Introduction to Social Network Analysis in Active Living

Tyler Prochnow

Meg Patterson

Bit.ly/snaworkshop

Introductions

This is a “network” workshop, after all!

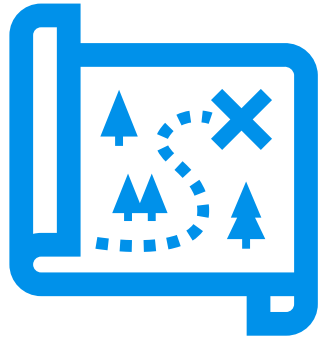
Tell us your name, affiliation, and if we were visiting where you live, what would be one thing we would need to SEE, DO, or EAT?

What's in store?

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

Agenda

- SNA Background, Terms, and Theory
- Whole Networks
- Personal Networks
- 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

"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 data is different!

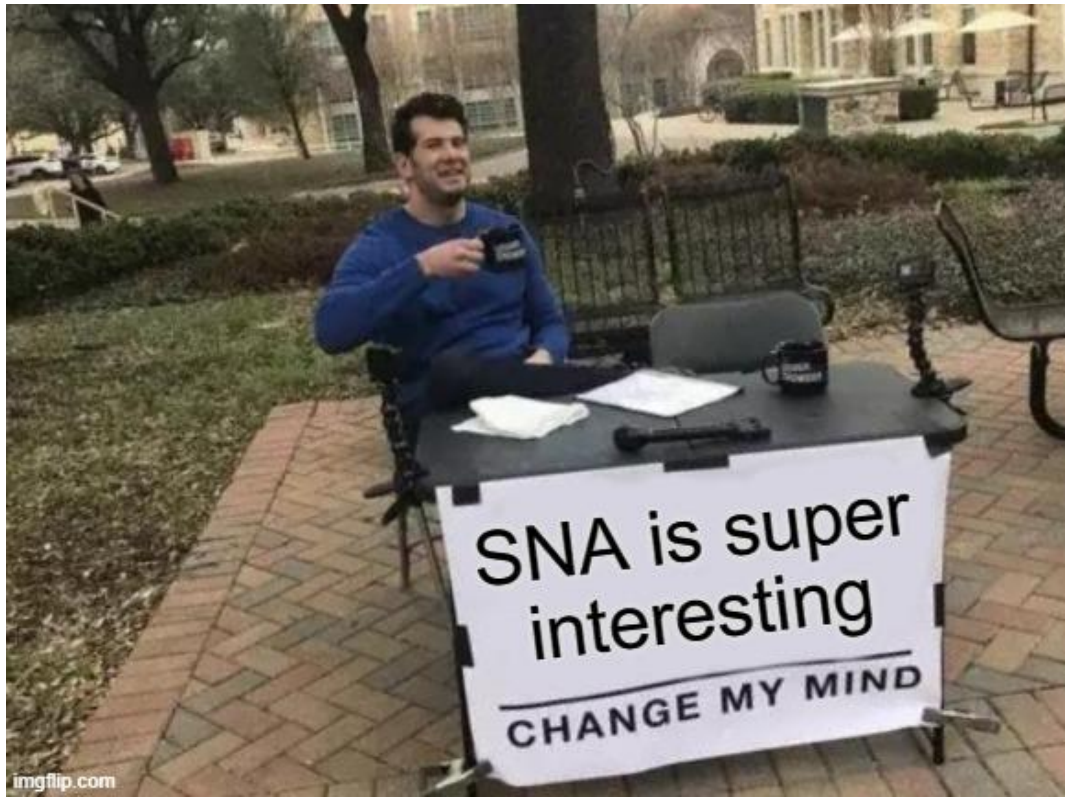
- Independence is NOT assumed
  - Actually, that's an irresponsible way to think, according to network theory
- "The whole is more than the sum of its parts"
  - Nonlinearity
  - Inputs and outputs
  - Variance explained

Why Might We Need SNA?

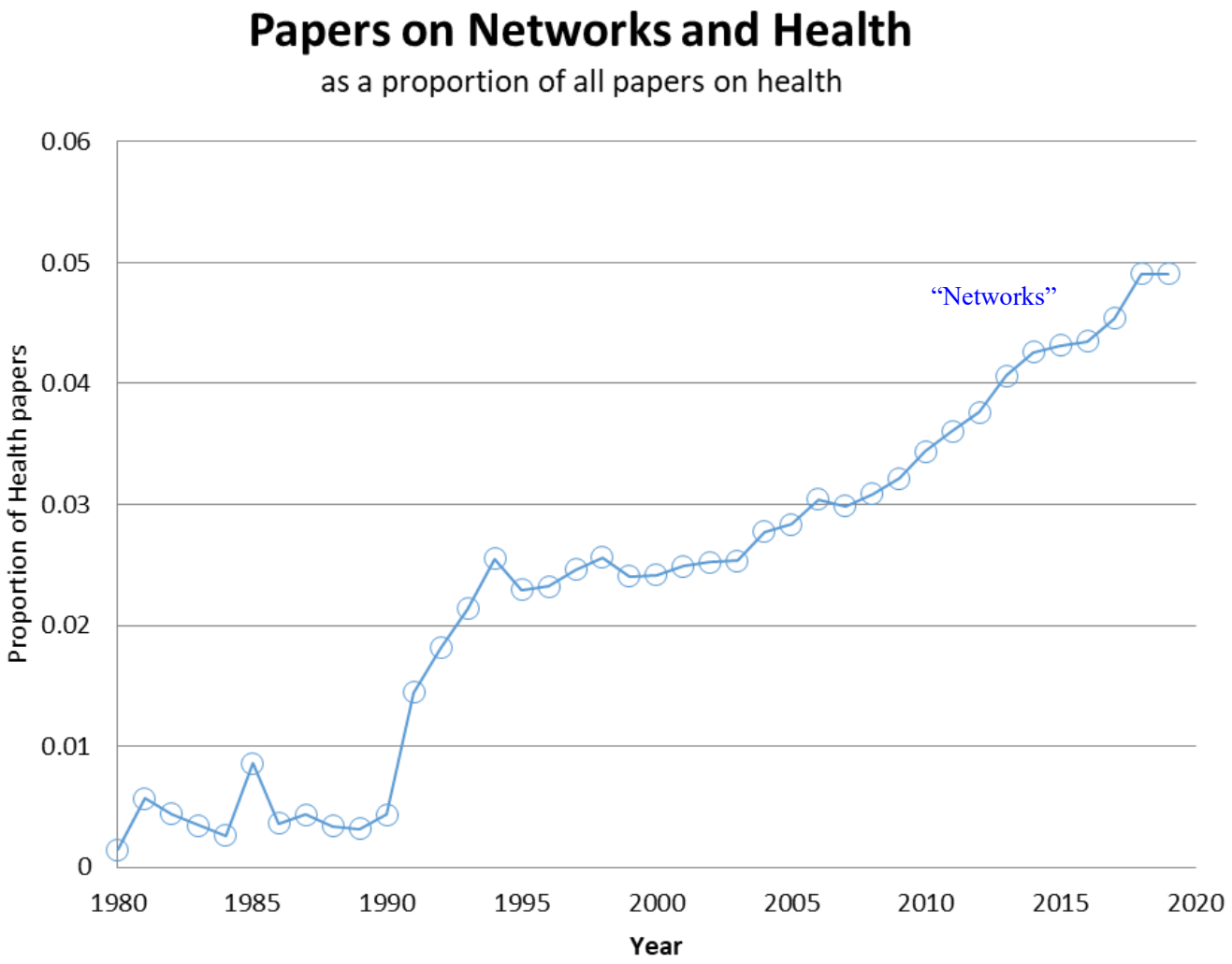
- Dissatisfaction with attribute theories of behavior
- “Qualintative”
- More realistic modeling of human behavior
  - Behaviors and diseases spread through social contacts, so model that!
- Develop better programs/interventions!

Why Might We Need SNA?

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



SNA in Health



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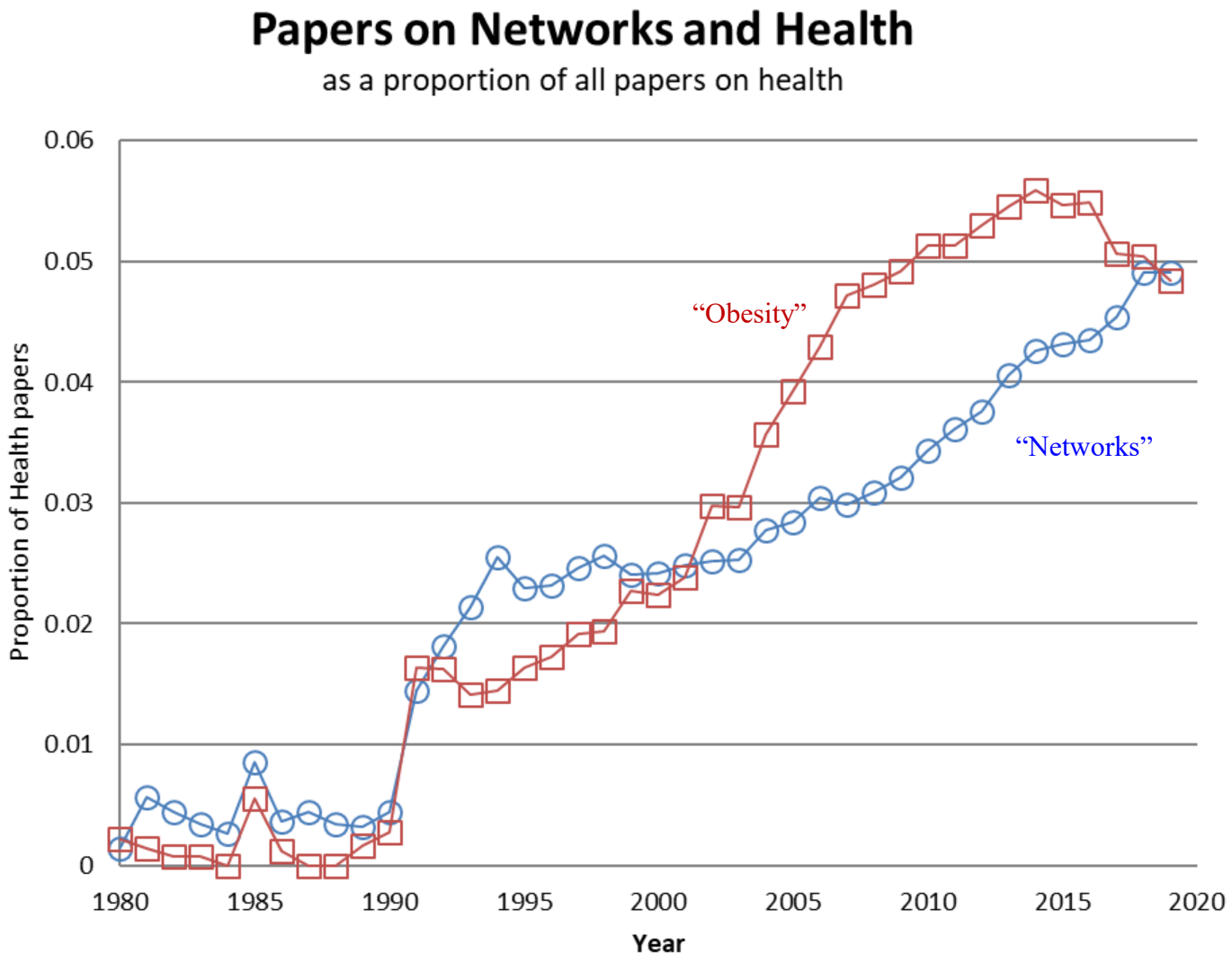
SNA in Health



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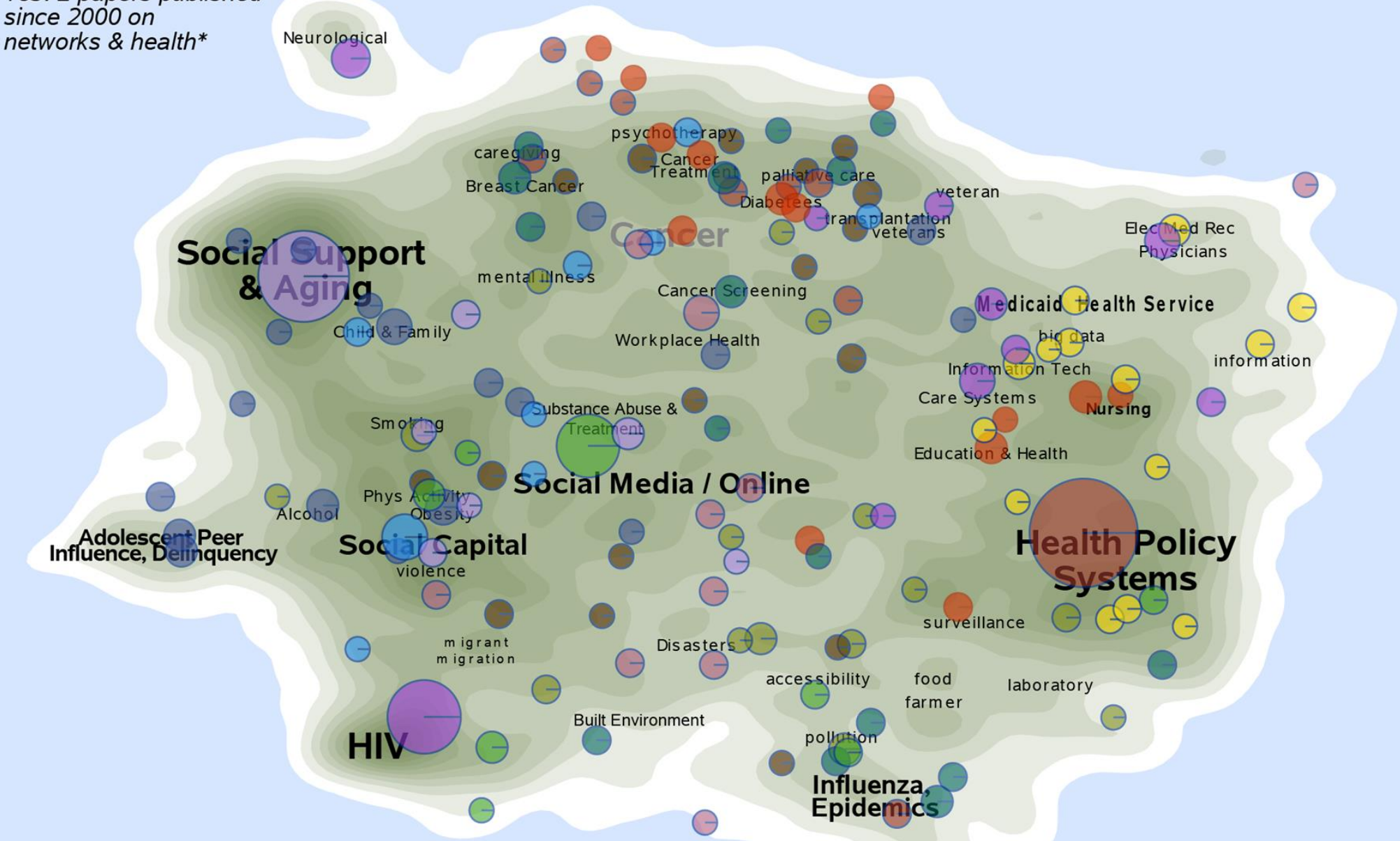
Social Networks & Health Intellectual Landscape

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



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

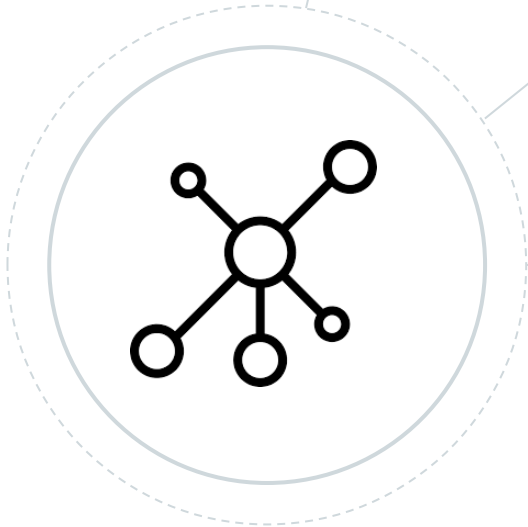
What questions can we answer?

- 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

Important Terms

Starting with the basics

Network



A group of individual entities
connected in a meaningful way

Node/Actor/Agent

Individual units

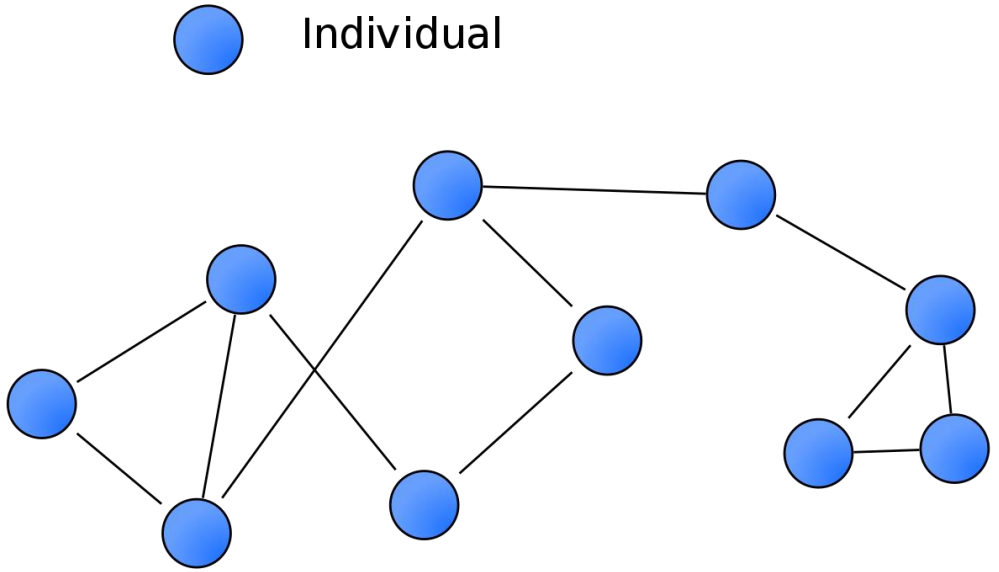
Can be many things!

- 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: Boys & Girls Club
  - Nodes: Children at the club
  - Ties: Friendships
- 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, but aren't.

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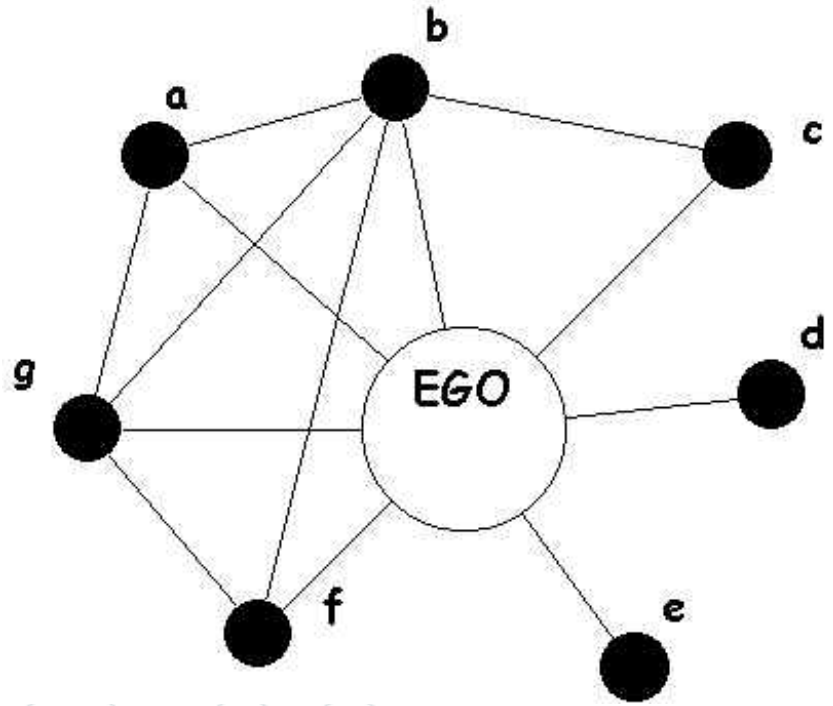
Two Approaches to SNA

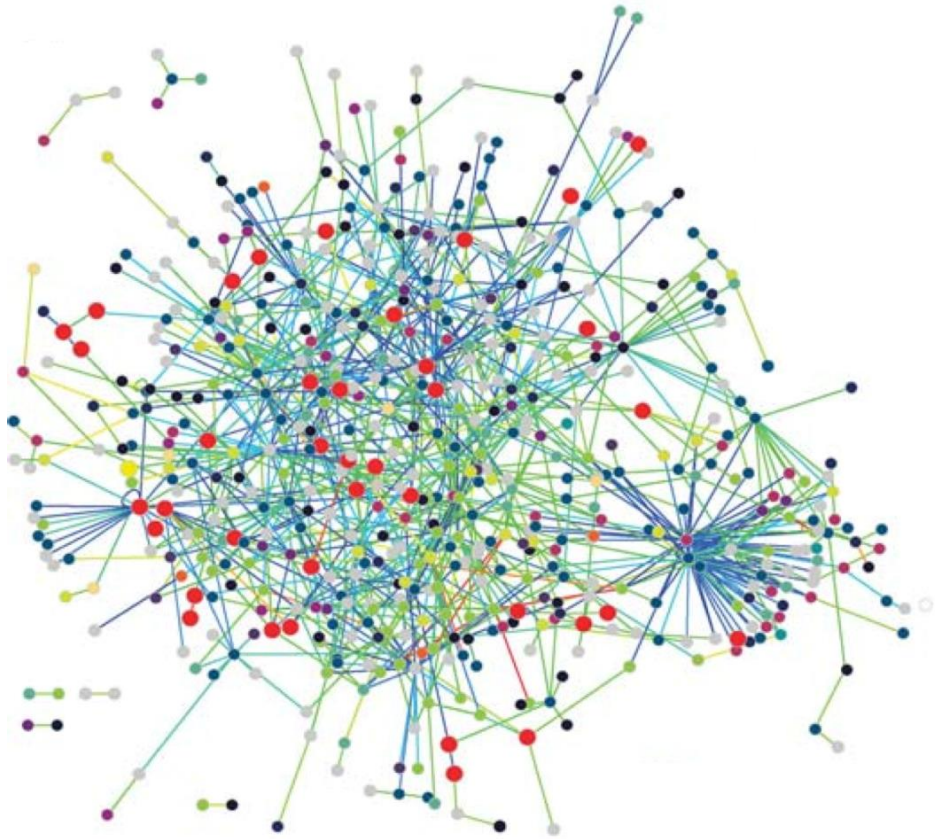
Egocentric and Whole Network Research

Egocentric vs. Whole Networks

Egocentric Network

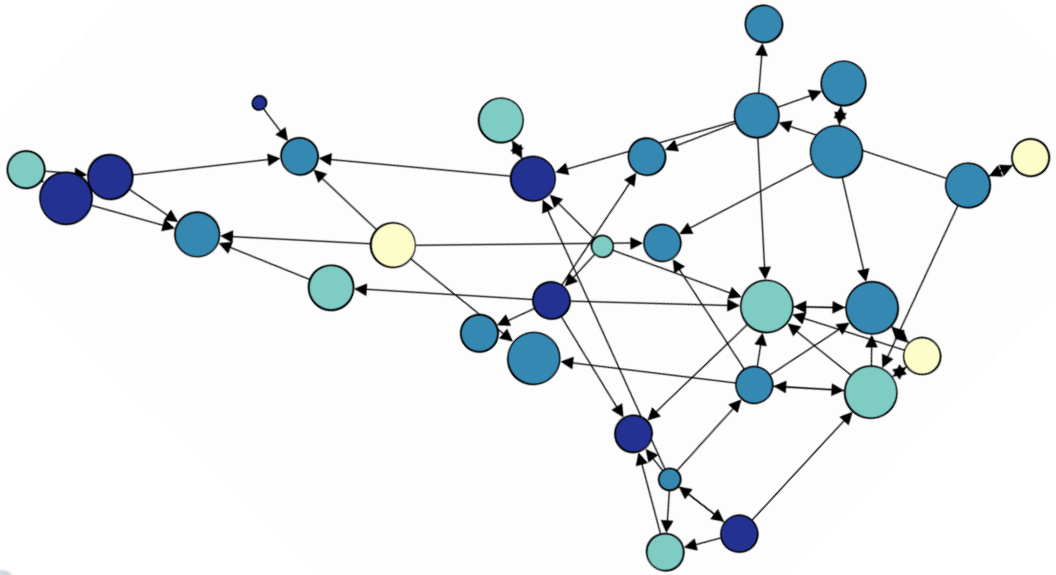


Whole Network



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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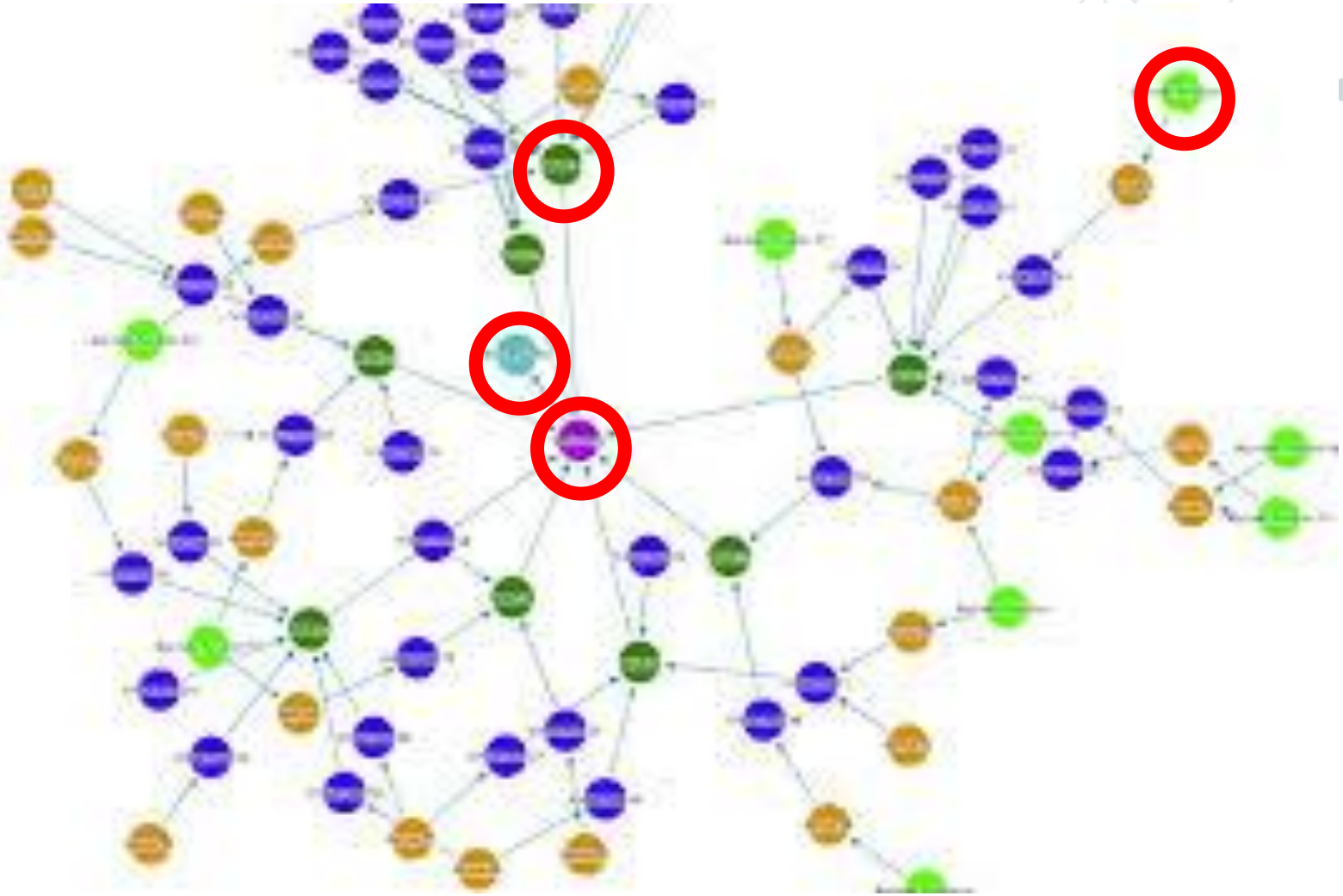
Centrality

- 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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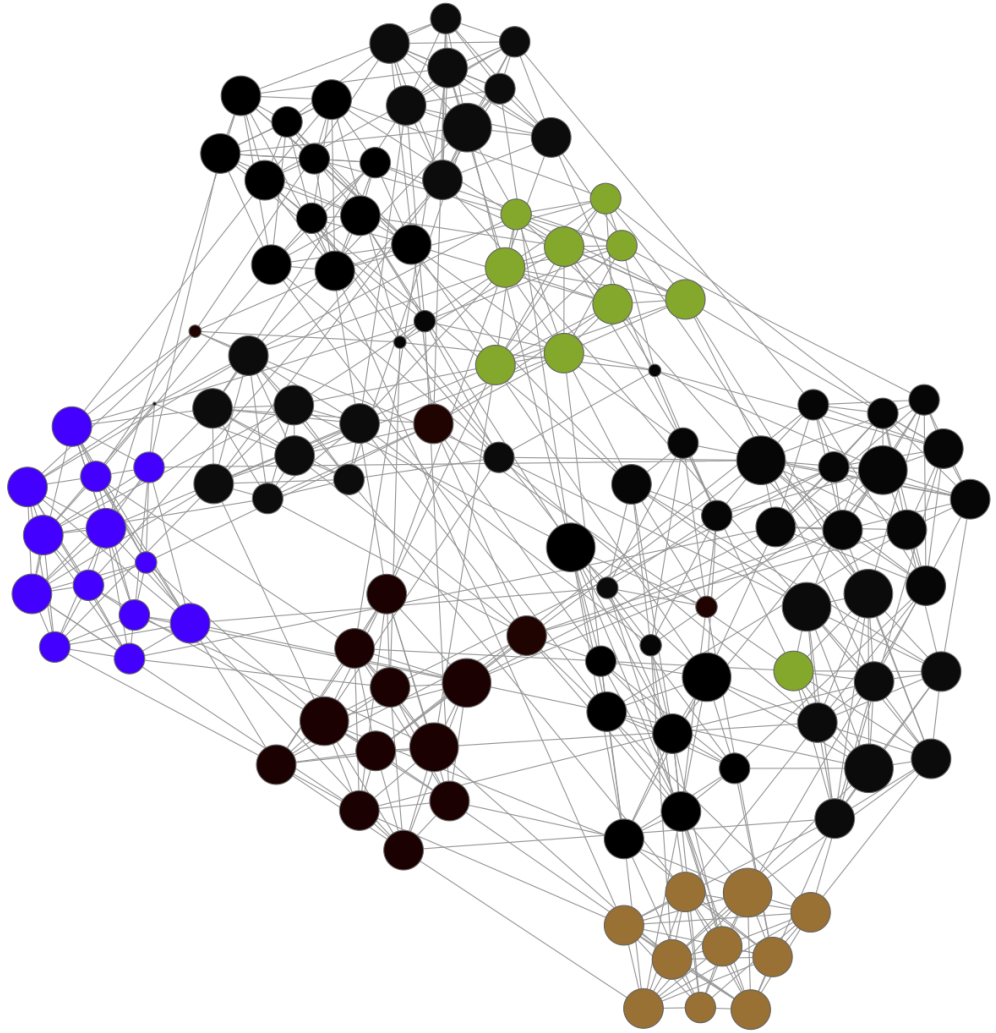
Group-Level Measures



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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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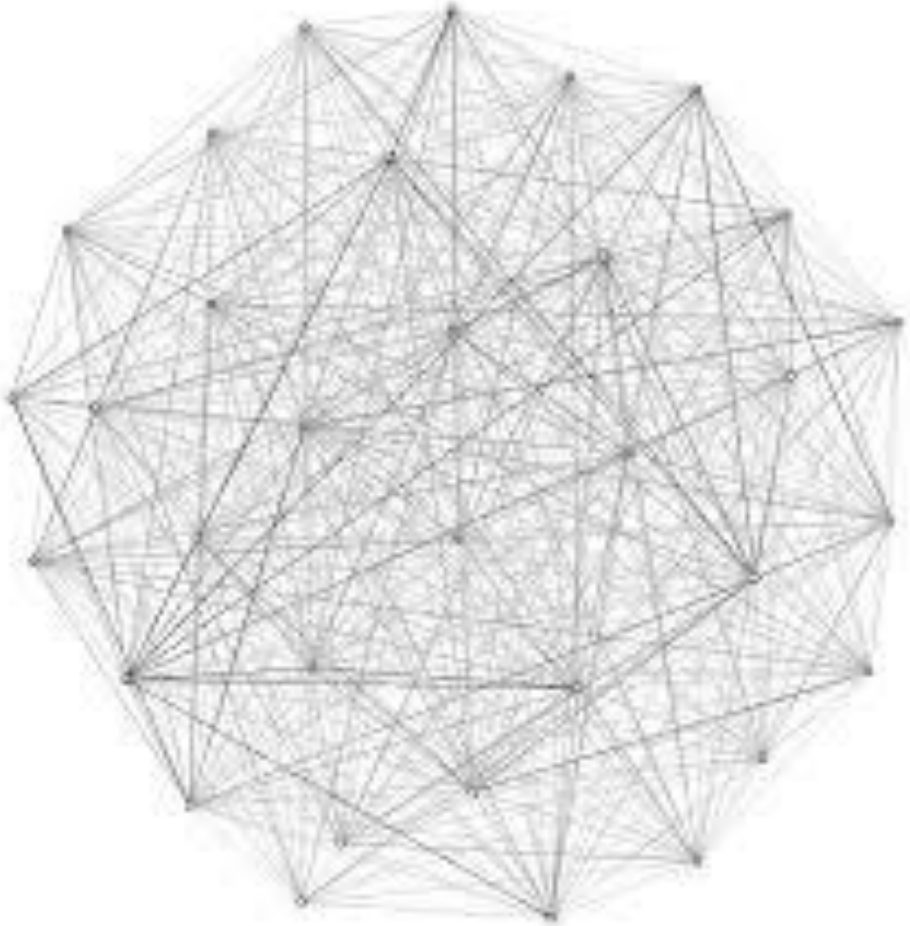
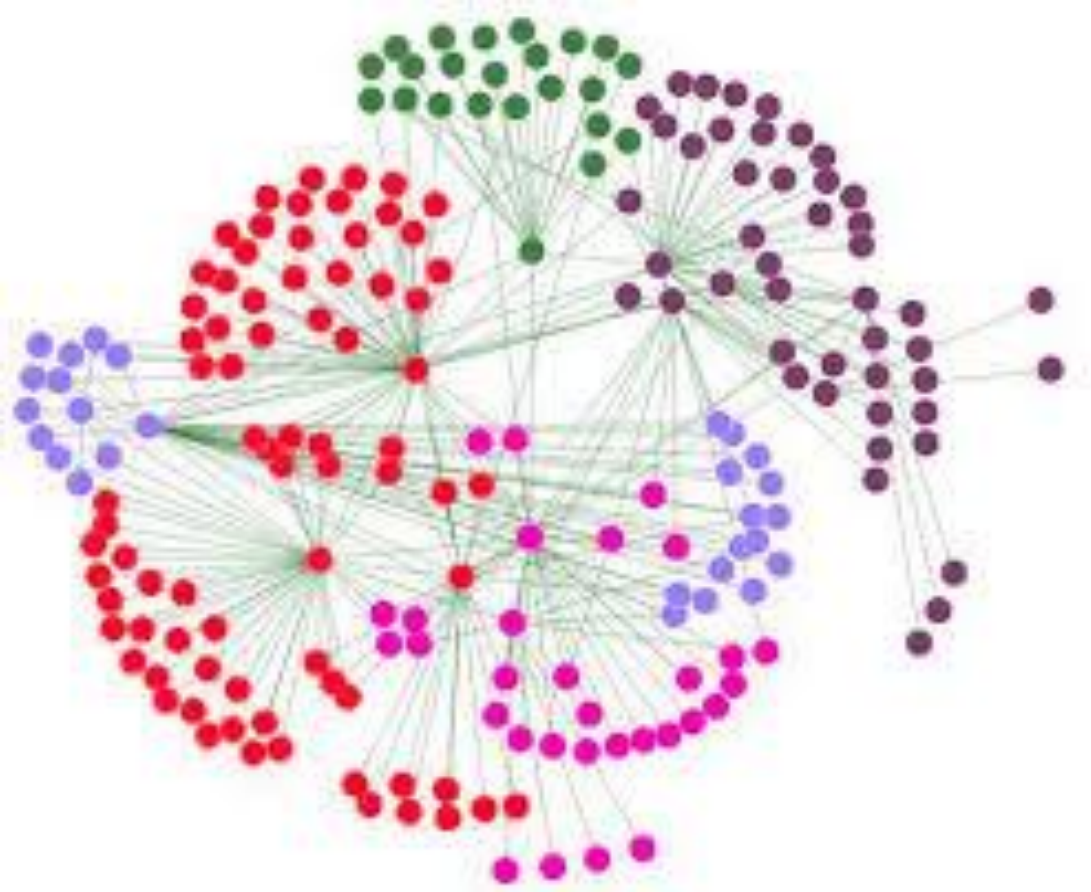
Density and Centralization





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Whole Network Examples and Research Questions

Article

HEALTH EDUCATION & BEHAVIOR

Health Education & Behavior
1–10

DOI: 10.1177/10901981221076399
journals.sagepub.com/home/heb
SAGE

Summer Friends and Physical Activity: Social Network Effects on Child Self-Reported Physical Activity at Summer Care Programs

Tyler Prochnow, PhD, MEd[1], Megan S. Patterson, PhD[1], Christina N. Bridges Hamilton, MPH[2], and M. Renée Umstattd Meyer, PhD, MCHES, FAAHB[3]

Abstract

Summer is a time of reduced physical activity (PA) for children; however, summer care programs (SCPs) can provide opportunities for children to be active and foster friendships. This study investigated associations between PA and friendship formation at SCPs. Children (ages 8–12 years) from two SCPs reported demographics, PA, and up to five friends at the program. Exponential random graph modeling determined significant factors associated with connections at each time point and between time points. PA was a significant factor in sending and maintaining friendship connections. A further understanding of the social dynamics which assist in the maintenance of PA behaviors during summer may improve the odds children engage in the recommended amounts of PA during this crucial time.

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Whole Network Examples and Research Question

The current issue and full text archive of this journal is available on Emerald Insight at:
https://www.emerald.com/insight/1477-7266.htm

Health coalition collaboration network, perceived satisfaction and success

Tyler Prochnow
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Megan S. Patterson and Joseph Sharkey
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Baylor University, Waco, Texas, USA

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Accepted 22 September 2020

Abstract

Purpose – The health equity and prosperity of communities is closely linked to the effectiveness and success of local health coalitions. Social network analysis (SNA) is one mechanism to quantify and understand the factors leading to collaboration and effectiveness within these coalitions. This study aims to investigate network characteristics associated with perceived success and satisfaction in a health coalition and determine significant factors related to organizational collaborations.

Design/methodology/approach – This study examined the Olympic Peninsula Healthy Community Coalition (OPHCC) which aims to prevent chronic disease in rural Clallam County, Washington. Representatives (n = 21) from member organizations (n = 18) were asked to report on organization characteristics, perceived satisfaction in coalition activities, perceived success toward coalition's mission, and collaborations with other organizations in the coalition. Multilevel modeling used to analyze whether an organization's position within the coalition network was associated with their perceived satisfaction and perceived success. Exponential random graph modeling was used to examine what factors may impact collaboration ties between coalition members.

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Whole Network Examples and Research Questions

Journal of Physical Activity and Health, (Ahead of Print)
https://doi.org/10.1123/jpah.2019-0655

Human Kinetics
ORIGINAL RESEARCH

Network Effects on Adolescents' Perceived Barriers to Physical Activity

Tyler Prochnow, Thabo J. van Woudenberg, and Megan S. Patterson

Background: Adolescent physical activity (PA) is widely linked to positive health outcomes. Unfortunately, 80% of adolescents do not meet recommendations, which may be due to perceived barriers to PA. Peer interactions significantly affect adolescent PA behaviors. This study aims to analyze distribution of PA barriers throughout adolescent friendship networks and barriers' associations with PA. **Methods**: Adolescents (N = 383, mean = 10.77 y, SD = 1.30 y, 51.4% male) reported frequency of experiencing PA barriers (body related, social, fitness, convenience, and resource) and names of their friends. Average steps and minutes of moderate- to vigorous-intensity PA per day were measured using accelerometers. Linear network autocorrelation models determined if friends perceived barriers similarly when compared with nonfriends and analyzed relationships between barriers and objective PA measures while controlling for network effects. **Results**: Moderate- to vigorous-intensity PA, steps per day, body-related barriers, and social barriers displayed significant network effects, suggesting significant association with the scores of their friends. Average steps per day were significantly associated with age, sex, and social barriers, while inversely associated with fitness barriers. **Conclusions**: This research suggests adolescents' perceived PA barriers are significantly associated with those of their friends. Researchers and practitioners aiming to reduce barriers to PA among adolescents may wish to assess peer reinforcing effects.

Keywords: accelerometry, behavioral science, health behavior, social network analysis, friends

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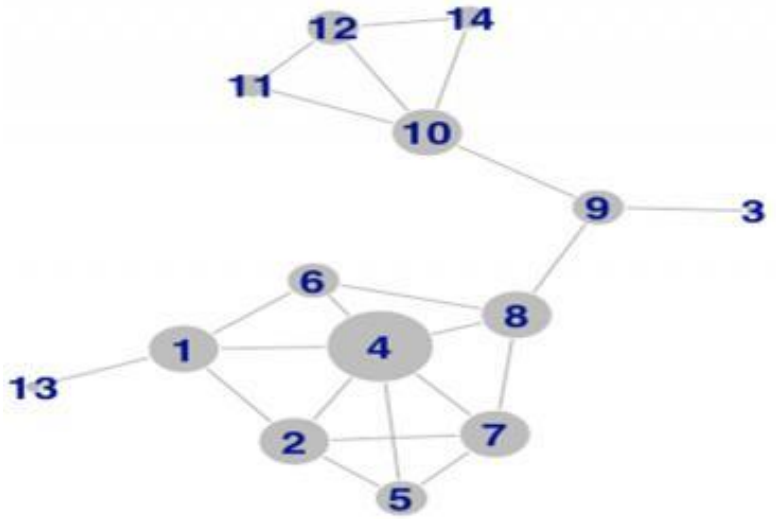
Centrality Activity

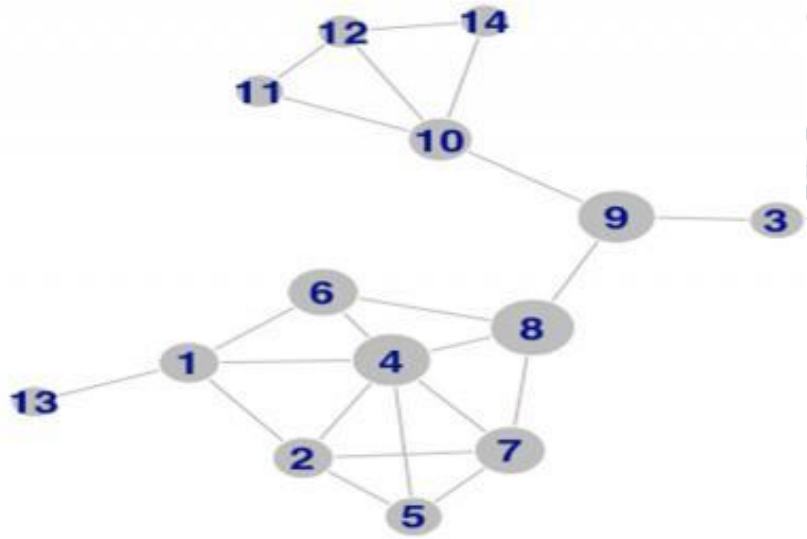
- Stolen secrets from drawer in office.
- 5 suspects (not in the room): Adam, Brandon, Erica, Jake, Lisa
- Can only speak to the people you work with (listed on next slide)
- Each Round you can exchange one clue (any clue you have been given) with one person you work with (Dyadic exchange)
- Track clues on sheet.
- Rounds will last 1 minute

1	2	4	6	13		
2	1	4	5	7		
3	9					
4	1	2	5	6	7	8
5	2	4	7			
6	1	4	8			
7	2	4	5	8		
8	4	6	7	9		
9	3	8	10			
10	9	11	12	14		
11	10	12				
12	10	11	14			
13	1					
14	10	12				

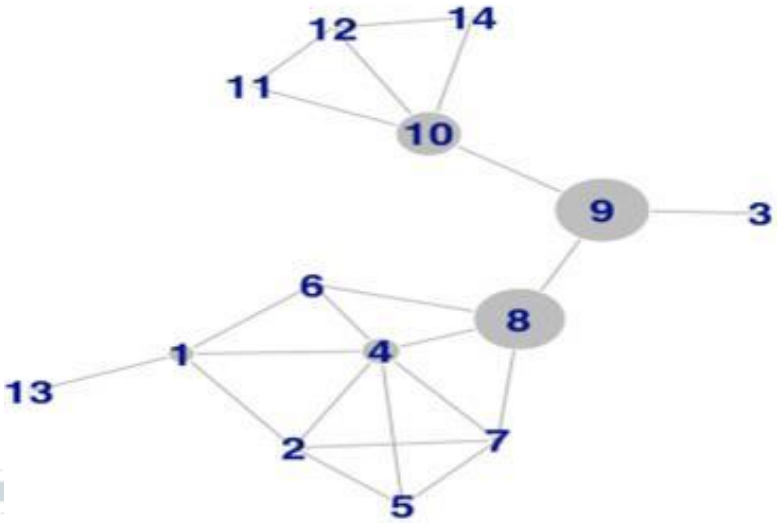
Degree Centrality



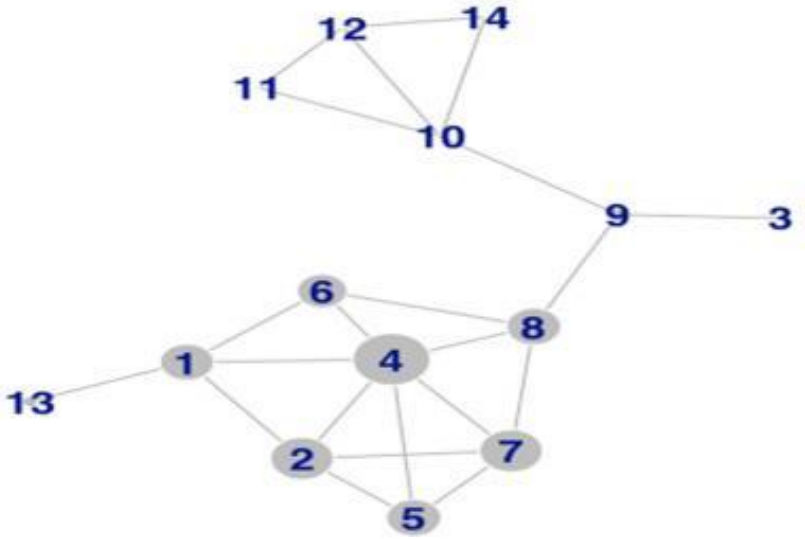
Closeness Centrality



Betweenness Centrality

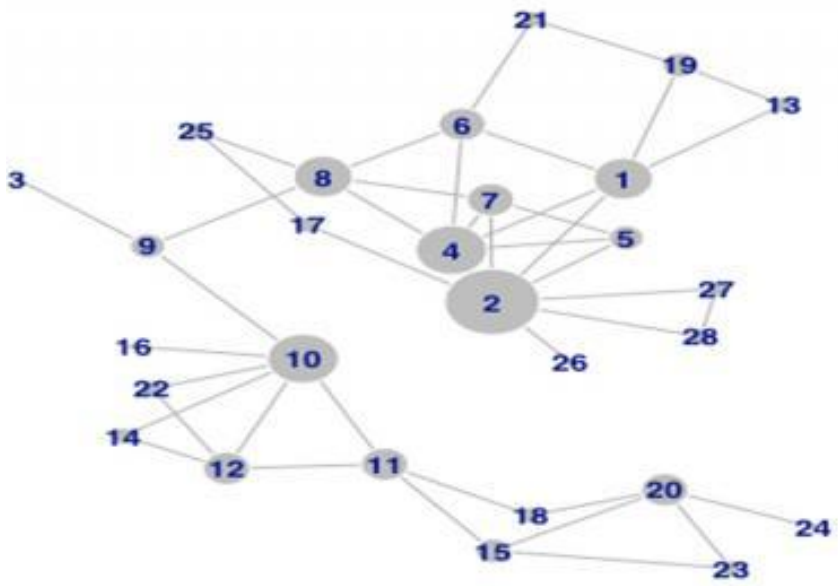


Eigenvector Centrality

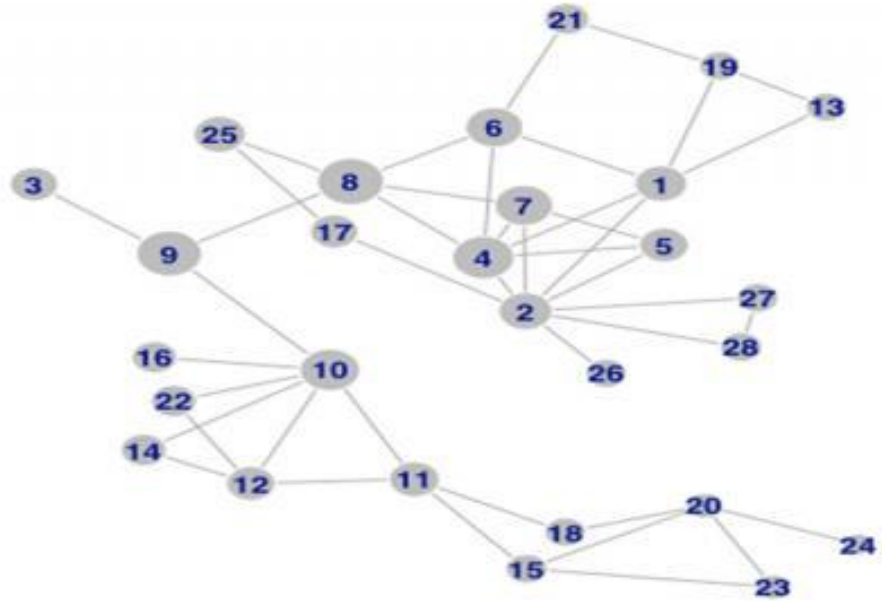


1	2	4	6	13	19			
2	1	4	5	7	17	26	27	28
3	9							
4	1	2	5	6	7	8		
5	2	4	7					
6	1	4	8	21				
7	2	4	5	8				
8	4	6	7	9	25			
9	3	8	10					
10	9	11	12	14	16	22		
11	10	12	15	18				
12	10	11	14	22				
13	10	19						
14	1	12						
15	11	20	23					
16	10							
17	2	25						
18	11	20						
19	1	13	21					
20	15	18	23	24				
21	6	19						
22	10	12						
23	15	20						
24	20							
25	8	17						
26	2							
27	2	28						
28	2	27						

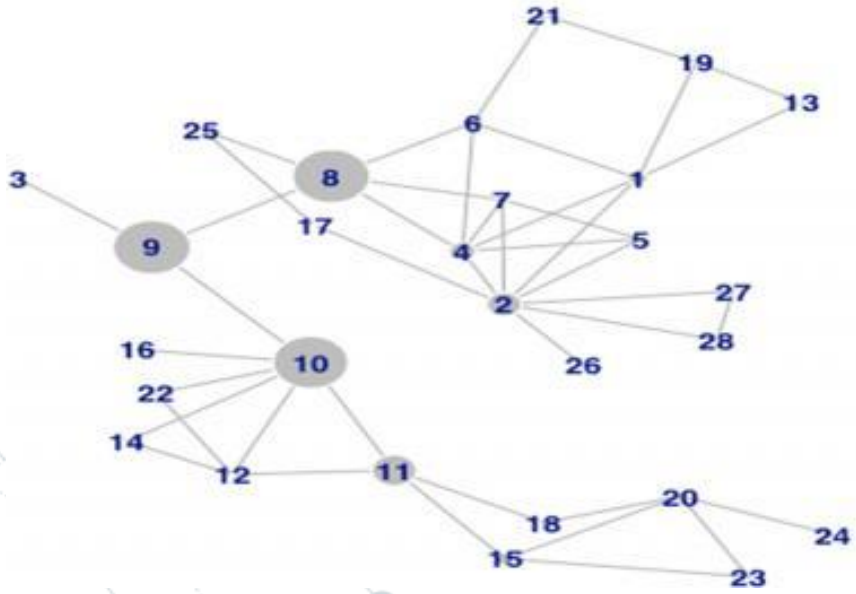
Degree Centrality



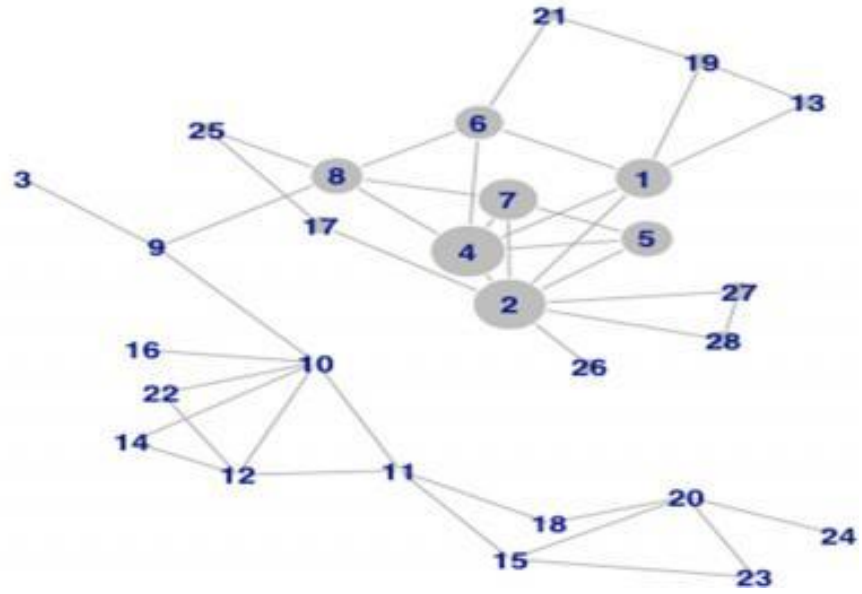
Closeness Centrality



Betweenness Centrality



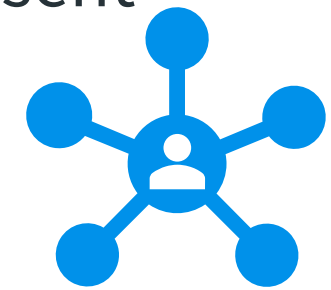
Eigenvector Centrality

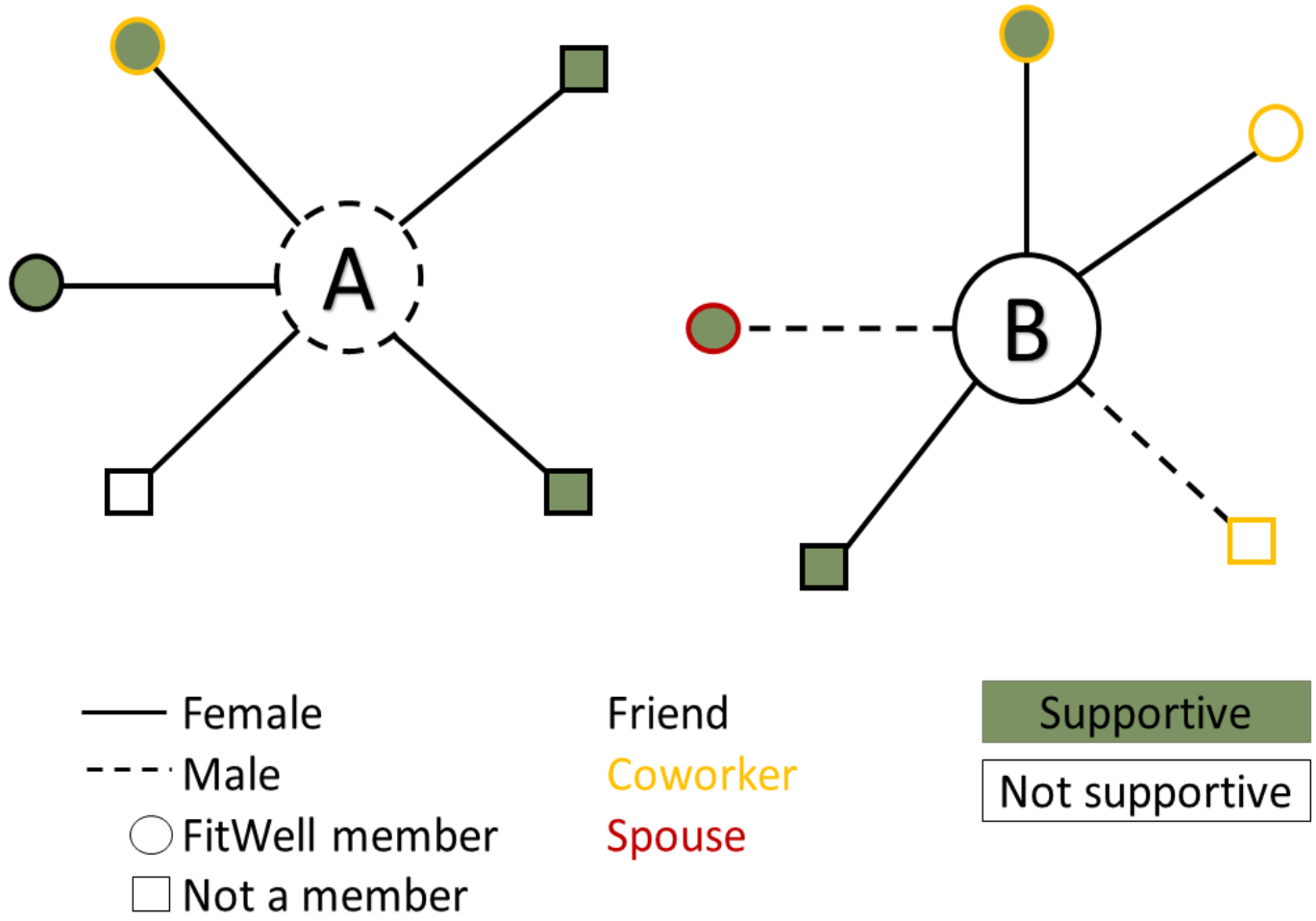


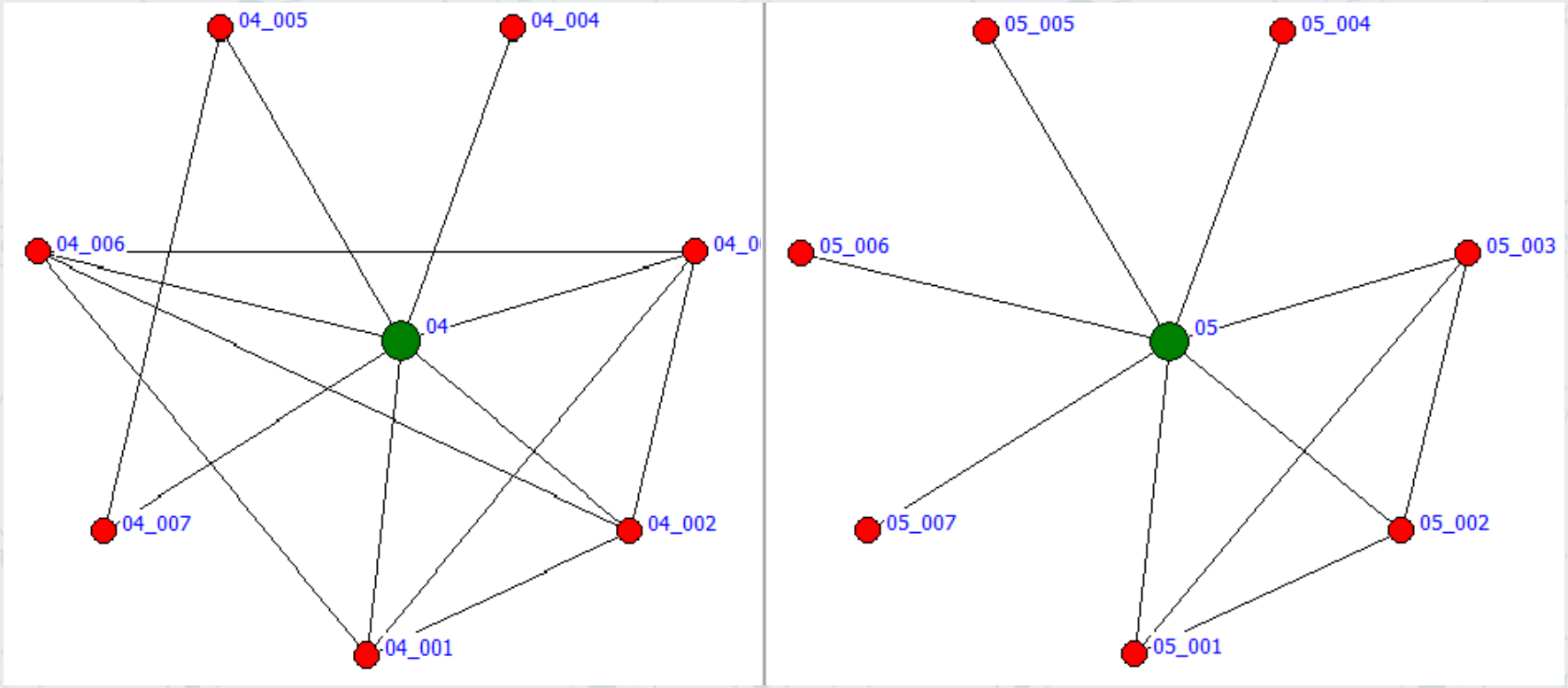
Let’s Take a Break!

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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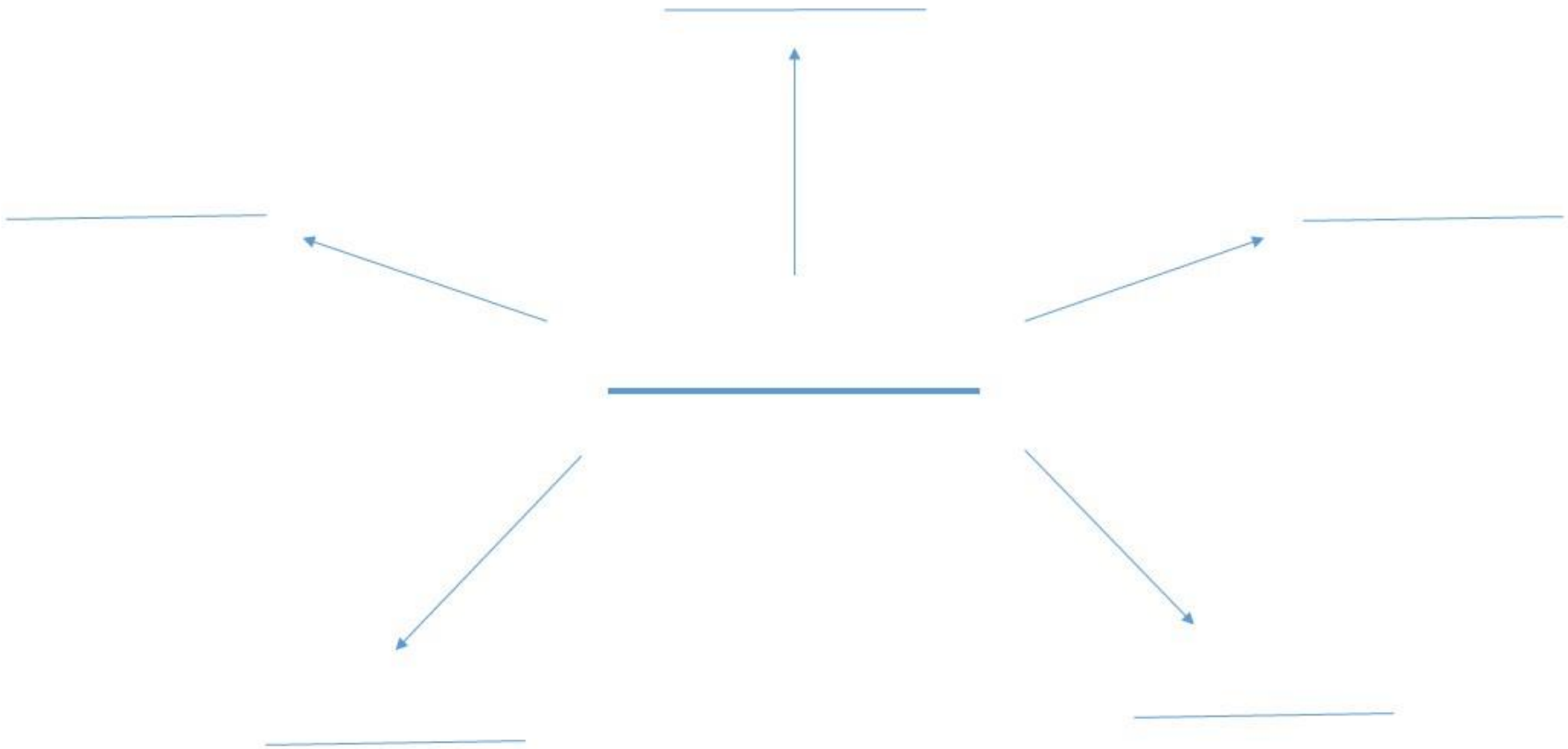
Egocentric Network Activity

Please have a piece of paper and pen ready!



Egocentric Network Measures

- Composition
- Homophily
- Heterogeneity
- Structural Holes

Egocentric Network Examples and Research Questions

International Journal of *Environmental Research and Public Health*

MDPI

Article

Papás Activos: Associations between Physical Activity, Sedentary Behavior and Personal Networks among Fathers Living in Texas *Colonias*

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Egocentric Network Examples and Research Questions

AMERICAN JOURNAL OF HEALTH EDUCATION
https://doi.org/10.1080/19325037.2021.2020184

Routledge
Taylor & Francis Group

Check for updates

Active Play Social Network Change for Mexican-Heritage Children Participating in a Father-Focused Health Program

Tyler Prochnow[a], M. Renee Umstattd Meyer[b], Megan S. Patterson[a], Andrew Meyer[b], Tony Talbert[b], and Joseph Sharkey[a]

[a]Texas A&M University; [b]Baylor University

ABSTRACT

Background: Physical activity (PA) is beneficial for physical, mental, and emotional health; however, Latinx children report lower PA levels. Scholars have called for a renewed focus on fathers to promote child health.

Purpose: This study examines changes in Mexican-heritage child active play networks through participation in a father-focused family-centered health program.

Methods: Families (child aged 9–11, mother, and father) from *colonias* participated in a six-week healthy eating and active living program. Children reported up to five people they actively played with most before and after the program, their relationship, frequency with which they played with the person, and what they did most often with that person.

Results: Children (n = 42, M age = 9.79, SD = 1.01; 54.8% girls) reported a mean of 3.79 people in their network before and 4.24 people after the program. Children reported significantly more frequent active play with others after the program. Girls reported significantly more frequent active play with others when compared to boys; however, boys were significantly more likely to increase their frequency of active play with others.

Discussion: Results indicate family-centered father-focused programs could increase active play with networks.

Translation to Health Education Practice: Incorporating elements of co-participation in active play may increase frequency of active play.

ARTICLE HISTORY
Received 7 September 2021
Accepted 27 October 2021

Let’s Take a Break!

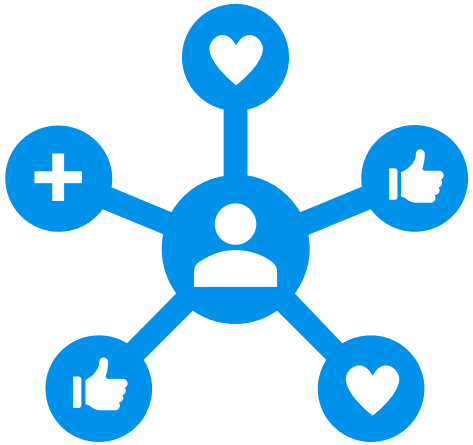
Data Collection and Management

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)

*

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MDPI

Article

Conducting Physical Activity Research on Racially and Ethnically Diverse Adolescents Using Social Network Analysis: Case Studies for Practical Use

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Abstract: Adolescent physical activity (PA) is significantly impacted by peer behaviors through peer influence, peer selection, and popularity. However, the scales for these social constructs may not fully capture the detailed social networks and mechanisms responsible for PA behavior changes. This level of detail and granularity can be quantified and analyzed through social network analysis (SNA). To demonstrate the variety, utility, and efficacy of SNA in adolescent PA research, this article aims to provide four case studies on the collection of social network and PA data on ethnically and racially diverse adolescents. Through case studies, this article provides tangible ways in which SNA can be used to evaluate social influences on PA behaviors. Case studies are presented on: (1) Youth Engagement in Sport—an egocentric analysis of middle school youth participation in an experiential sport program with 3- and 6-month follow-ups; (2) Summer care program networks—an egocentric and whole network longitudinal study of adolescents at summer care programs; (3) The Convoy method—a qualitative egocentric discussion activity with adolescents from *colonias* on the Texas-Mexico border; and (4) A father-focused, family-centered health program—an egocentric experimental analysis of children participating in a health program. Data collection procedures are listed and example surveys are provided. Descriptive analyses are included, as are recommendations

Citation: Prochnow, T.; Patterson, M.; Umstattd Meyer, M.R.; Lightner, J.; Gomez, L.; Sharkey, J. Conducting Physical Activity Research on Racially and Ethnically Diverse Adolescents Using Social Network

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:

*

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

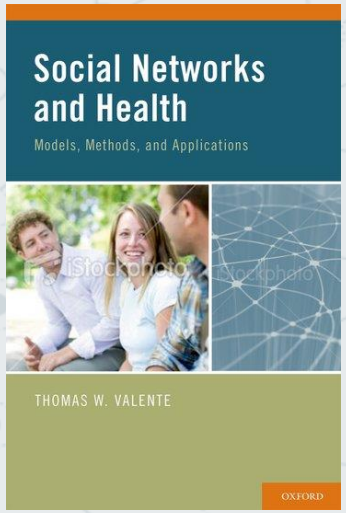
- Attribute table – file containing all ego information
- Demographics, outcome variables, etc.

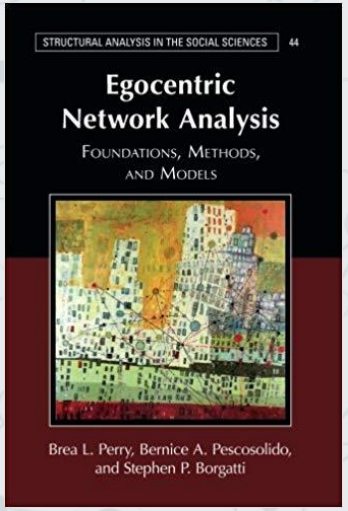
	Age	BMI	PA	PHQ-9	Sex
A	30	20	5	3	1
B	25	25	4	6	0
C	19	30	3	2	1
D	28	22	5	1	0
E	38	25	4	4	0

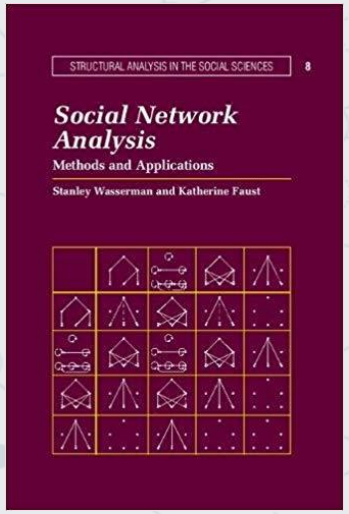
Resources

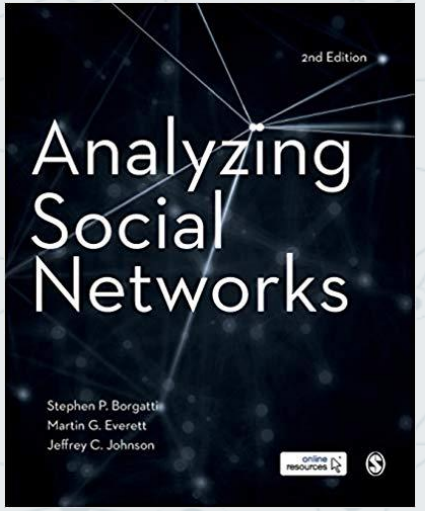
Add these to your reading list:

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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5 key takeaways

- Social networks are everywhere
- Social networks are important for health and health behavior
- There are two main approaches to network analysis: sociocentric, egocentric
- Network analysis can answer research questions related to both network level and individual level variables
- This is just the beginning!

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?
- 1 minute elevator pitch report to group

*

Final Words

Questions or Comments?

https://forms.office.com/r/uAcnZef5E0

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