Social Networks & Health

Moody, James, Lisa A. Keister, M. Giovanna Merli “Focused Training in Social Networks and Health” NICHD, 2 R25 HD079352-06
Social Networks & Health

Outline

1. Part 1: Introduction & Theory
   1. History & Big Picture
   2. Network Relevance to Health Research
   3. Network Theory
      1. Connections & Positions

2. Part 2: Points & Lines
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   2. Visualization
   3. Network Metrics

3. Part 3: Network Models
   1. Diffusion
      1. Disease
      2. Network Autocorrelation
   2. Random Graph Models
   3. SOAM
   4. Open Questions
Introduction: Why Networks?

We live in a connected world:

“To speak of social life is to speak of the association between people – their associating in work and in play, in love and in war, to trade or to worship, to help or to hinder. It is in the social relations men establish that their interests find expression and their desires become realized.”

Peter M. Blau

_Exchange and Power in Social Life_, 1964
Introduction: Why Networks?

We live in a connected world:

"If we ever get to the point of charting a whole city or a whole nation, we would have … a picture of a vast solar system of intangible structures, powerfully influencing conduct, as gravitation does in space. Such an invisible structure underlies society and has its influence in determining the conduct of society as a whole."

J.L. Moreno, *New York Times*, April 13, 1933

*1934, NYTimes. Moreno claims this work was covered in "all the major papers" but I can't find any other clips…*
Introduction: Why Networks?

But scientists are starting to take networks seriously:

![Graph showing the proportion of papers on networks and health over time.](image-url)
Introduction: Why Networks?

But scientists are starting to take network seriously: why?

**Papers on Networks and Health**

*as a proportion of all papers on health*

- **“Obesity”**
- **“Networks”**

5918 papers in 2018
Introduction: Why Networks?

…and NSF is investing heavily in it.

Figure 1. Value and number of NSF grants with “Network Analysis” in the title.
Introduction: Why Networks?

High Schools as Networks
Countryside High School, by grade
Countryside High School, by race

- White
- Black
- Mixed/Other
Social network analysis is:

- a set of *relational* methods for systematically understanding and identifying connections among actors.

Social network analysis (SNA):

- is motivated by a structural intuition based on ties linking social actors
- is grounded in systematic empirical data
- draws heavily on graphic imagery
- relies on the use of mathematical and/or computational models.

SNA embodies a range of theories relating types of observable social spaces and their relation to individual and group behavior.
Introduction: Why Networks & Health?

Social Determinants of Health

Social effects hold promising multiplier effects:

**Figure 3**

In the conventional perspective on medical care, the costs and benefits of health care are judged according to their ability to achieve direct, intended outcomes in patients. However, because patients are connected to others via social ties, health care delivered to one person, quite apart from its effects on that person, may have health effects on others. The cumulative impact of the intervention is thus the sum of the direct outcomes in the patient plus the collateral outcomes in others. (Adapted from Christakis 2004.)
A Brief History of Networks & Health
- Coleman: The Adolescent Society
- White: Anatomy of Kinship
- Rosenberg: Society & The Adolescent Self-Image
- Rogers: Diffusion of Innovation
- Cartwright & Harary: Social Balance
- Granovetter: Strength of Weak Ties
- White, Boorman & Brieger: Block Models
- INSNA is founded
  - Kandel: Homophily, Selection & Socialization
  - Berkman: Am j. Epi: Social Ties & Health
  - Freeman: Centrality in Social Networks
- Klovdahl: Social Networks & The Spread of Disease
- Rothenberg & Potterat: Project 90 (esque)
- Coleman: Social Capital
- House: Social Relations & Health
- Pescosolido: Durkheim & Suicide
- Coleman: The Adolescent Society
- White: Anatomy of Kinship
- Rosenberg: Society & The Adolescent Self-Image
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- Coleman: Social Capital
- House: Social Relations & Health
- Pescosolido: Durkheim & Suicide
**Homophily, Selection, and Socialization in Adolescent Friendships**

Denise B. Kandel  
*New York State Psychiatric Institute and Columbia University*

Longitudinal sociometric data on adolescent friendship pairs, friends-to-be, and former friends are examined to assess levels of homophily on four attributes (frequency of current marijuana use, level of educational aspirations, political orientation, and participation in minor delinquency) at various stages of friendship formation and dissolution. In addition, estimates are developed of the extent to which observed homophily in friendship dyads results from a process of selection (assortative pairing), in which similarity precedes association and the extent to which it results from a process of socialization in which association leads to similarity. The implications of the results for interpreting estimates of peer influence derived from cross-sectional data are discussed.
1960
- Coleman: The Adolescent Society
- White: Anatomy of Kinship

1965
- Rosenberg: Society & The Adolescent Self-Image
- Rogers: Diffusion of Innovation
- Cartwright & Harary: Social Balance

1970
- Granovetter: Strength of Weak Ties

1975
- White, Boorman & Brieger: Block Models
- INSNA is founded
- Kandel: Homophily, Selection & Socialization
- Berkman: Am j. Epi: Social Ties & Health
- Freeman: Centrality in Social Networks

1980
- Klovdahl: Social Networks & The Spread of Disease
- Rothenberg & Potterat: Project 90 (esque)
- Coleman: Social Capital
- House: Social Relations & Health
- Pescosolido: Durkheim & Suicide

1990
- SEEKING THE POSITIVES
  A Life Spent on the Cutting Edge of Public Health
- John J. Potterat
Social Relationships and Health

James S. House, Karl R. Landis, Debra Umberson

Recent scientific work has established both a theoretical basis and strong empirical evidence for a causal impact of social relationships on health. Prospective studies, which control for baseline health status, consistently show increased risk of death among persons with a low quantity, and sometimes low quality, of social relationships. Experimental and quasi-experimental studies of humans and animals also suggest that social isolation is a major risk factor for mortality from widely varying causes. The mechanisms through which social relationships affect health and the factors that promote or inhibit the development and maintenance of social relationships remain to be explored.

... my father told me of a careful observer, who examined hundreds of hundreds and died from it, and who positively stated that his pulse was abnormally irregular in an extreme degree; yet to his great disappointment it invariably became regular as soon as my father entered the room. — Charles Darwin (7)

Scientists have long noted an association between social relationships and health. More socially isolated or less socially integrated individuals are less healthy, psychologically and physically, and more likely to die. The first major work of experimental sociology found that less socially integrated people were more likely to commit suicide than the most integrated (7). In subsequent epidemiologic research age-adjusted mortality rates from all causes of death are consistently higher among the unmarried (3,5). Unmarried and more socially isolated people have also manifested higher rates of tuberculosis (6), septicemia (7), and psychiatric disorders such as schizophrenia (8, 9). And as the above quote from Darwin suggests, clinicians have also observed potentially health-enhancing qualities of social relationships and contacts.

The causal interpretation and explanation of these associations has, however, been less clear. Does a lack of social relationships cause people to become ill or die? Or are unhealthy people less likely to establish and maintain social relationships? Or is there some other factor, such as a misanthropic personality, which predisposes people both to have a lower quantity or quality of social relationships and to become ill or die?

Such questions have been largely unanswerable before the last decade for two reasons. First, there was little theoretical basis for causal explanation. Durkheim (2) proposed a theory of how social relationships affected suicide, but this theory did not generalize to morbidity and mortality from other causes. Second, evidence of the association between social relationships and health, especially in general human populations, was almost entirely retrospective or cross-sectional before the late 1970s. Retrospective studies from death certificates or hospital records ascertained the nature of a person's social relationships after they had become ill or died, and cross-sectional surveys of general populations determined whether people who reported ill health also reported a lower quantity or quality of relationships. Such studies used statistical control of potential confounding variables to rule out third factors that might produce the association between social relationships and health, but could do this only partially. They could not determine whether poor social relationships preceded or followed ill health.

Fig. 1. Level of social integration and age-adjusted mortality for males in five prospective studies. RR, the relative risk ratio of mortality at the lowest versus highest level of social integration.

1. S. House is professor and chair of sociology and a research scientist in the Survey Research Center of the Institute for Social Research, Institute of Gerontology, and Department of Epidemiology at the University of Michigan, Ann Arbor. M.I. Umberson is a research scientist in the Survey Research Center of the University of Michigan and assistant professor-designate of sociology at the University of Texas, Austin.
ASR

DURKHEIM, SUICIDE, AND RELIGION:
TOWARD A NETWORK THEORY OF SUICIDE*

Bernice A. Pescosolido
Indiana University

Sharon Georgianna
Seattle Pacific University

This paper redirects debates over the religion-suicide link away from specific empirical quarrels to a consideration of Durkheim's general proposition regarding religion's protective power. We argue that his proposition must be tailored to social and historical contexts and that research must specify the underlying social mechanism at work. A consideration of historical trends leads to a more detailed specification of religions in analyses of contemporary cases, and more importantly, to an inductive elaboration of Durkheim's theoretical underpinnings. Analysis of reveals that Evangelicalism is leading to inconsistent examining a evidence on finding this clarify and

AJS

Beyond Rational Choice: The Social Dynamics of How People Seek Help

Bernice A. Pescosolido
Indiana University

A classic problem common to sociology and other social science approaches revolves around how people make decisions. Some recent approaches to action framework, making the essential (SOS) framework approach.

Kolvahl: Social Networks & The Spread of Disease

Rothenberg & Potterat: Project 90 (esque)

Coleman: Social Capital

House: Social Relations & Health

Pescosolido: Durkheim & Suicide

Public Conceptions of Mental Illness: Labels, Causes, Dangerousness, and Social Distance

“A Disease Like Any Other”? A Decade of Change in Public Reactions to Schizophrenia, Depression, and Alcohol Dependence

Bernice A. Pescosolido, Ph.D.  Objective: Clinicians, advocates, and policy makers have presented mental illness as medical illnesses in efforts to overcome low service use, poor adherence, and stigma. The authors examined the impact of this approach with a 10-year comparison of public endorsement of treatment and prejudice.

Jack K. Martin, Ph.D.  Method: The authors analyzed responses to vignettes in the mental health modules of the 1994 and 2006 General Social Survey describing individuals meeting DSM-IV criteria for schizophrenia, major depression, and alcohol dependence to explore the likelihood of support for treatment.
Concurrent partnerships and transmission dynamics in networks

Martina Morris a,*, Mirjam Kretzschmar b

a Department of Sociology and School of Public Health, Columbia University, New York, NY 10027, USA
b National Institute of Public Health and Environmental Protection (RIVM), Bilthoven, Netherlands

Abstract
Concurrent partnerships and the spread of HIV

Martina Morris and Mirjam Kretzschmar*

Objective: To examine how concurrent partnerships amplify the rate of HIV spread, using methods that can be supported by feasible data collection.

Methods: A fully stochastic simulation is used to represent a population of individuals, the sexual partnerships that they form and dissolve over time, and the spread of an infectious disease. Sequential monogamy is compared with various levels of concurrency, holding all other features of the infection process constant. Effective summary measures of concurrency are developed that can be estimated on the basis of simple local network data.

Results: Concurrent partnerships exponentially increase the number of infected individuals and the growth rate of the epidemic during its initial phase. For example, when one-half of the partnerships in a population are concurrent, the size of the epidemic after 5 years is 10 times as large as under sequential monogamy. The primary cause of this amplification is the growth in the number of people connected in the network at any point in time: the size of the largest ‘component’. Concurrency increases the size of this component, and the result is that the infectious agent is no longer trapped in a monogamous partnership after transmission occurs, but can spread immediately beyond this partnership to infect others. The summary measure of concurrency developed here does a good job in predicting the size of the amplification effect, and may therefore be a useful and practical tool for evaluation and intervention at the beginning of an epidemic.

Conclusion: Concurrent partnerships may be as important as multiple partners or cofactor infections in amplifying the spread of HIV. The public health implications are that data must be collected properly to measure the levels of concurrency in a population, and that messages promoting ‘one partner at a time’ are as important as messages promoting fewer partners.
1990
- Morris: Concurrency
- May & Anderson: Infectious Diseases
- Ennett & Bauman: peers & smoking
  - Wasserman & Faust: Social Network Analysis
- Provan & Milward: Network Effectiveness
  - Valente: Network Models of Diffusion
  - Snijders: Siena Model Introduced (JMS)
- Add Health Released
- Watts: Small World Models
  - C. Latkin: Peer Leaders
  - Wasserman: P* Introduced
- Berkman: Social Integration & Health
  - Moody: Race & Friendship
  - McPherson: Birds of a Feather
- Statnet: Handcock, Hunter, Butts, Morris
- Bearman: Chains of Affection
- Adimora: Race Disparities
- Christakis & Fowler: Obeisity
  - Ellison et al, Facebook & Self-Esteem

2000

2005

2010
- Valente: Social Networks & Health
  - Snijders: R-Siena
The Contribution of Influence and Selection to Adolescent Peer Group Homogeneity: The Case of Adolescent Cigarette Smoking

Susan T. Ennett and Karl E. Bauman

Understanding the homogeneity of peer groups requires identification of peer groups and consideration of influence and selection processes. Few studies have identified adolescent peer groups, however, or examined how they become homogeneous. This study used social network analysis to identify how social influence and selection influence homogeneity in adolescent smoking.

Peer Group Structure and Adolescent Cigarette Smoking: A Social Network Analysis*

SUSAN T. ENNETT
Research Triangle Institute

KARL E. BAUMAN
University of North Carolina, Chapel Hill

Peer Influence on Adolescent Drug Use

Karl E. Bauman
Department of Health Behavior and Health Education, School of Public Health, University of North Carolina at Chapel Hill

Susan T. Ennett
Research Triangle Institute, Research Triangle Park, NC

Prominent researchers (Newcomb & Bentler, 1989; Oetting & Beauvais, 1986) and organizations (National Institute on Drug Abuse, 1991; U.S. Department of Education, 1990) are among many who have concluded that peer group influence is one of the major reasons adolescents begin to use drugs. Other reports, ignored in most considerations of adolescent drug use, suggest that peer influence is overestimated. One purpose of this comment is to present our perspective on these positions; a related pur-
A Preliminary Theory of Interorganizational Network Effectiveness: A Comparative Study of Four Community Mental Health Systems

Keith G. Provan  
University of Kentucky  
H. Brinton Milward  
University of Arizona

This paper presents the results of a comparative study of interorganizational networks, or systems, of mental health delivery in four U.S. cities, leading to a preliminary theory of network effectiveness. Extensive data were collected from surveys, interviews, documents and observations. Network effectiveness was assessed by collecting and aggregating data on outcomes from samples of clients, their families, and their case managers at each site. Results of analyses of both quantitative and qualitative data collected at the individual, organizational, and network levels of analysis showed that network effectiveness could be explained by various structural and contextual factors, specifically, network integration, external control, system stability, and environmental resource munificence. Based on the findings, we develop testable propositions to guide theory development and future research on network effectiveness.*
1990
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- Ennett & Bauman: peers & smoking
  - Wasserman & Faust: Social Network Analysis
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- Statnet: Handcock, Hunter, Butts, Morris
- Bearman: Chains of Affection
- Adimora: Race Disparities

2005
- Christakis & Fowler: Obesity
  - Ellison et al, Facebook & Self-Esteem

2010
- Valente: Social Networks & Health
- Snijders: R-Siena

Social network thresholds in the diffusion of innovations

Thomas W. Valente
Population Communication Services, Center for Communication Programs, School of Hygiene and Public Health, 111 Market Place, Suite 310, The Johns Hopkins University, Baltimore, MD 21202, USA

The term "network interventions" describes the process of using social network data to accelerate behavior change or improve organizational performance. In this Review, four strategies for network interventions are described, each of which has multiple tactical alternatives. Many of these tactics can incorporate different mathematical algorithms. Consequently, researchers have many intervention choices at their disposal. Selecting the appropriate network intervention depends on the availability and character of network data, perceived characteristics of the behavior, its existing prevalence, and the social context of the program.
...more than 7500 publications...
PUBLIC HEALTH REPORTS, 1998

Carl A. Latkin, PhD

Outreach in Natural Settings: The Use of Peer Leaders for HIV Prevention among Injecting Drug Users’ Networks

Stressful Neighborhoods and Depression: A Prospective Study of the Impact of Neighborhood Disorder*

Carla A. Latkin
Aaron D. Curry
Johns Hopkins University

HIV Prevention Among Drug Users: Outcome of a Network-Oriented Peer Outreach Intervention

Carl A. Latkin, Susan Sherman, and Amy Knowlton
Johns Hopkins University

The Lancet


Prevention of HIV infection for people who inject drugs: why individual, structural, and combination approaches are needed

Prof Louis Degenhardt, PhD
Bradley Mathers, MBChB
Peter Vickerman, DPhil
Tim Rhodes, PhD
Carl Latkin, PhD
Matt Hickman, PhD

Show more
From social integration to health: Durkheim in the new millennium

Lisa F. Berkman\textsuperscript{ab}, Thomas Glass\textsuperscript{b}, Ian Brissette\textsuperscript{c}, Teresa E. Seeman\textsuperscript{d}

\textsuperscript{a}Harvard School of Public Health, Boston, MA 02115, USA
\textsuperscript{b}Center of Aging and Health, Johns Hopkins Medical Institutions, Baltimore, MD 21205, USA
\textsuperscript{c}Department of Psychology, Carnegie Mellon, Pittsburgh, PA 15213, USA
\textsuperscript{d}Division of Geriatrics, School of Medicine, University of California at Los Angeles, CA 90095, USA

Abstract

It is widely recognized that social relationships and affiliation have powerful effects on physical and mental health. When investigators write about the impact of social relationships on health, many terms are used loosely and interchangeably including social networks, social ties and social integration. The aim of this paper is to clarify these terms using a single framework. We discuss: (1) theoretical orientations from diverse disciplines which we believe are fundamental to advancing research in this area; (2) a set of definitions accompanied by major assessment tools; and (3) an overarching model which integrates multilevel phenomena.

Theoretical orientations that we draw upon were developed by Durkheim whose work on social integration and suicide are seminal and John Bowlby, a psychiatrist who developed attachment theory in relation to child development and contemporary social network theorists.

We present a conceptual model of how social networks impact health. We envision a cascading causal process beginning with the macro-social to psychological processes that are dynamically linked together to form the processes by which social integration effects health. We start by embedding social networks in a larger social and cultural context in which upstream forces are seen to condition network structure. Serious consideration of the larger macro-social context in which networks form and are sustained has been lacking in all but a small number of studies and is almost completely absent in studies of social network influences on health.

We then move downstream to understand the influences network structure and function have on social and interpersonal behavior. We argue that networks operate at the behavioral level through four primary pathways: (1) provision of social support; (2) social influence; (3) on social engagement and attachment; and (4) access to resources and material goods. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Social integration; Social networks; Social support; Mortality; Health status; Social epidemiology

Social Science & Medicine, 2000

**statnet**: Software tools for the Statistical Modeling of Network Data. URL

http://statnetproject.org
Chains of Affection: The Structure of Adolescent Romantic and Sexual Networks

Peter S. Bearman
Columbia University

James Moody
Ohio State University

Katherine Stovel
University of Washington

Figure 2. Structure of Romantic and Sexual Contact at Jefferson

- 1990
  - Morris: Concurrency
  - May & Anderson: Infectious Diseases
  - Ennett & Bauman: peers & smoking
  - Wasserman & Faust: Social Network Analysis
  - Provan & Milward: Network Effectiveness
  - Valente: Network Models of Diffusion
  - Snijders: Siena Model Introduced (JMS)
  - Add Health Released
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  - McPherson: Birds of a Feather
  - Statnet: Handcock, Hunter, Butts, Morris
  - Bearman: Chains of Affection

- 2005
  - Adimora: Race Disparities
  - Christakis & Fowler: Obeisity
  - Ellison et al, Facebook & Self-Esteem

- 2010
  - Valente: Social Networks & Health
  - Snijders: R-Siena
Social Context, Sexual Networks, and Racial Disparities in Rates of Sexually Transmitted Infections

Adnora A. Adimora and Victor J. Schoenbach
Department of Medicine, School of Medicine, and Department of Epidemiology, School of Public Health, University of North Carolina at Chapel Hill

**Background.** Social context (demographic, socioeconomic, macroeconomic, and sociopolitical features of the environment) influences the epidemiology and consequences of individual behaviors that affect health outcomes. This article examines the role of social context in heterosexual networks that facilitate the spread of human immunodeficiency virus (HIV) infection and other sexually transmitted infections (STIs), particularly in relation to persistent racial disparities in rates of STIs in the United States.

**Methods.** Review of the medical, public health, and social science literature.

**Results.** Contextual factors, such as poverty, discrimination, epidemiology of illicit drug use in the community, ratio of men to women, incarceration rates, and racial segregation, influence sexual behavior and sexual networks directly and indirectly through a variety of mechanisms. Disparities in these contextual features likely contribute substantially to the persistence of marked racial disparities in rates of STIs.

**Conclusions.** Given the importance of contextual factors and the sharply contrasting social contexts for blacks and whites, exclusive emphasis on individual risk factors and determinants is unlikely to produce solutions that will significantly decrease HIV rates among blacks. Effective HIV prevention in this population will require multidisciplinary research to address the contextual factors that promote patterns of sexual networks that facilitate transmission of STIs.

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- 1990
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- 1995
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- 2005
  - Christakis & Fowler: Obesity
  - Ellison et al, Facebook & Self-Esteem

- 2010
  - Valente: Social Networks & Health
  - Snijders: R-Siena
The Spread of Obesity in a Large Social Network over 32 Years

Nicholas A. Christakis, M.D., Ph.D., M.P.H., and James H. Fowler, Ph.D.
The Benefits of Facebook “Friends:” Social Capital and College Students’ Use of Online Social Network Sites

Nicole B. Ellison
Charles Steinfield
Cliff Lampe
Department of Telecommunication, Information Studies, and Media
Michigan State University

This study examines the relationship between use of Facebook, a popular online social network site, and the formation and maintenance of social capital. In addition to assessing bonding and bridging social capital, we explore a dimension of social capital that assesses one’s ability to stay connected with members of a previously inhabited community, which we call maintained social capital. Regression analyses conducted on results from a survey of undergraduate students (N = 286) suggest a strong association between use of Facebook and the three types of social capital, with the strongest relationship being to bridging social capital. In addition, Facebook usage was found to interact with measures of psychological well-being, suggesting that it might provide greater benefits for users experiencing low self-esteem and low life satisfaction.

doi:10.1111/j.1083-6101.2007.00367.x
1990
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2005
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- Ellison et al, Facebook & Self-Esteem

2010
- Valente: Social Networks & Health
- Snijders: R-Siena
State of the field

Trends

English language Articles indexed in Web of Science Social Science Citation Index on: ("health" or "well being" or "medicine") and "network*").

There have been 18572 such papers between 2000 - 2018.
State of the Field

Big-Picture

Bibliographic Similarity Networks: 1-step neighborhood of a single paper
State of the Field

Big-Picture

Bibliographic Similarity Networks: 2-step neighborhood of a single paper
State of the Field

Big-Picture

Since the net is large…
Use a force-directed layout to display the full space & overlay clusters….
Social Networks & Health Intellectual Landscape
18572 papers published since 2000 on networks & health*

*search was “Network*” and (Health or Medicine or well-being)
Social Networks & Health Intellectual Landscape

18572 papers published since 2000 on networks & health*

Modularity:
Top-Level: 0.798 @ 32 Clusters
2nd Level: 0.785 @ 150 Clusters

*search was “Network*” and (Health or Medicine or well-being)
Social Networks & Health Intellectual Landscape

18572 papers published since 2000 on networks & 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)
Introduction
Network Research Lifecycle
Introduction
Key Questions

Social network analysis lets us answer questions about social interdependence. These include:

“Networks as Variables” approaches
  • Are kids with smoking peers more likely to smoke themselves?
  • Do unpopular kids get in more trouble than popular kids?
  • Do central actors control resources?

“Networks as Structures” approaches
  • What generates hierarchy in social relations?
  • What network patterns spread diseases most quickly?
  • How do role sets evolve out of consistent relational activity?

Both: Connectionist vs. Positional features of the network

We don’t want to draw this line too sharply: emergent role positions can affect individual outcomes in a ‘variable’ way, and variable approaches constrain relational activity.
<table>
<thead>
<tr>
<th>Connections &amp; Positions: Network Problems</th>
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<tr>
<td><strong>Connectionist:</strong></td>
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<td><em>Networks as pipes</em></td>
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<td>- Structural Holes</td>
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<td>- Density</td>
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<td>- Mixing Models</td>
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<td><strong>Positional:</strong></td>
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<td>- Local Roles</td>
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<td>- Relational Block Models</td>
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<td>- Motifs</td>
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<td><strong>Ego</strong></td>
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<td>- Community Detection</td>
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<td>- Reachability</td>
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<td>- Homophily</td>
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<td>- Degree Distribution</td>
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<td>- Social Balance</td>
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<td>- ERGm</td>
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<td><strong>Complete</strong></td>
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<td>- Multi-layer networks</td>
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<td>- Multi-level models of multiple networks</td>
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<td><strong>Multiple</strong></td>
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<td>- Centralities</td>
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<td>- Cohesive blocking</td>
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<td>- Patterns in networks</td>
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Why Do Networks Matter?
Two Fundamental Mechanisms: Connections

**Connectionist network mechanisms**: Networks matter because of the things that flow through them. *Networks as pipes.*

- Disease diffusion
- Adoption of innovations
- Joining social movements
- Spread of misinformation online
- Rumors
- Peer influence
The spread of any epidemic depends on the number of secondary cases per infected case, known as the reproductive rate ($R_0$). $R_0$ depends on the probability that a contact will be infected over the duration of contact ($\beta$), the likelihood of contact ($c$), and the duration of infectiousness ($D$).

$$R_0 = \beta c D$$

For network transmission problems, the trick is specifying $c$, which depends on the network.
Why Do Networks Matter?
Two Fundamental Mechanisms: Connections Example

Isolated Vision
Why Do Networks Matter?
Two Fundamental Mechanisms: Connections Example
Connections: Diffusion
Example: small local changes can create cohesion cascades

Emergent Connectivity in “Low-Degree” Networks

Partner Distribution

Component Size/Shape

Based on work supported by R21-HD072810 (NICHD, Moody PI), R01 DA012831-05 (NIDA Morris, Martina PI)
Connections: Diffusion

Connectionist approaches are (by far) the most common aspect of network models in health research.

Theoretically any feature of the setting that governs spread through the network is of interest and will be reflected at multiple levels of the network.

Often we don’t have exact traces of the diffusion itself, only roughly timed outcome differences, which causes problems.
Why Do Networks Matter?
Two Fundamental Mechanisms: Positions

**Positional Network Mechanisms**: Networks matter because of the way they capture role behavior and social exchange. *Networks as Roles.*
Why do networks matter?
Two Fundamental Mechanisms: Positions

Positional Network Mechanisms: Networks matter because of the way they capture role behavior and social exchange. *Networks as Roles.*

- **Parent**
- **Child**

- **Romantic Love**
- **Provides food for**
- **Bickers with**
Why do networks matter?

Two Fundamental Mechanisms: Positions

**Positional Network Mechanisms**: Networks matter because of the way they capture role behavior and social exchange. *Networks as Roles.*

Basic structuralist duality: persons are the intersection of *who* (& *how*) they are connected to; while collectives are the emergent structure built from those connections.

*Social life is a collective & structured affair: the groups we belong to & the roles we occupy simultaneously define us and our social setting.*
There is a classic structure-action tension between network structuralism and any duality-as-identity.

On the one hand, strong structures constrain interaction opportunities and acceptable activities to such a degree that the network, and one’s position in it, is fixed. *Actors are structural dupes.*

On the other hand, personal agency implied by self-authorship & “selection” suggest rapidly changing networks that (seem to) lack the substantive stability necessary to warrant being called “structure” in any meaningful sense. *Networks become the epiphenomenon of action.*

Network tools allow us to empirically interrogate the (also classic) route out of this dilemma: structures are (re)constituted in the ways actors behave; regularized ways of interacting create dynamically-stable settings.

This creates multiple levels of measurement & modeling
Why Do Networks Natter?
Two Fundamental Mechanisms: Positions Example – School Hierarchy
Stability & Trajectory patterns across:

1) Direct ties: consistent micro mechanisms
2) Popularity structure: global macro structure
3) Role positions
4) Peer groups

Each level requires new techniques or tools to capture setting

That we find stability at the macro level despite lots of churn at the local level raises interesting questions:

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Positional approaches are less common in health research, but very promising as new ways to conceptualize context effects.