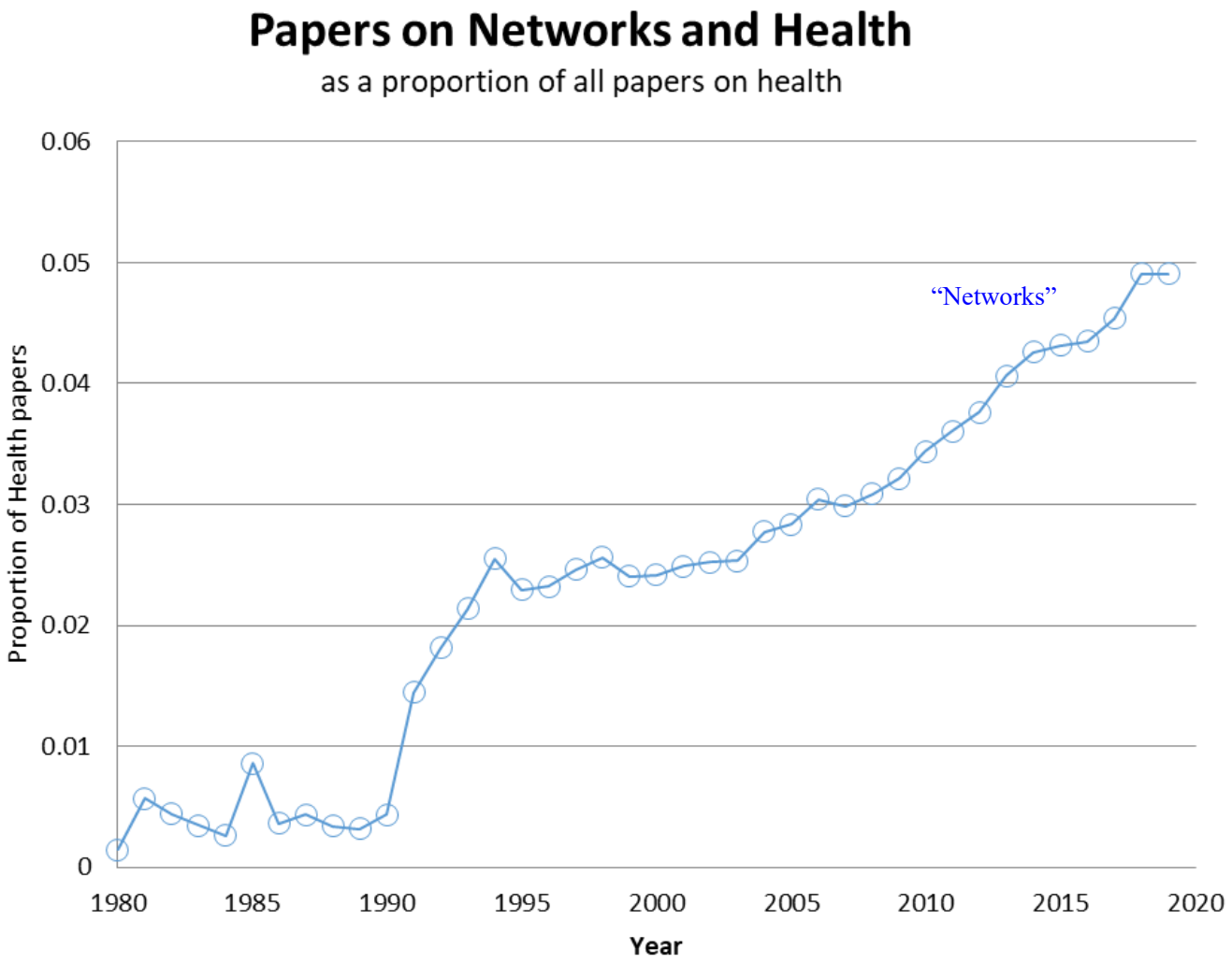
What questions can we answer?

- Network variables as explanatory variables
  - Networks precede some outcome
  - Where a node is positioned impacts what the node does/is influenced by
  - Diffusion of Innovations
  - Peer Influence
  - Disease transmission
- Network variables as outcome variables
  - Attributes precede network formation
  - What attributes impact how a node connects with others in the group
  - Social Integration / Selection
  - Popularity or structuration

"For the last thirty years, empirical social research has been dominated by the sample survey. But as usually practiced, … the survey is a sociological meat grinder, ***tearing the individual from his social context and guaranteeing that nobody in the study interacts with anyone else in it****."*

Allen Barton, 1968 (Quoted in Freeman 2004)

SNA in Health



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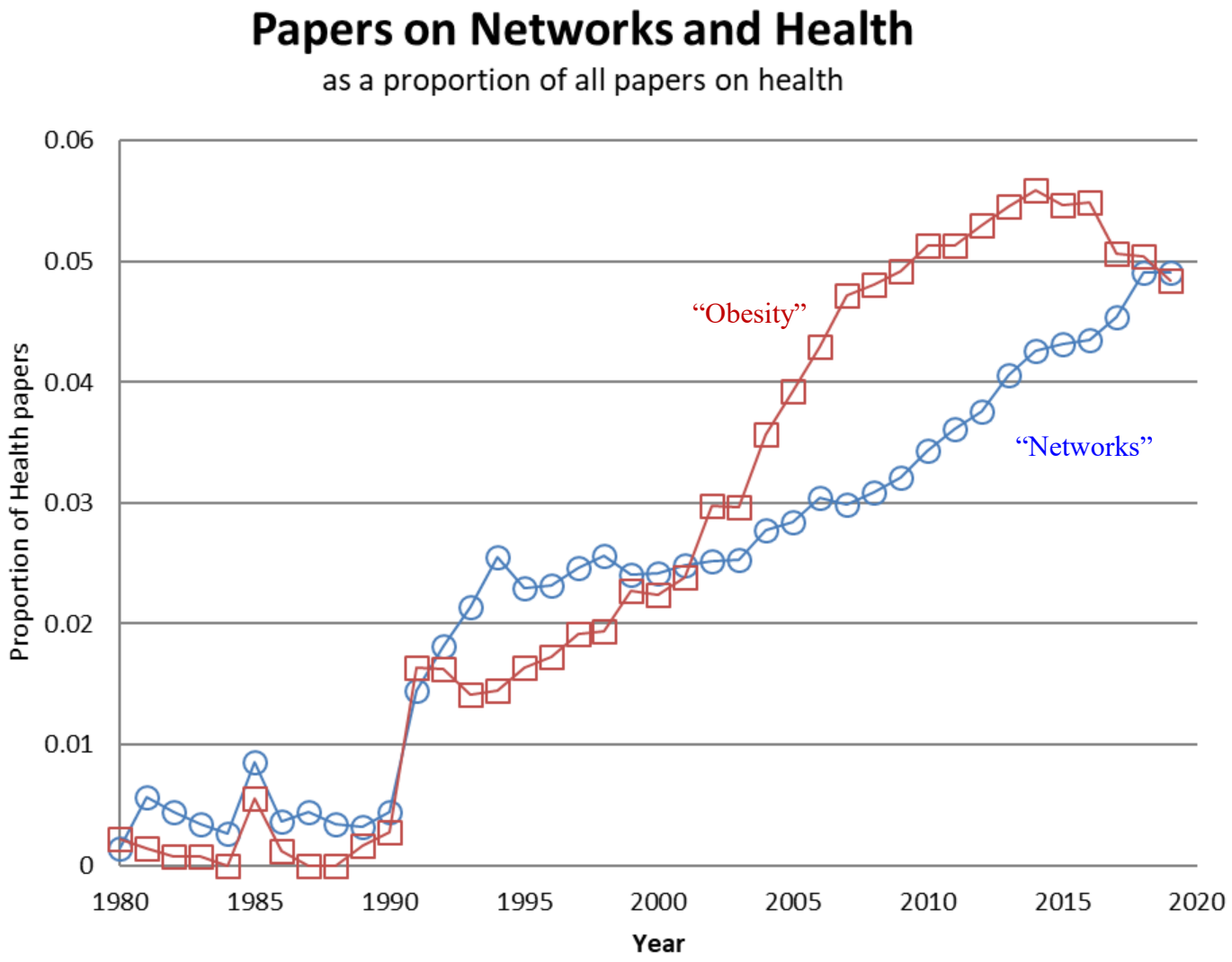
SNA in Health



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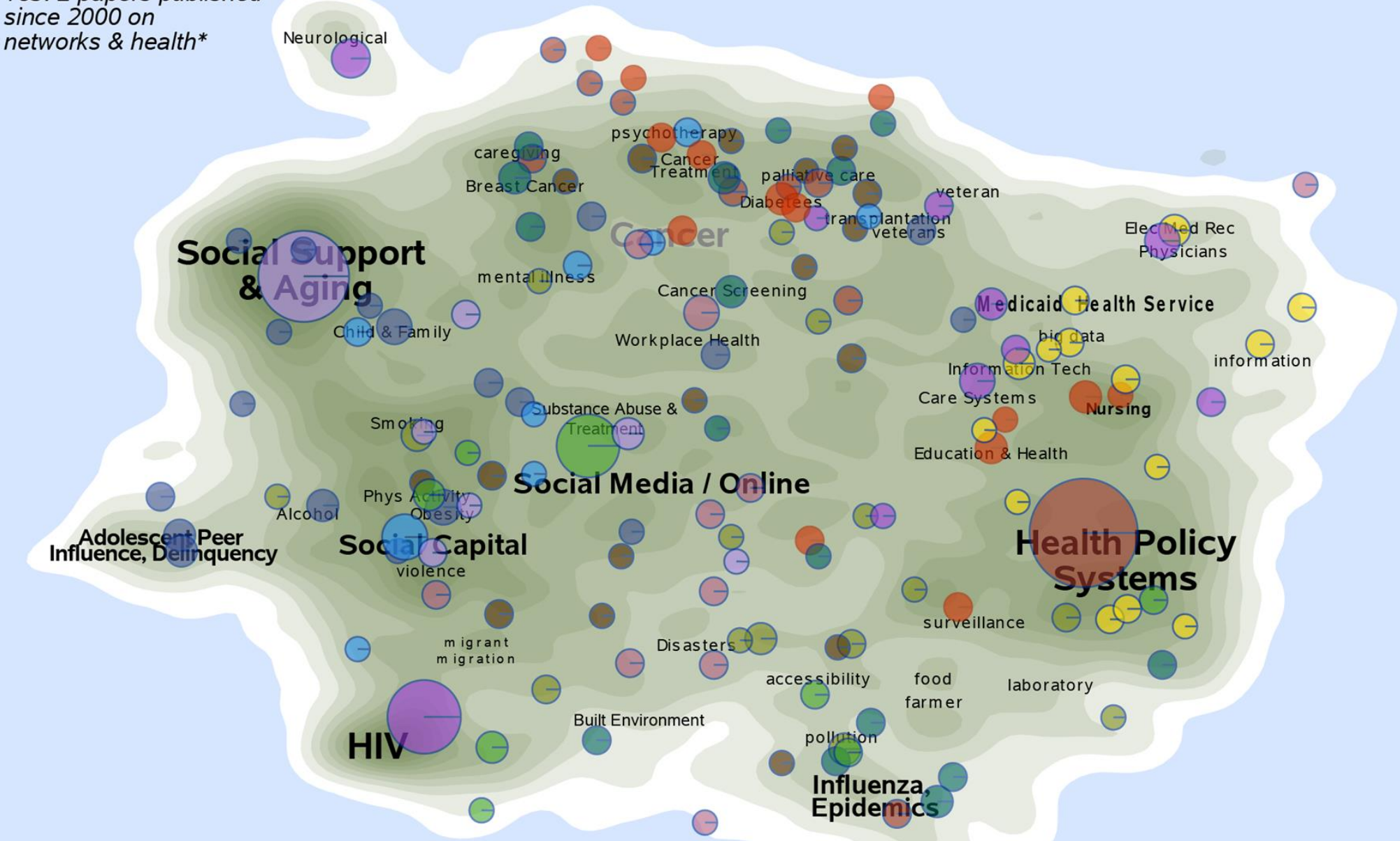
Social Networks & Health Intellectual Landscape

*18572 papers published since 2000 on networks & health**



search was “Network” and (Health or Medicine or well-being)

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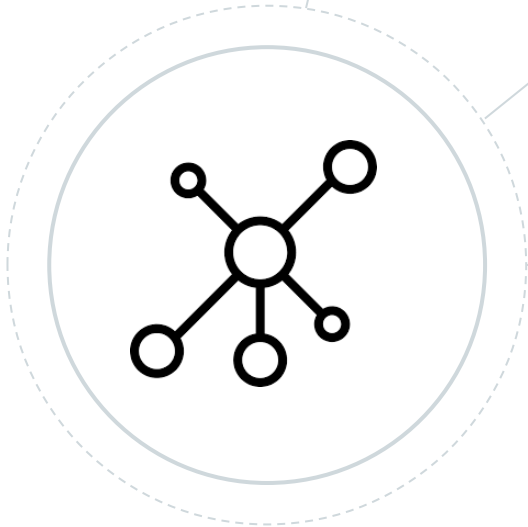
Important Terms

Starting with the basics

Network



A group of individual entities
connected in a meaningful way

Node/Actor/Agent

Individual units

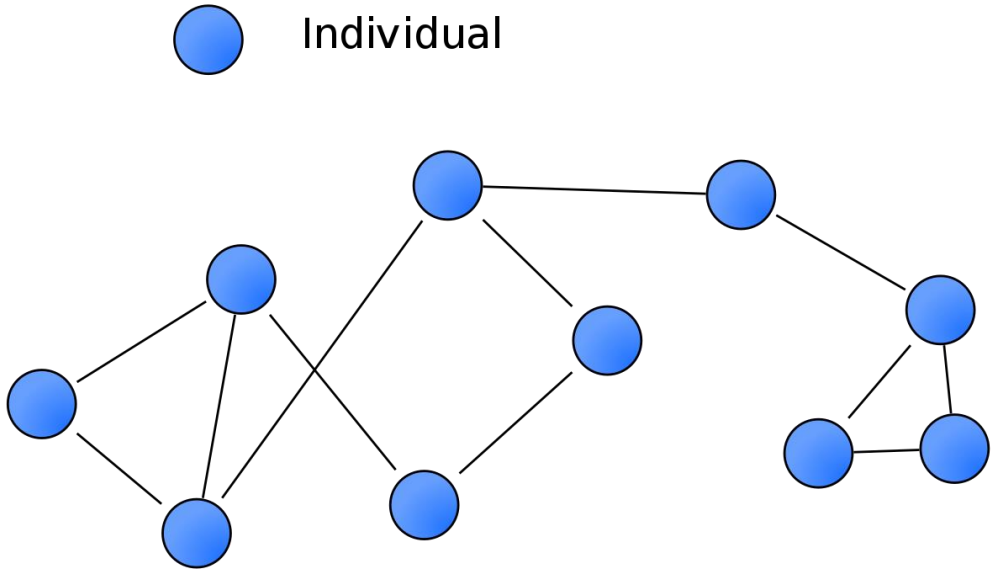
Can be many things!

- People
- Organizations
- States
- Proteins
- Neurons

Edge/Tie/Connection

Defined relationship or connection between nodes

- Directed or undirected
- Reciprocal or not



Examples of Nodes, Ties, and Networks

- Network: Sorority
  - Nodes: Members of the sorority
  - Ties: Friendships
- Network: Dairy cattle sharing a pen
  - Nodes: Cows
  - Ties: Dominance behavior (head budding other cows)
- Network: Health Coalition
  - Nodes: Orgs in the coalition
  - Ties: Collaborations

- Examples that are NOT networks:
  - All the pregnant women you know on Facebook
  - Firefighters in LA County
  - Hospitals in Houston, TX

  - There needs to be a meaningful connection BETWEEN nodes other than a shared attribute*

Attributes vs. Relations

Attributes: What we measure all the time!

- Income
- Education
- Gender
- Self-efficacy
- Behavioral variables (e.g., physical activity)

Relations: ties and structures within networks

- Who do you know, talk to, trust, spend time with, etc.
- Which organizations does yours share resources with?
- Relations tell us:
  - Tie strength: How closely are you connected to others? How many people are you connected to?
  - Network structure: Is the network you're apart of dense, hierarchical, clustered and does that matter?

Think-Pair-Share

Think about a network you could be interested in studying, what are the nodes and what are the ties/connections between them?

Hints:

- Make sure you can determine what is and what is NOT a tie/connection
  - Functionally, theoretically, what does that connection mean?
  - Similarities are not connections
- How do you determine who is part of the network and who is not?
  - Theoretically, all members in a network could be connected.

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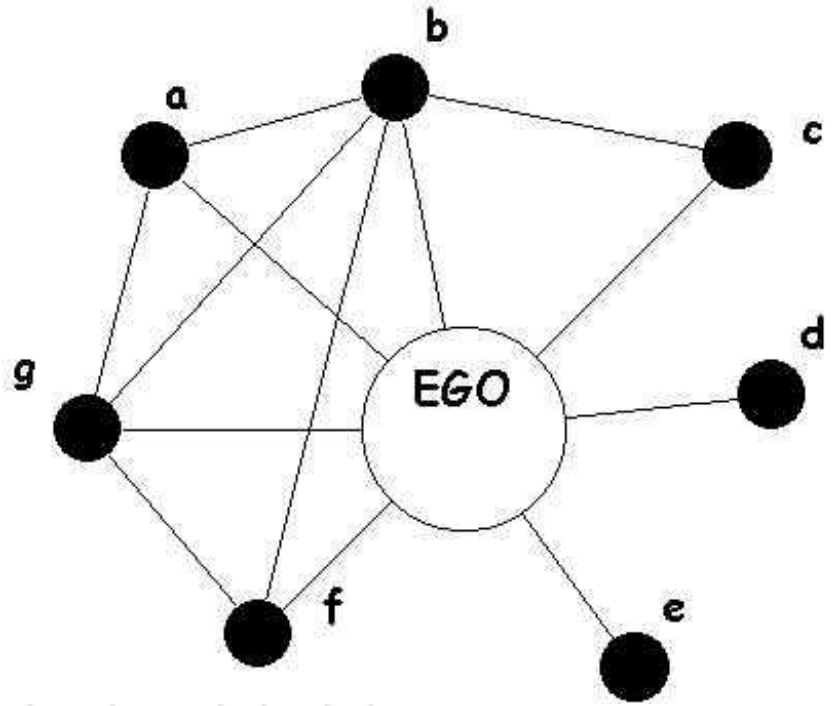
Let’s Take a Break!

Two Approaches to SNA

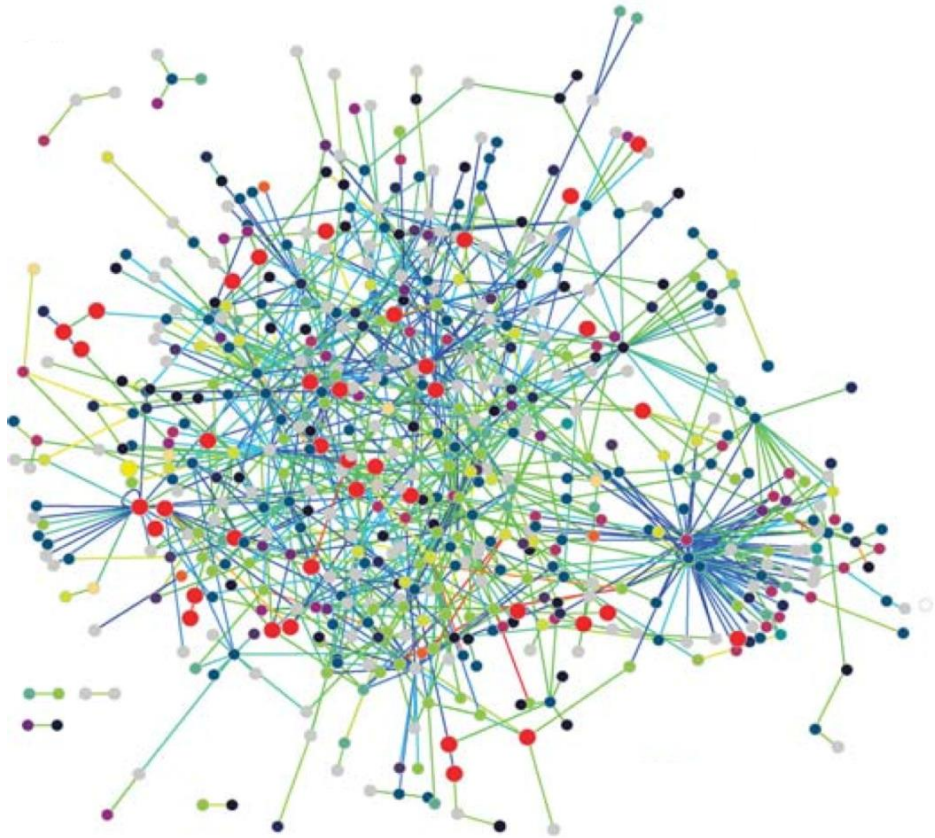
Egocentric and Whole Network Research

Egocentric vs. Whole Networks

Egocentric Network

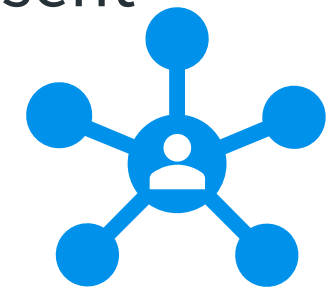


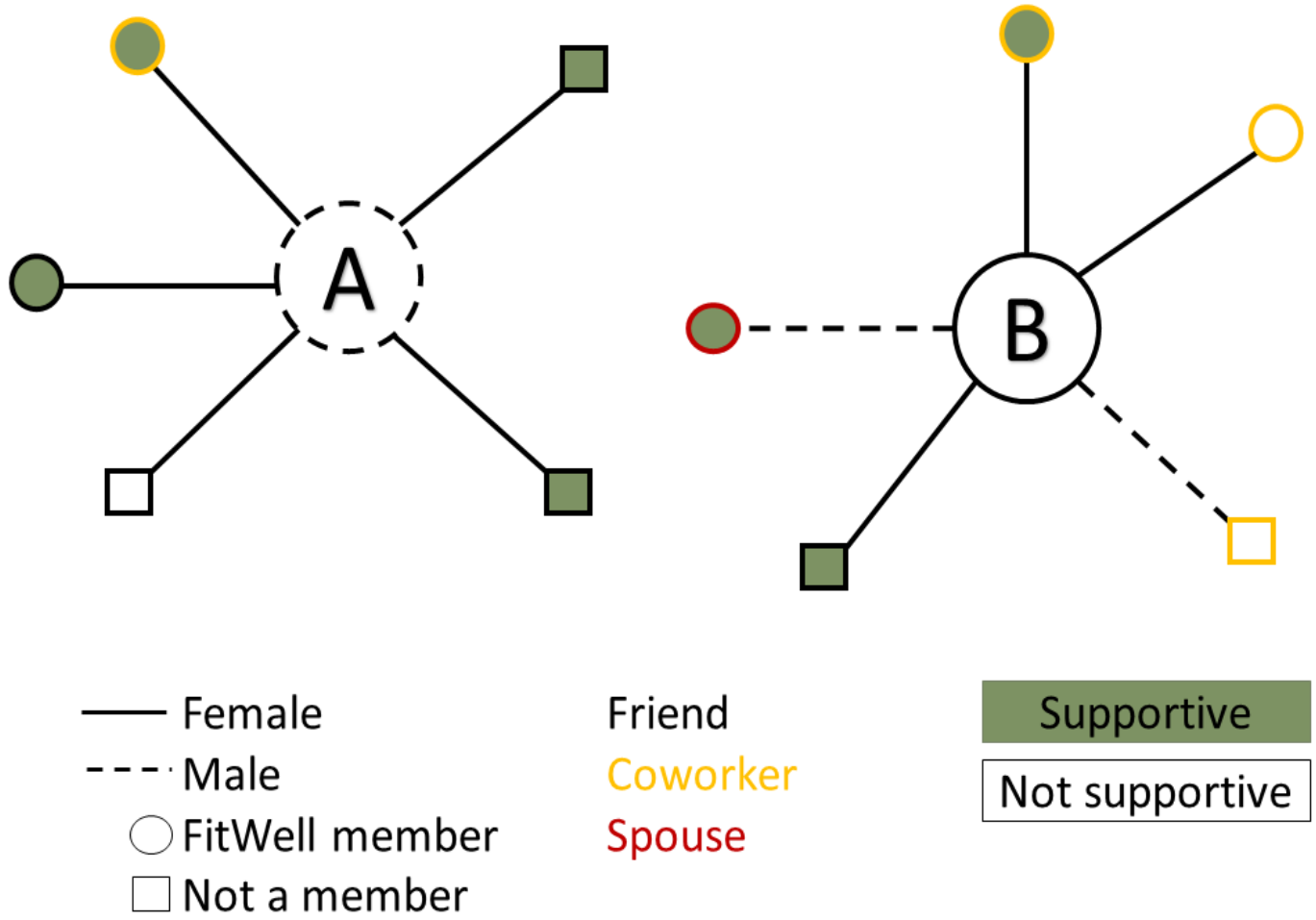
Whole Network

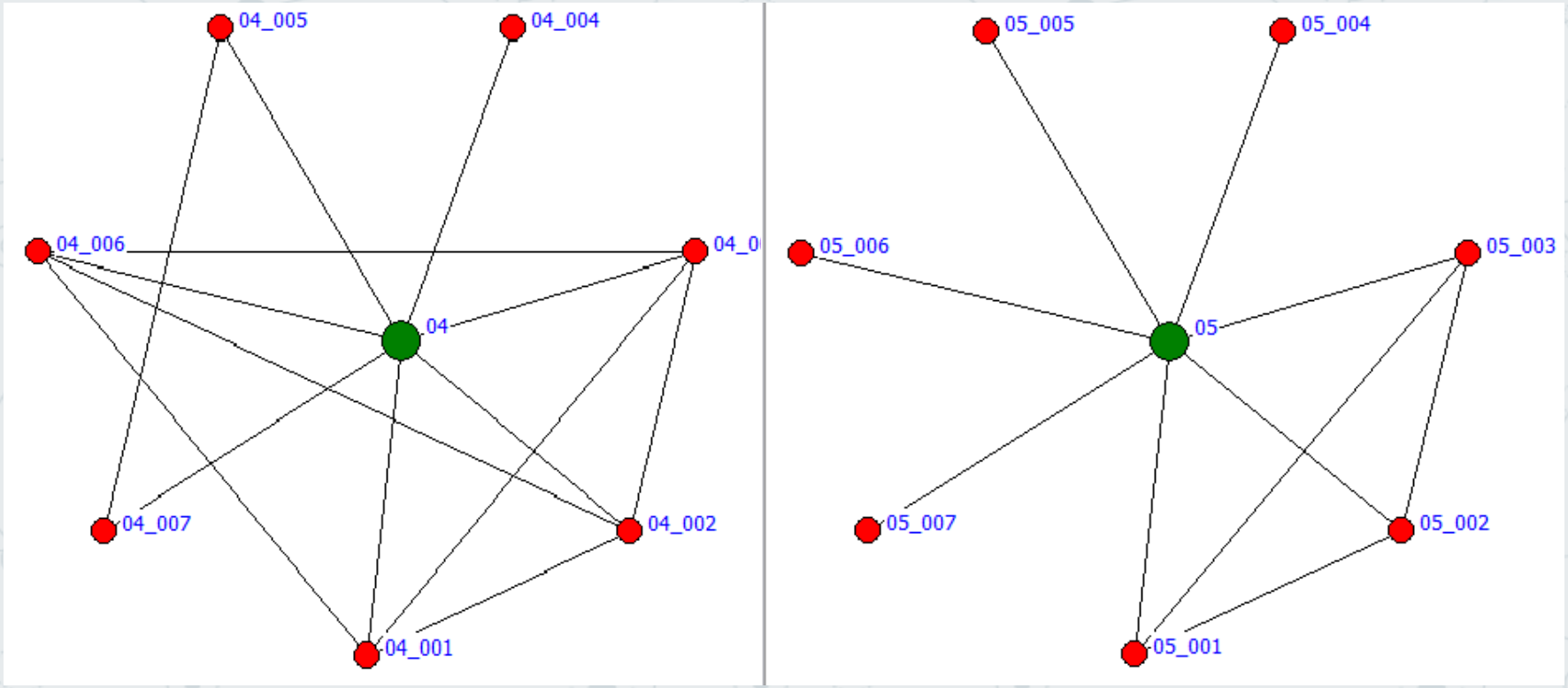


Egocentric Network Research

- Focuses on personal networks of individual people
  - The ego is the "hub" of the network
- Constrained by the environments and activities in which the ego is embedded
- Fits well within standard social/behavioral research
- Helps us understand if characteristics or structures present within personal networks associate with the ego in a meaningful way




A
B
Female
Male
FitWell member
Not a member
Friend
Coworker
Spouse
Supportive
Not supportive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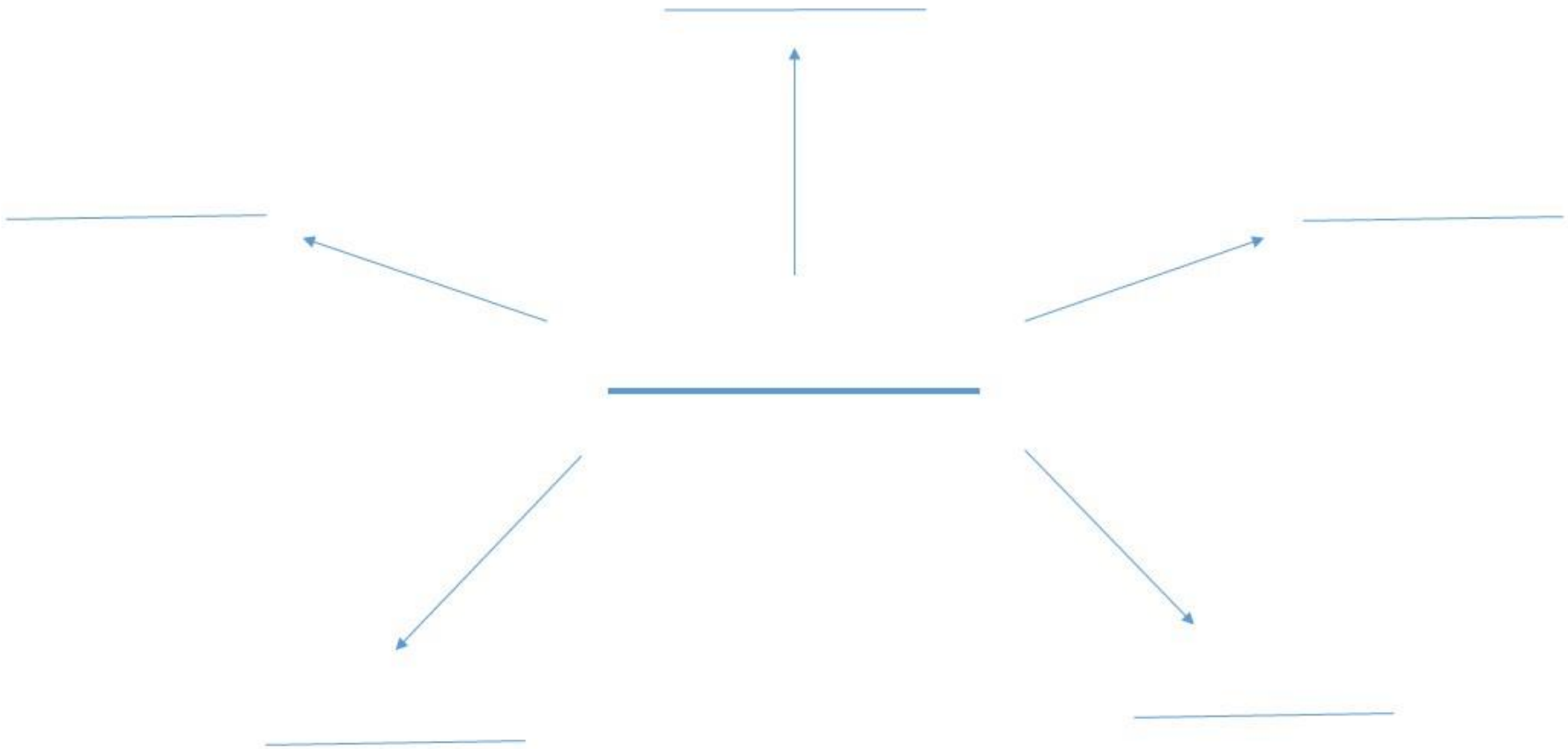
Egocentric Network Activity

Please have a piece of paper and pen ready!



Egocentric Network Measures

- Composition
- Homophily
- Heterogeneity
- Structural Holes

Egocentric Network Examples and Research Questions

Journal of Physical Activity and Health, 2018, 15, 755-762
https://doi.org/10.1123/jpah.2017-0570

Human Kinetics
ORIGINAL RESEARCH

The Role of Ego Networks in Compulsive Exercise Behavior Among a Sample of College Sorority Women

Megan S. Patterson and Patricia Goodson

Background: Compulsive exercise (CE) is a harmful form of exercise that elevates the risk of developing/sustaining clinical eating disorders. College-aged sorority women are especially prone to CE. Due to the pronounced impact social relationships have on college students' behavior, this study aims to examine personal networks and CE among a sample of sorority women through an egocentric network analysis. **Methods**: A total of 204 women in a sorority from a large, private university in the southeastern United States completed a cross-sectional survey in spring 2015. Descriptive and regression analyses were conducted on demographic, attribute, and ego network data. **Results**: Relationships with siblings, significant others, and roommates were protective against CE in this sample. Conversely, body dissatisfaction and exercise frequency predicted CE. **Conclusions**: Findings suggest that social relationships can impact CE behaviors in this sample. Along with promoting body satisfaction and healthy exercise, public health efforts should focus on facilitating close interpersonal relationships, especially between sorority women and siblings, significant others, and roommates.

Keywords: social networks, personal networks, disordered exercise, obligatory exercise, social health

Egocentric Network Examples and Research Questions

JOURNAL OF AMERICAN COLLEGE HEALTH
https://doi.org/10.1080/07448481.2019.1679150

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MAJOR ARTICLE

Check for updates

Social networks, group exercise, and anxiety among college students

M. S. Patterson, PhD, MPH[a,b], L. R. Gagnon, MPH[b,c], A. Vukelich, MSEd[b], S. E. Brown, BSPH[a,b], J. L. Nelon, MPH[a], and T. Prochnow, MEd[d]

[a]Department of Health & Kinesiology, Texas A&M University, College Station, Texas, USA; [b]Division of Student Life, Baylor University, Waco, Texas, USA; [c]Missouri Council for Activity & Nutrition, University of Missouri Extension, Columbia, Missouri, USA; [d]Department of Health, Human Performance, and Recreation, Baylor University, Waco, Texas, USA

ABSTRACT

Objective: This study aimed to evaluate the relationship between group exercise membership, social network characteristics, and general state anxiety in a sample of college students. **Participants:** 490 undergraduates from a private university in the southern US participated in the study. **Methods:** An egocentric network analysis was conducted to test whether demographic variables, leisure-time physical activity, group exercise membership, flourishing scores, and network variables were related to anxiety. **Results:** Regression analyses ($R^2 = .174$, $F = 7.650$, $p < .0001$) suggest group exercise membership ($\beta = -.105$, $p = .034$) and flourishing scores ($\beta = -.342$, $p < .0001$) were related to lower anxiety scores, while being a racial/ethnic minority ($\beta = .094$, $p = .036$), and having personal networks composed of more people who exercise often ($\beta = .100$, $p = .025$), were related to higher anxiety scores in this sample. **Conclusions:** Findings suggest a connection between group exercise membership, activity habits of peers, and anxiety. Encouraging group exercise participation could be an effective way of combating anxiety for college students.

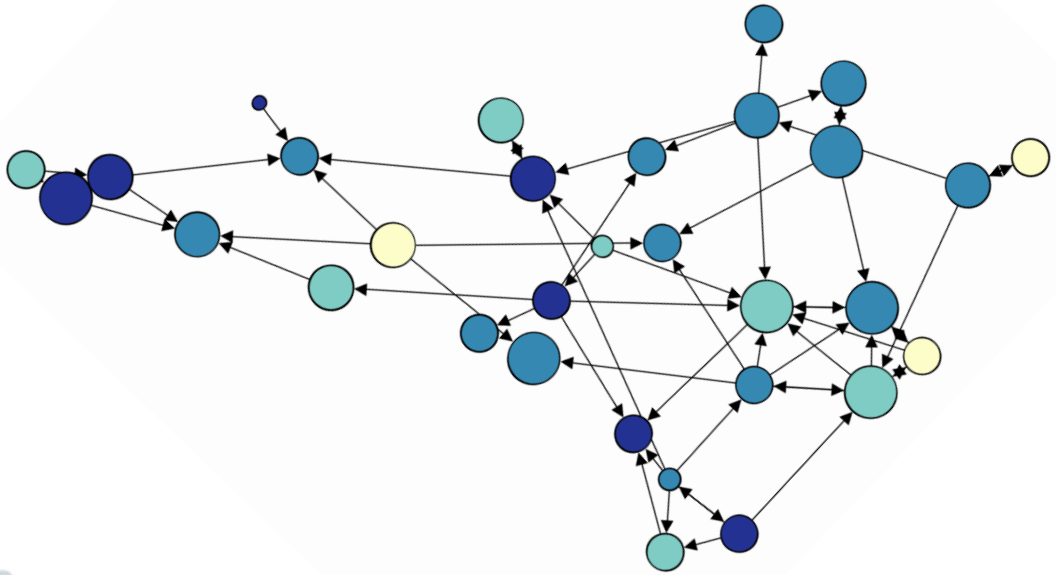
ARTICLE HISTORY
Received 10 February 2019
Revised 21 July 2019
Accepted 6 October 2019

KEYWORDS
Egocentric networks; mental health; physical activity; social support

Let’s Take a Break!

Whole Network Research

- Considers all sets of ties among all members of a given network
- All alters in a whole network are egos, and all egos are alters
  - No longer a focal ego
- Allows for individual, group, and network level analysis



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Whole Network Measures: Centrality

- A property of a person's position in a network
  - Where does someone "land" in relation to other nodes in a network?
- Central nodes usually carry positions of popularity, power, and prestige
  - Centrality typically implies structural importance
- Central nodes often have influence in behavior spread across a network
- Over 100 calculations/centrality measures exist!

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Whole Network Measures: Centrality

- Degree - The number of links to and from a node; number of other points to which a given point is adjacent
  - “Activity”
  - In- and Out- Degree
- Eigenvector Centrality - Nodes who are closely connected to centrally located nodes
  - Connected to powerful nodes

*

Whole Network Measures: Centrality

- Betweenness - Frequency to which a node lies on the shortest path connecting everyone else in the network
  - “Control”
  - Occupies a strategic position in the network – Information sharing
- Closeness – Distance to all other nodes.
  - Dependence or reachability
  - In- and Out-closeness
  - Isolate problems

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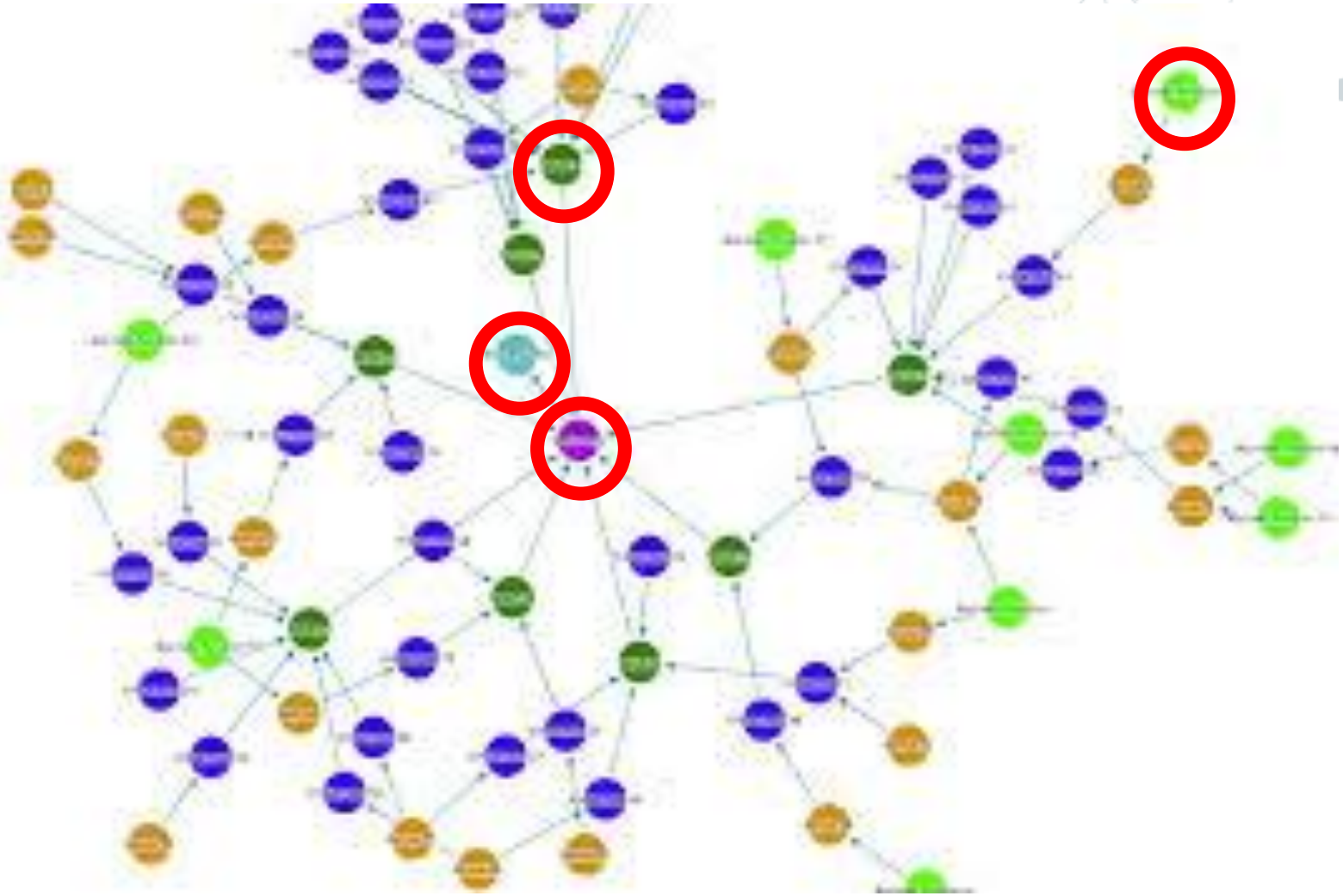
Centrality

- Degree
- Eigenvector
- Betweenness
- Closeness



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Whole Network Measures: Group-Level

- Component (most basic): all nodes that can reach one another through any number of steps
- K-core: subset of the network in which each node is connected to at least K other people
- Clique: all members of a group are connected to all members of that group

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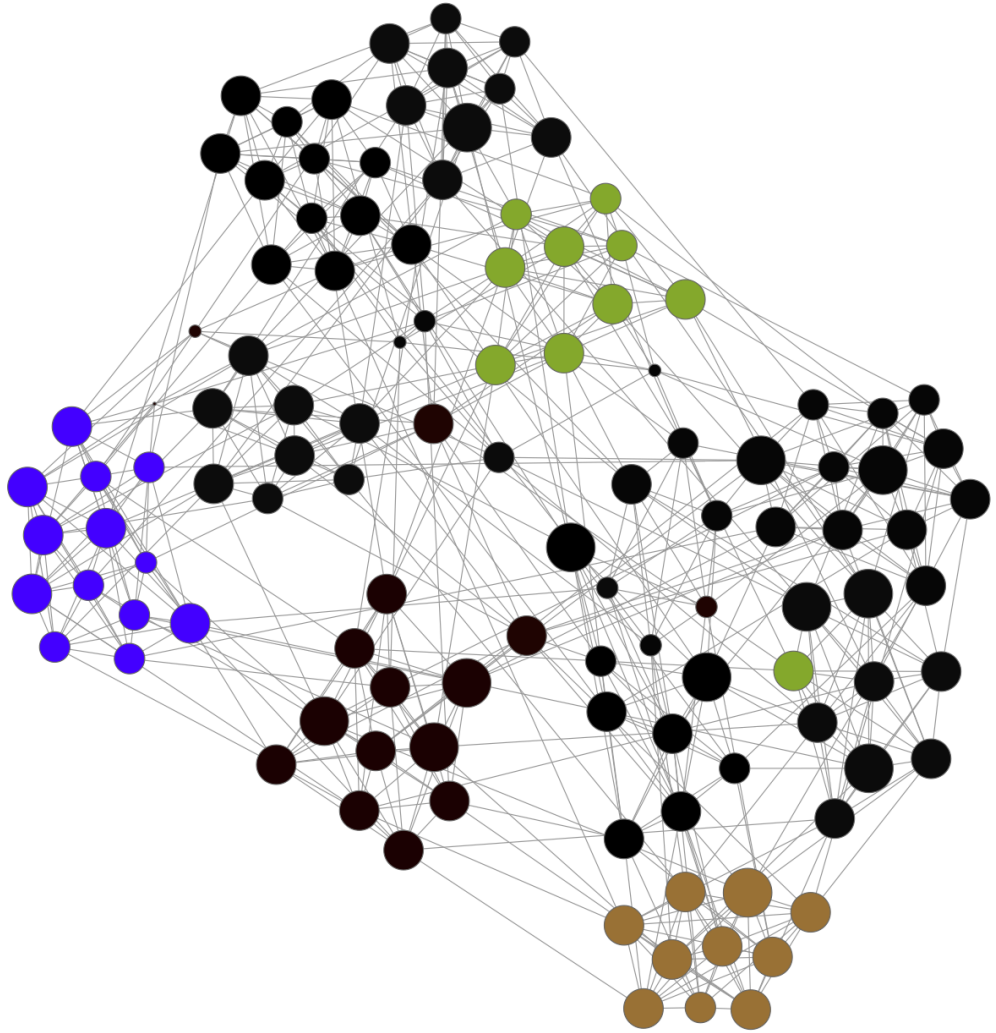
Group-Level Measures



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Whole Network Measures: Network-Level

- Calculated on the whole network (as opposed to each node)
- Investigates the network from a global (or bird's eye) perspective

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- Density
- Average path length
- Centralization
  - Centralized → Hierarchical
  - Decentralized → evenly distributed ties
  - A function of the variance in individual centrality score

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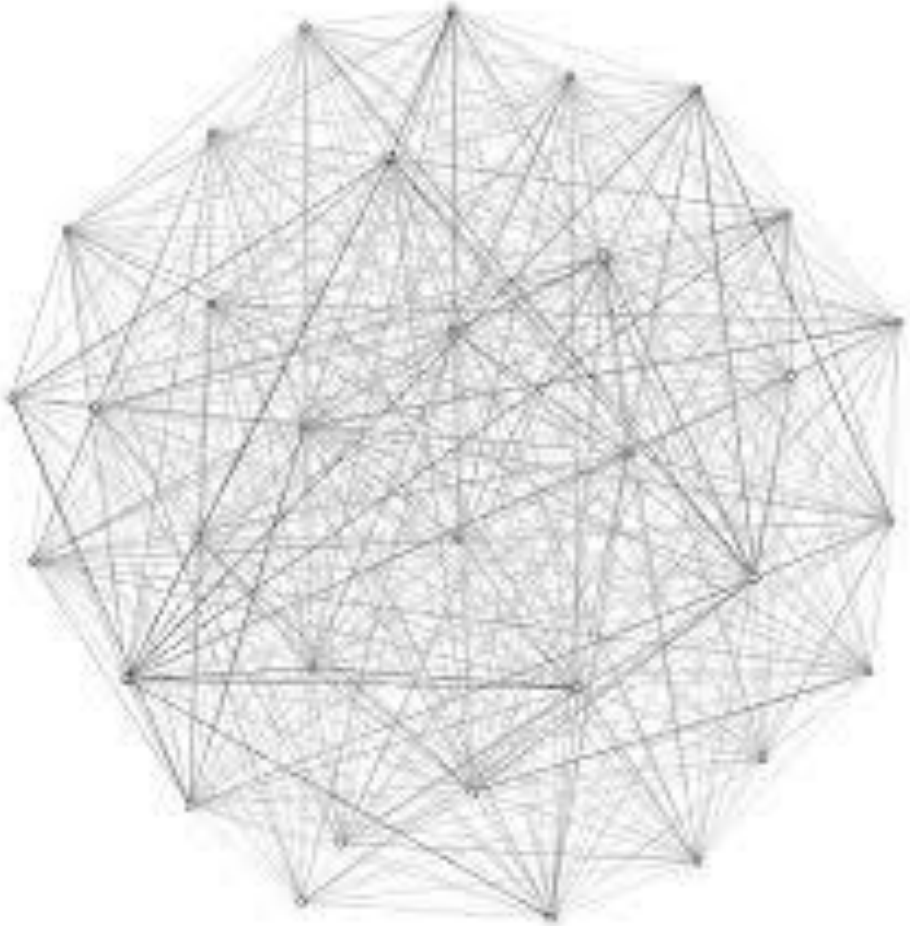
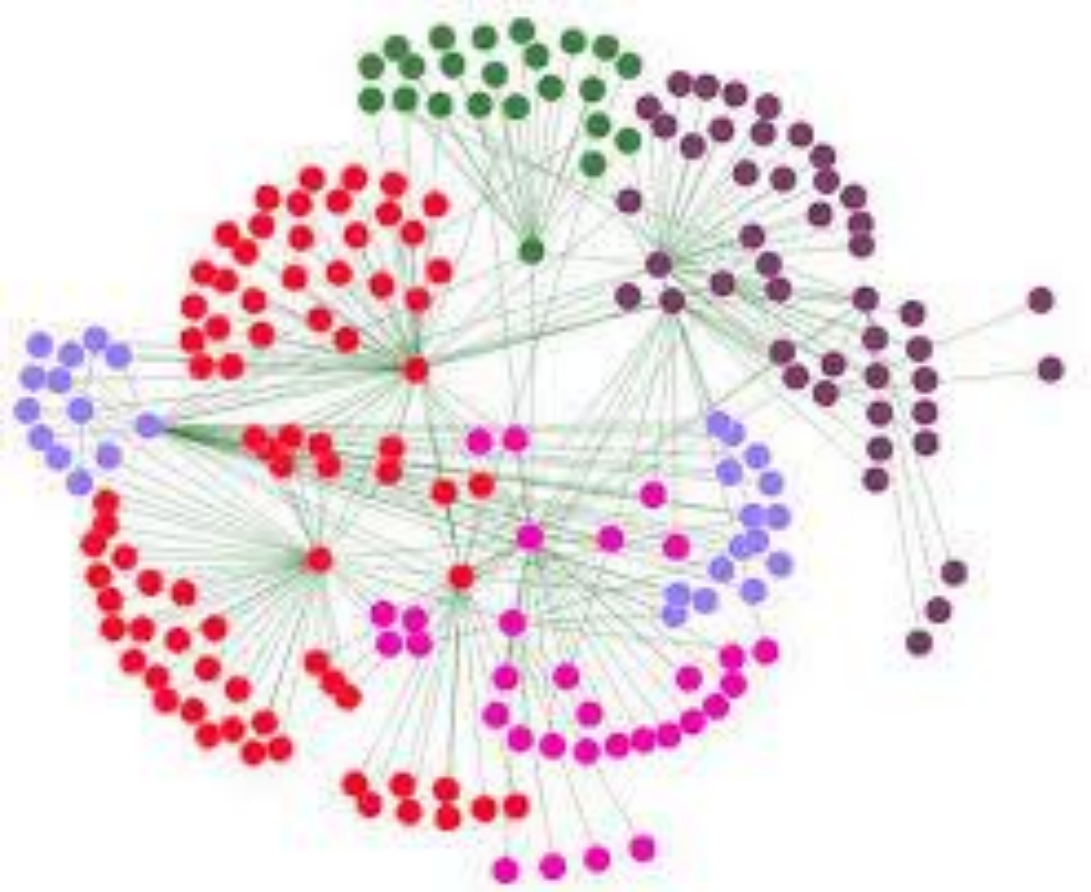
Density and Centralization





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Whole Network Examples and Research Questions

JOURNAL OF AMERICAN COLLEGE HEALTH
https://doi.org/10.1080/07448481.2019.1657121

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Check for updates

MAJOR ARTICLE

A social network approach to analyzing body dissatisfaction among sorority members using two network generators

Tyler Prochnow, MEd[a], Megan S. Patterson, PhD[b], and M. Renée Umstattd Meyer, PhD, MCHES[c]

[a]Department of Health Human Performance and Recreation, Baylor University, Waco, TX, USA; [b]Department of Health and Kinesiology, Texas A&M University, College Station, TX, USA; [c]Department of Public Health, Baylor University, Waco, TX, USA

ABSTRACT

Objective: This article uses social network analysis (SNA) to analyze how various measures of social connectedness relate to body dissatisfaction (BD) in sorority members.
Participants: 208 sorority members participated in the study.
Methods: Measures of social connectedness (network variables) were created based on two relational networks: persons members felt closest to and persons they spent the most time with. SNA tested whether demographic variables, body mass index (BMI), compulsive exercise, and network variables were related to BD in both networks.
Results: Members reported BD was related to less social connectedness in the "close-to" and the "time-spent" networks, although specific network variables varied between the two. Compulsive exercise, BMI, and grade classification were related to BD in both networks.
Conclusions: How a sorority member connects to others in her network could impact BD in this population. This study supports efforts facilitating increased social connection within a sorority as a means to decrease BD.

ARTICLE HISTORY
Received 13 December 2018
Revised 24 June 2019
Accepted 13 August 2019

KEYWORDS
Body image; Greek life; social network analysis

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Whole Network Examples and Research Questions

Social support, depressive symptoms, and online gaming network communication

Tyler Prochnow, Megan S. Patterson and Logan Hartnell

Abstract

Purpose – *The increase of videogame use has raised concerns regarding mental health of gamers (e.g. social isolation, depression); however, online gaming may offer the benefit of social connectivity. Many games provide ways for people to meet and interact, providing social opportunities difficult to come by for some young adults. One way to investigate social connection is through social network analysis, which explores the influence of connections on behaviors. The purpose of this paper is to analyze factors related to social connections within an online gaming community, with an emphasis on the influence of social support and depressive symptoms on network ties.*

Design/methodology/approach – *All members of an online gaming site were asked to report demographics, site use, depressive symptoms, "in-real-life" (IRL) social support, and online social support. Members were also asked to nominate those in their gaming network with whom they spoke to about important life matters. Moran's I determined the spatial autocorrelation of depressive symptoms and IRL support within the network. Exponential random graph modeling determined factors significantly associated with tie presence between members.*

Findings – *Members (n = 37) were significantly more likely to speak to other members about important life matters if they reported more site hours, more depressive symptoms, and less IRL support. Depressive symptoms and IRL support were not significantly spatially autocorrelated within this network.*

Originality/value – *Results suggest members may be filling an IRL social support deficit with friends they have met online. Additionally, members who reported more depressive symptoms may be seeking help from informal online connections through online gaming.*

Keywords *Social support, Social network analysis, Depressive symptoms, Help seeking, Online gaming*

Paper type *Research paper*

Tyler Prochnow is based at the Baylor University, Waco, Texas, USA.
Megan S. Patterson is based at the Texas A&M University College Station, College Station, Texas, USA.
Logan Hartnell is based at the Adler University, Chicago, Illinois, USA.

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Let’s Take a Break!

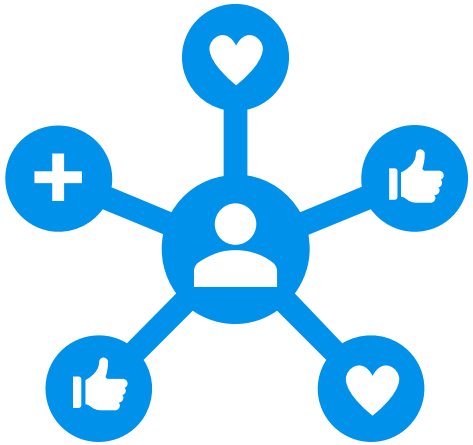
Data Collection and Management

Survey Design

- Network Generator – question or prompt which generates a list of alters related to a specific relationship or connection
  - Connect, interact, communicate, influence
- Name interpreters – questions designed to collect information regarding the alters listed above
  - Gender, age, frequency of contact, perception of activity/support
- Alter interrelater – questions designed to determine connections between alters
  - Does Meg know Tyler?
  - Details structural holes

Egocentric

- Can use all three – generator, interpreter, interrelater
- Alter names are not needed – why?
- Collect information on alters from the ego's perspective
  - Alter Limits – Some surveys limit the number of alters an ego can nominate



Egocentric Example

bit.ly/egoexample

22-26.	22. Person 1	23. Person 2	24. Person 3	25. Person 4	26. Person 5
a. Person X Initials / Name					
b. Is [Person X] a boy or girl?	☐ Boy ☐ Girl	☐ Boy ☐ Girl	☐ Boy ☐ Girl	☐ Boy ☐ Girl	☐ Boy ☐ Girl
c. What is your relationship to [Person X]? (Are they your…)	☐ Mother ☐ Father ☐ Sibling ☐ Friend ☐ Relative ☐ Other: _____	☐ Mother ☐ Father ☐ Sibling ☐ Friend ☐ Relative ☐ Other: ____	☐ Mother ☐ Father ☐ Sibling ☐ Friend ☐ Relative ☐ Other: ____	☐ Mother ☐ Father ☐ Sibling ☐ Friend ☐ Relative ☐ Other: ____	☐ Mother ☐ Father ☐ Sibling ☐ Friend ☐ Relative ☐ Other: ____
d. How old is [Person X]?					
e. Does [Person X] live….?	☐ In your household ☐ In your neighborhood ☐ Outside your neighborhood ☐ I don't know	☐ In your household ☐ In your neighborhood ☐ Outside your neighborhood ☐ I don't know	☐ In your household ☐ In your neighborhood ☐ Outside your neighborhood ☐ I don't know	☐ In your household ☐ In your neighborhood ☐ Outside your neighborhood ☐ I don't know	☐ In your household ☐ In your neighborhood ☐ Outside your neighborhood ☐ I don't know
f. How often do you actively play with [Person X]?	☐ Often ☐ Sometimes ☐ Never	☐ Often ☐ Sometimes ☐ Never	☐ Often ☐ Sometimes ☐ Never	☐ Often ☐ Sometimes ☐ Never	☐ Often ☐ Sometimes ☐ Never
g. How many hours per week do you think [Person X] usually exercises in their free time, so much	☐ None ☐ About half an hour ☐ About one hour ☐ About 2-3	☐ None ☐ About half an hour ☐ About one hour ☐ About 2-3	☐ None ☐ About half an hour ☐ About one hour ☐ About 2-3	☐ None ☐ About half an hour ☐ About one hour ☐ About 2-3	☐ None ☐ About half an hour ☐ About one hour ☐ About 2-3

Whole Network

- Only uses name generator
  - All other elements are reported by the others in the network
- Roster based - supplies a roster of names from the bounded network
  - Can be helpful to match names
  - May be difficult with large networks or not possible if you do not have all of the names
- Free recall - the ego supplies names from memory
  - Larger networks or networks in which you do not know all members
  - May be difficult to match names (Bob/Robert)
- Both come with a level of bias – roster may lead to over reporting, free recall may lead to under reporting

*

Whole Network - Example

bit.ly/wholenetwork

For the following questions please refer to the Organization ID Sheet. Please list all, if any, organizations that fit each question. Please write the ID followed by a comma for multiple answers.

Which organizations within the OPHCC, if any, have you collaborated with most frequently in the past year? (please list as many organizations that apply)

_____

_____

_____

Which organizations within the OPHCC, if any, have you competed with most frequently in the past year? (please list as many organizations that apply)

_____

_____

_____

Which organizations within the OPHCC, if any, does your organization have non-financial formal agreements with? (please list as many organizations that apply)

*

Survey Administration

- Researcher administered
- Online surveys – can be difficult based on software
- Nomination limits
- Roster / Recall

*

Software Available (collection)

- EgoWeb2.0
- PARTNER
- Network Canvas
- Enso (formerly OpenEddi)
- Qualtrics

*

Other types of collection

- Observational networks
- Natural networks
- Cognitive mapping
- Public record
- Two-mode networks

*

Two-Mode Networks

- Nodes are not connected to each other but are connected through a second type of node (mode)
- Example:

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Data Files

- Relational data: connects one node to another
- Edgelist: easiest form – A-B, B-C, A-D
- Matrix: all members are listed on X and Y axis, 1 is placed in each cell which a connection is present a 0 is placed if there is no connection

	A	B	C	D	E
A	-	1	1	0	1
B	1	-	1	0	0
C	0	0	-	1	0
D	0	1	0	-	0
E	1	0	0	0	-

A	B
A	C
A	E
B	A
B	C
C	D
D	B
E	A

Data Files

- Attribute table – file containing all ego information
- Demographics, outcome variables, etc.

	Age	BMI	PA	PHQ-9	Sex
A	30	20	5	3	1
B	25	25	4	6	0
C	19	30	3	2	1
D	28	22	5	1	0
E	38	25	4	4	0

Group Case Study

Activity

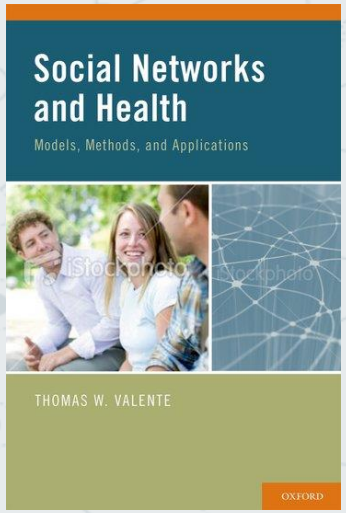
- Develop a network study based on shared interest
- Objectives:
  - Identify the network
    - What are your Nodes and Ties?
    - Egocentric or whole?
  - What research question are you answering?
  - What variables are you measuring?
    - Attributes? Relational?
  - How will you collect data
    - Network generators, interpreters, interrelaters?
- 2-3 minute elevator pitch report to group

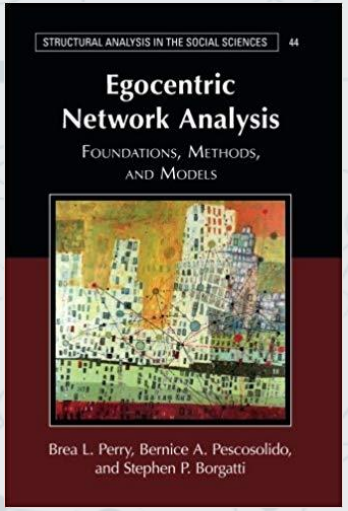
*

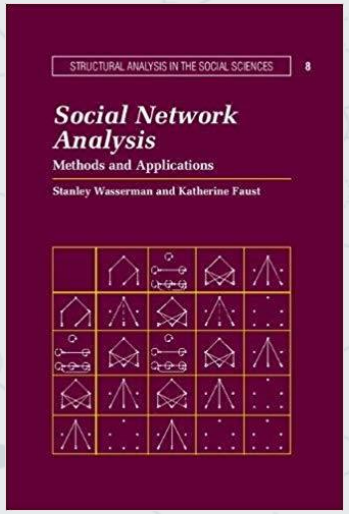
Resources

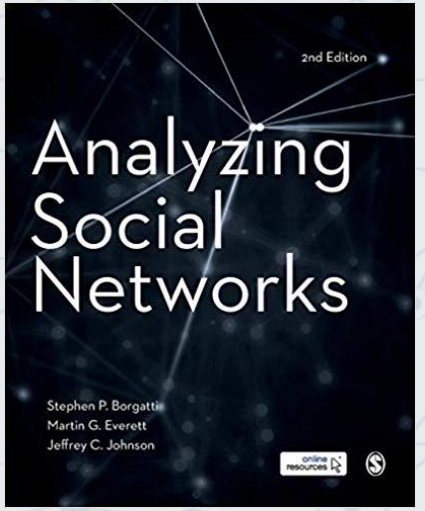
Add these to your reading list:

Social Networks and Health: Models, Methods, and Applications – Thomas Valente
Egocentric Network Analysis – Brea Perry, Bernice Pescosolido, and Stephen Borgatti
Social Network Analysis: Methods and Applications – Stanley Wasserman and Katherine Faust
Analyzing Social Networks – Stephen Borgatti, Martin Everett, and Jeffrey Johnson
Network Science – Albert-Laszlo Barabasi (networksciencebook.com)









Other Resources

- Massive Open Online Courses
- Conferences and Trainings
  - International Network for Social Network Analysis
  - Duke Network Analysis Center
  - LINKS (University of Kentucky)

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Final Words

Questions or Comments?

http://bit.ly/SNApostworkshop

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Tyler Prochnow
Tyler_prochnow1@baylor.edu
Tprochnow.com

Contact Info

Megan S. Patterson
megpatterson@tamu.edu
Megpatterson.netlify.com