



RAND

HEALTH

***Applying Network Science in Health  
Promotion and Disease Prevention  
An Evolving Perspective***

**Harold D. Green, Jr.**

**Director, RAND Center for Applied Social Network Analysis  
and System Science**

**ACBS World Conference  
Plenary Session  
June 19, 2014**

***What the hell am I  
going to talk about  
for an hour?***

## *In this Talk*

- **What is social network analysis (SNA)?**
- **How is SNA applied to understand the social context?**
- **How is the social context related to individual behaviors and attitudes?**
  - **Substance Use**
  - **Exercise**
  - **HIV Care Adherence**
- **How have we been using what we learn from SNA studies to develop interventions that relate to the social context?**

# ***SNA and Health Promotion***

- **Are obesity and exercise associated with an individual's position in a social network?**
- **Can participating in peer-based interventions change children's behaviors and social networks?**
- **How might homelessness or other significant characteristics affect an individual's social network?**
- **How can we use networks to improve social support for people with chronic conditions like depression or PTSD?**

# The New York Times.

Copyright, 1933, by The New York Times Company.

Entered as Second-Class Matter,  
Postoffice, New York, N. Y.

NEW YORK, MONDAY, APRIL 3, 1933.

TWO CENTS

## EMOTIONS MAPPED BY NEW GEOGRAPHY

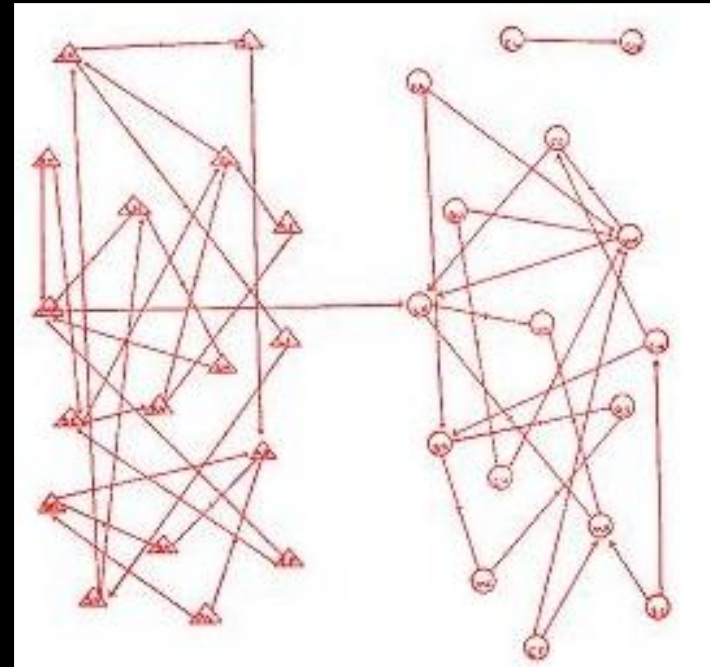
Charts Seek to Portray the  
Psychological Currents of  
Human Relationships.

### FIRST STUDIES EXHIBITED

Colored Lines Show Likes and  
Dislikes of Individuals  
and of Groups.

### MANY MISFITS REVEALED

Dr. J. L. Moreno Calculates There  
Are 10 to 15 Million Isolated  
Individuals in Nation.

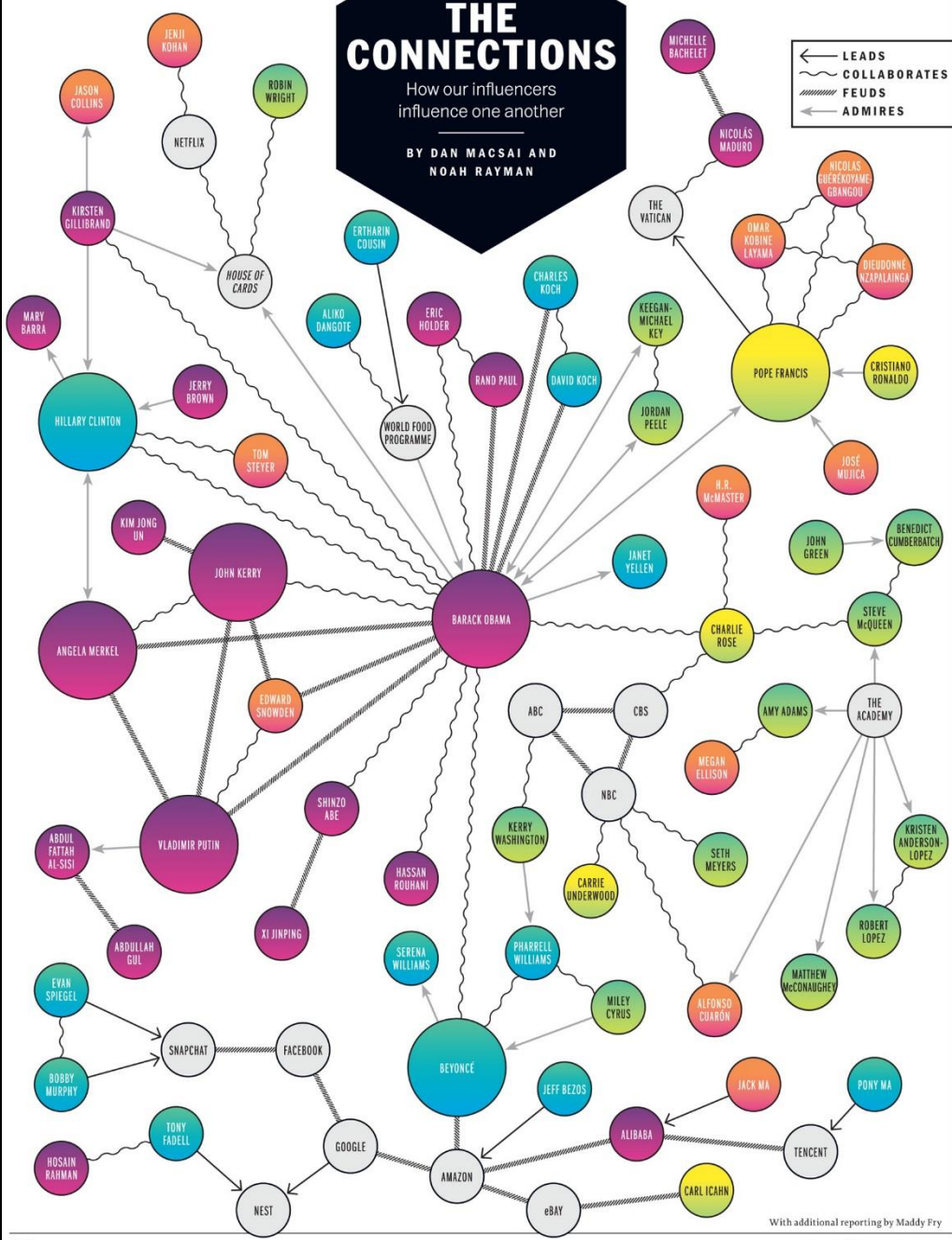


# THE CONNECTIONS

How our influencers influence one another

BY DAN MACSAI AND NOAH RAYMAN

← LEADS  
~ COLLABORATES  
- FEUDS  
← ADMIRES

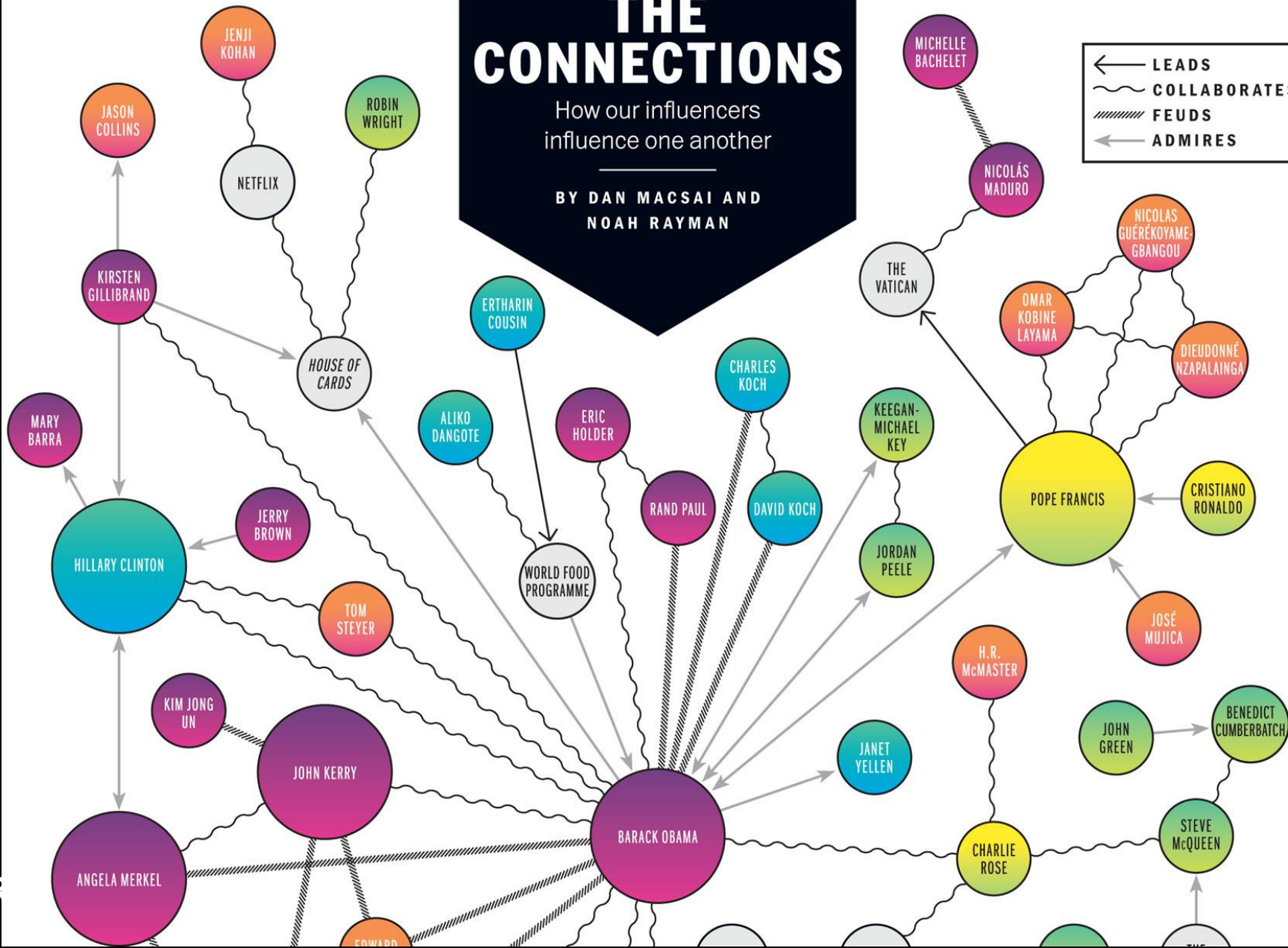


With additional reporting by Maddy Fry

# THE CONNECTIONS

How our influencers influence one another

BY DAN MACSAI AND NOAH RAYMAN



# ***We Already Think in a Network Context***

- **Birds of a feather flock together**
- **A friend of my friend is also my friend**
- **Activate a prayer chain or a phone tree**
- **I'm in with the "in" crowd**
- **Membership has its privileges**



# ***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**

**"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."**

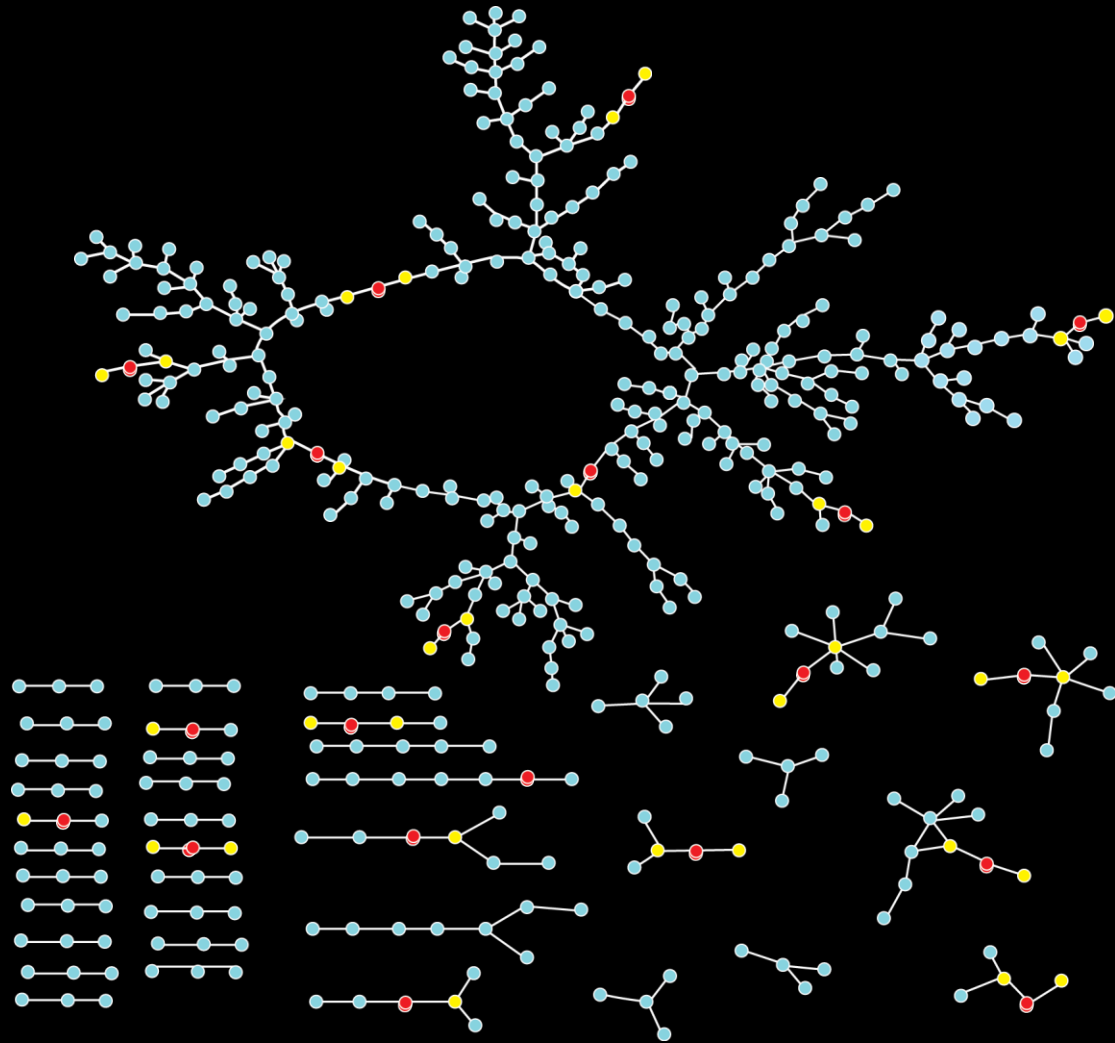
**J.L. Moreno, New York Times, April 13, 1933**

# *The Network Perspective*

- **Relations v. Attributes**
  - Interdependence rather than independence
- **Composition *and* Structure**
  - The elements *and* their interconnections are important
- **SNA is in line with current movements toward ecological perspectives and systems science**
  - Including, I think, ideas of functional contextualism

# Colorado Springs HIV Transmission Network

- Collect information from individual patients
  - Understand prevalence and some epidemiology
- Collect information on sexual relationships
  - Understand transmission processes

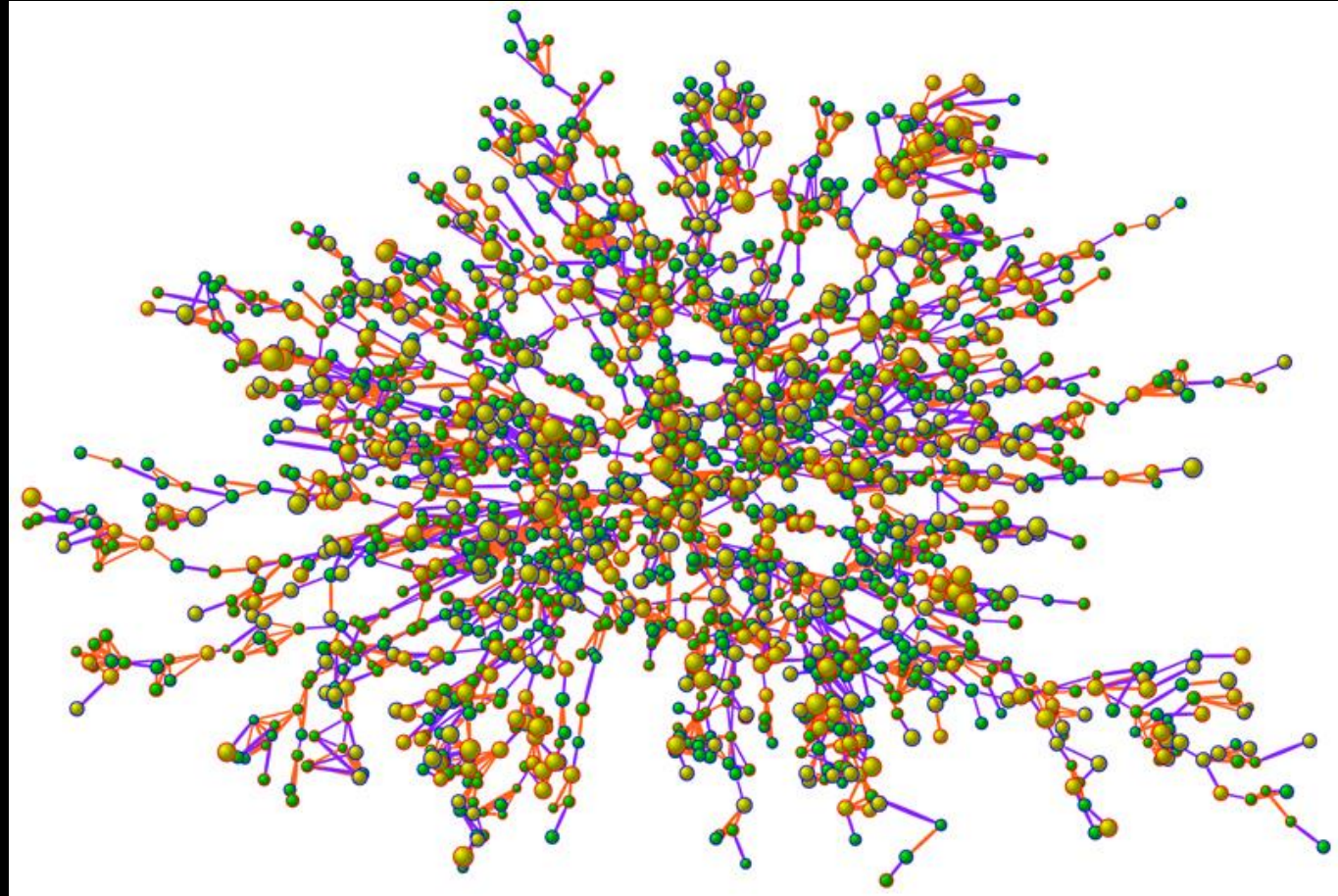


# ***What Is Social Network Analysis (SNA)?***

- **Formal methods for understanding connections**
  - motivated by structural intuition
  - grounded in observed data
  - relies on graphic imagery
  - uses mathematical, statistical, and computational models
- **SNA embodies a range of theories relating observable “social” spaces to individual and group behavior**
- **New statistical approaches assume interdependency and work to explain how the social context and behaviors co-evolve: influence and selection**

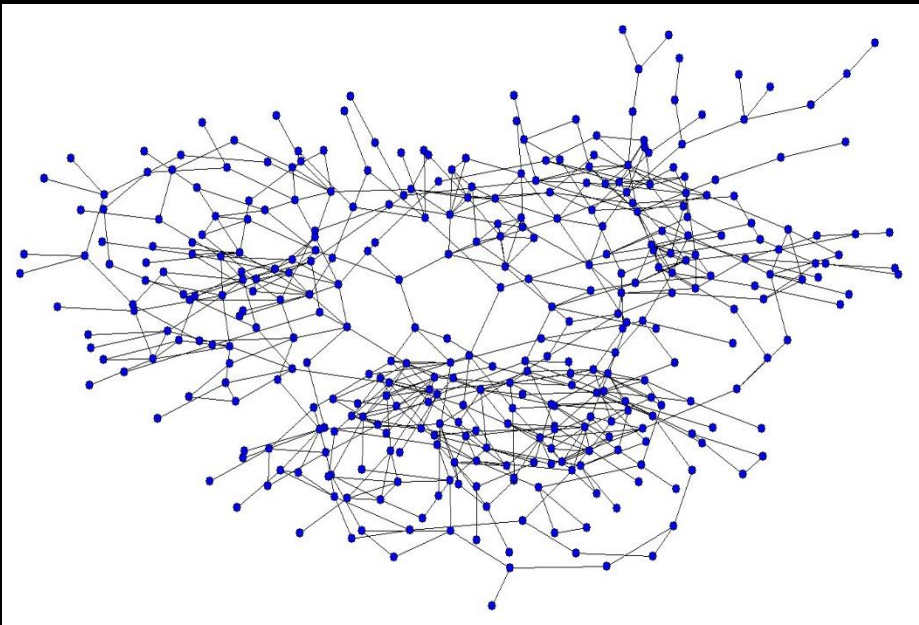
# Framingham Heart Study

- Network shows the largest connected group in Framingham
- Data were collected in 2000
- Obesity clusters among family and friends

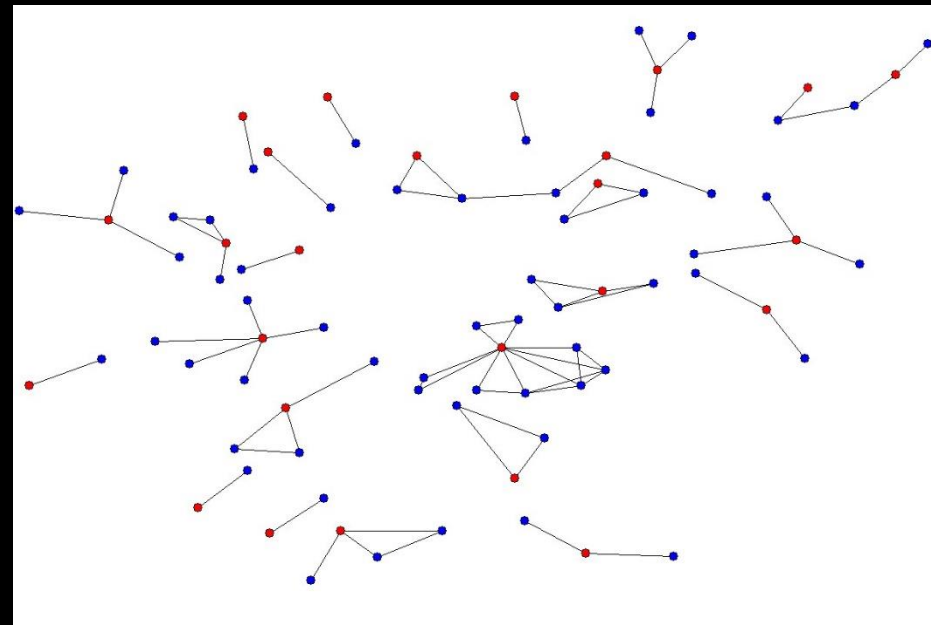


# *Two Types of SNA Studies*

## Complete Network Studies

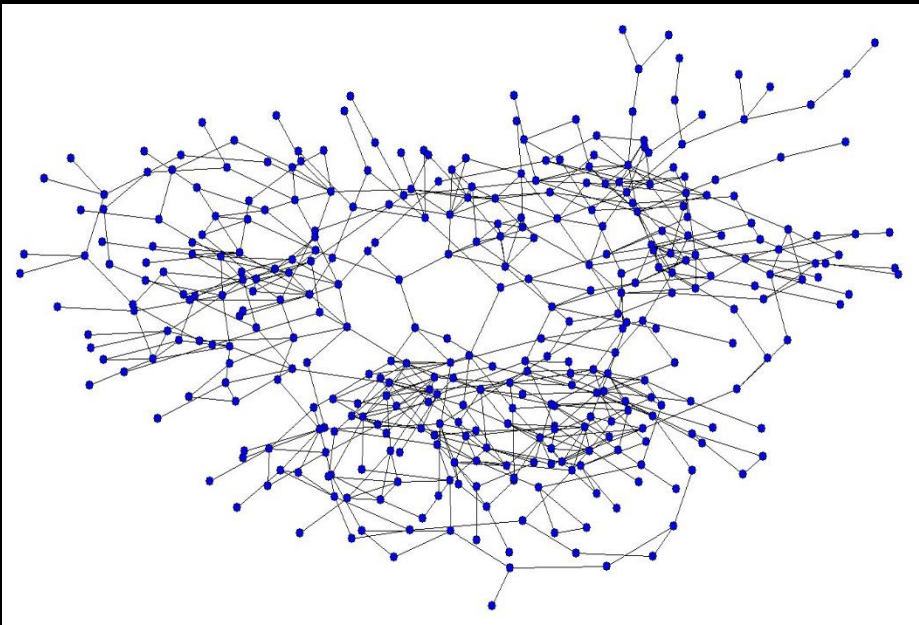


## Personal Network Studies



# Selected RAND SNA Research

## Complete Network Studies



## Add Health

Are substance use trajectories linked to differences in peer influence?

## CARBIN

Do patterns of substance use and peer influence change across the transition to high school?

## Project CHOICE

Does participation in an after school prevention program influence behavior? Does it influence social structure?

# *Selected RAND SNA Research*

## **Homeless Youth**

Do personal opinion leaders influence risk behaviors? Provide social support?

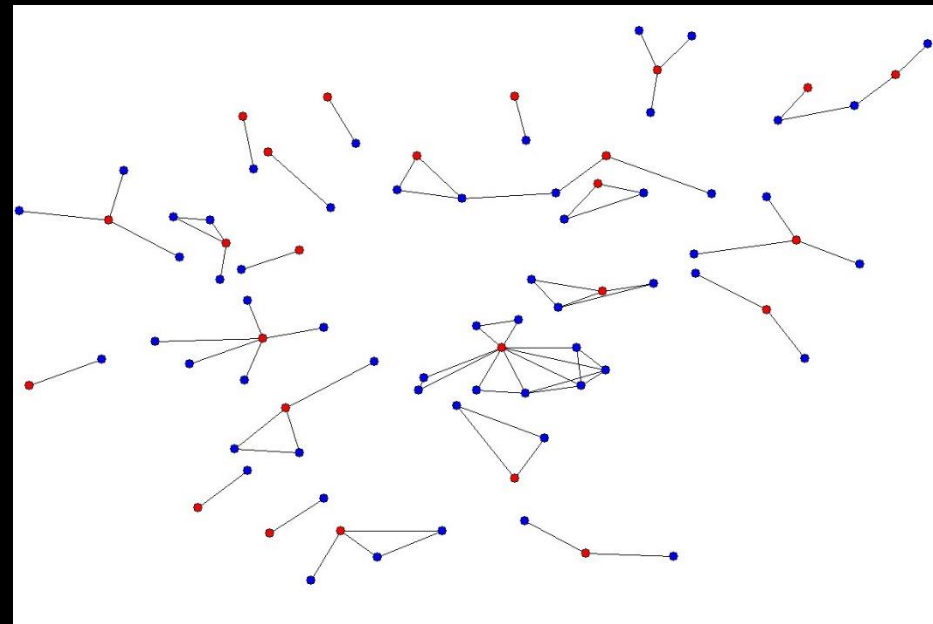
## **PLHA in Uganda**

How does disclosure of HIV status impact stigma, discrimination, social support? How is that linked to HIV care adherence?

## **Homeless Men**

How is men's homelessness history linked to their social network structure and composition?

## **Personal Network Studies**





# A Timeline of RAND's SNA Research

## Complete Network Studies

2007

- Add Health Smoking
- Prevalence: Influence/Selection

2008

- Project CHOICE
- Intervention Impact: Selection

2009

- Add Health Alcohol
- Trajectories: Influence/Selection

2010

- Add Health Marijuana
- Influence/Selection: Variation

2011

- CARBIN
- Transition to High School

2013+

- Missing Data Simulations
- Link Complete/Personal

## Personal Network Studies

2007

- Homeless Women
- Childhood Abuse/Adult Networks

2008

- Homeless Youth
- Opinion Leaders/Risk and Support

2009

- PLHA in Uganda
- Disclosure/Adherence

2010

- Homeless Men
- Homelessness Trajectories

2011

- MSM in Lebanon
- Sexual Risk Behaviors

2013+

- Americans on Disability
- Network Interventions

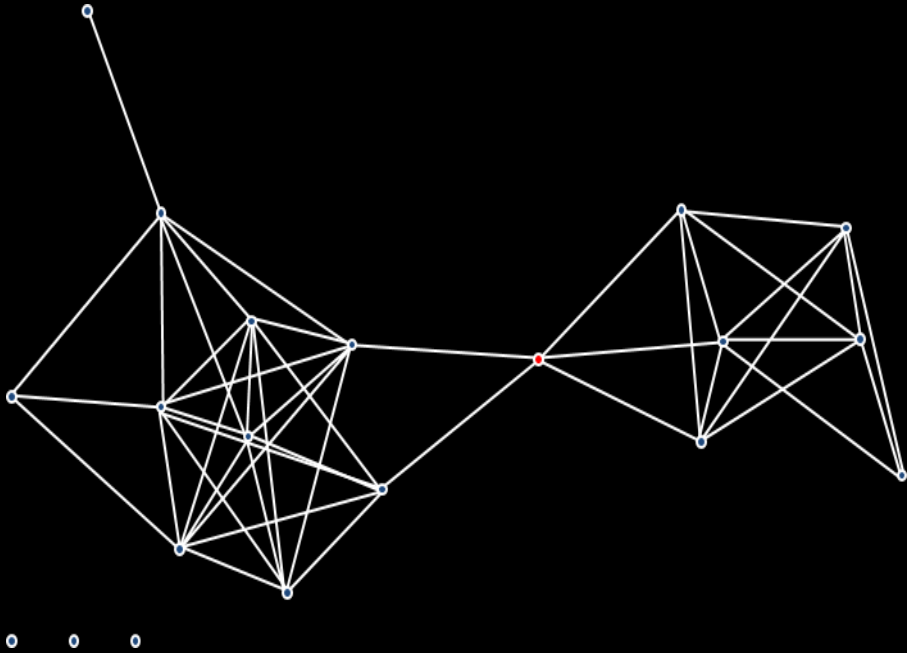
# *My Research Portfolio*

- **Understanding effect of social context on individual behaviors and attitudes**
  - **At RAND, this focus is specifically on health related behaviors and attitudes**
- **The goal is to provide research with as direct link to real change, real application, and real intervention as possible.**
- **My approach to applying research on peer effects has evolved based on the theoretical frameworks I work within, the analytic methods we use, and the diversity of RAND projects**

# *My Initial Perspective on Network Interventions*

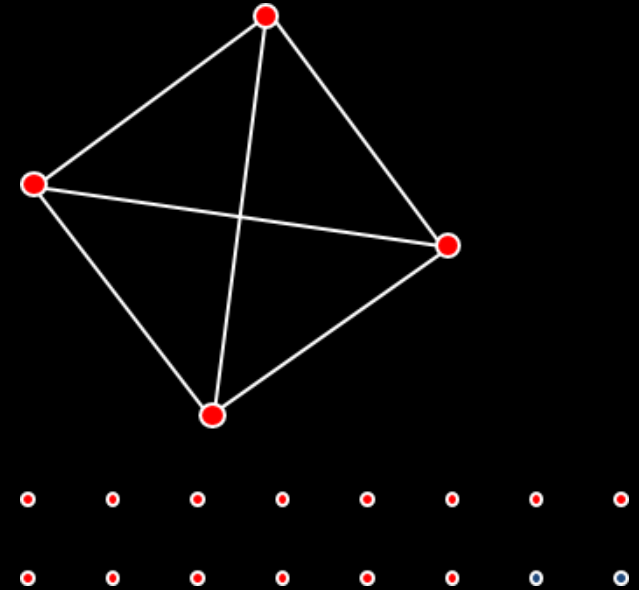
- **Simple links between individual behaviors and personal networks**
  - **Ho: The number of drug users in one's network is related to the likelihood of a respondent using drugs**
  - **Ho: The density of a respondent's network is related to the likelihood that they will use services**
- **Some interesting results:**
  - **For women, the effects of childhood abuse last into adulthood and are associated with riskier and more fragmented networks**
  - **For men, intermittent homelessness in the near term is associated with riskier networks while chronic homelessness is associated with network fragmentation**
  - **For youth, substance use is associated with the number of substance users in one's network**

# Impact of Homelessness on Men's Networks



## Recently Homeless

- Well-connected network
- Few risky network members



## Long-term Homeless

- Disconnected Network
- Many risky network members

## *However...*

- **These findings weren't as strong as I'd expected**
- **Ecological fallacies might impact results**
  - **How do we understand the specialized impact of an important subgroup like family?**
  - **How do we understand the role of important relationships like those with sex partners?**
- **How do we tell a homeless woman to modify the centralization of her network?**
- **How do we tell a homeless man to increase the overall number of supportive network members?**

# *What Got Me Thinking*

- **Monge and Contractor**
  - **Theories of Communication Networks**
    - **Self Interest, Exchange, Collective Action**
    - **(and the meta-theory of goals)**
- **Heaney and Israel's typology of network Interventions**
- **Gottlieb's individual motivations for network change**
- **Valente, Gest, and tons of others!**

## *Heaney and Israel (2002)*

- **Enhancing existing network relationships**
  - Ego/alter
  - Alter/alter
- **Developing new network relationships**
- **Enhancing networks via natural helpers**
  - Change agents
  - Opinion leaders
- **Enhancing networks through community-based approaches**

## ***Gottlieb (2002)***

- **Encouraging new ties is recommended if a network**
  - **Is impoverished**
  - **Reinforces undesirable behaviors**
  - **Lacks relevant resources**
  - **Expert skill is required**
- **Reinforcing existing ties is recommended if a network**
  - **Needs strengthening for long-term, continuing support**
  - **If a problem is highly stigmatizing**
  - **There is a cultural gap between ego and support providers**



# *How My Thinking Changed Our Approach*

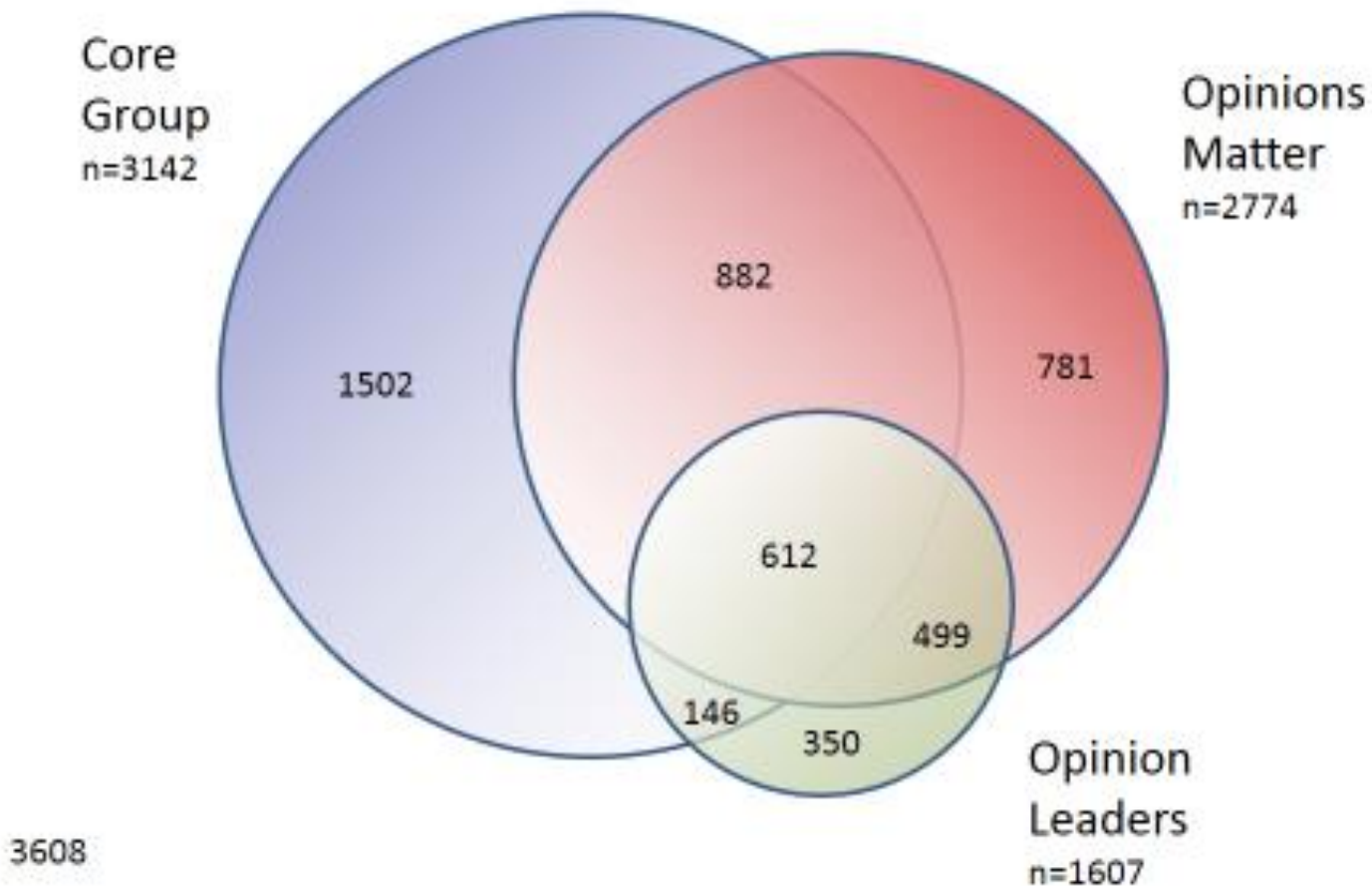
- **Shift focus from global network features to key subgroups, individuals, and relationships**
- **Facilitated by Multi-level approaches like the social relations model and other dyadic approaches, by Stochastic Actor-Based Models, and ERGM/p\* models**
  - **Application of SABMs and ERGMs to the hundreds of networks we collect in a personal network study is only now emerging**

# ***New Approaches, More Interesting Results!***

- **Homeless Women**
  - **Unprotected sex is most strongly predicted by emotional closeness within specific relationships**
  - **Protected sex is predicted by density of ties among non-sex partners with whom a respondent discusses HIV**
- **Homeless Youth**
  - **Youth's risk behaviors are correlated with the behaviors of individuals who occupy specific functional roles within their networks (core group, community leaders, personal opinion leaders)**
  - **Youth substance use with network members is predicted by emotional closeness, provision of support, alter popularity and alter importance to the ego**

# Homeless Youth: Opinion Leaders

## How These Groups Overlap



3608

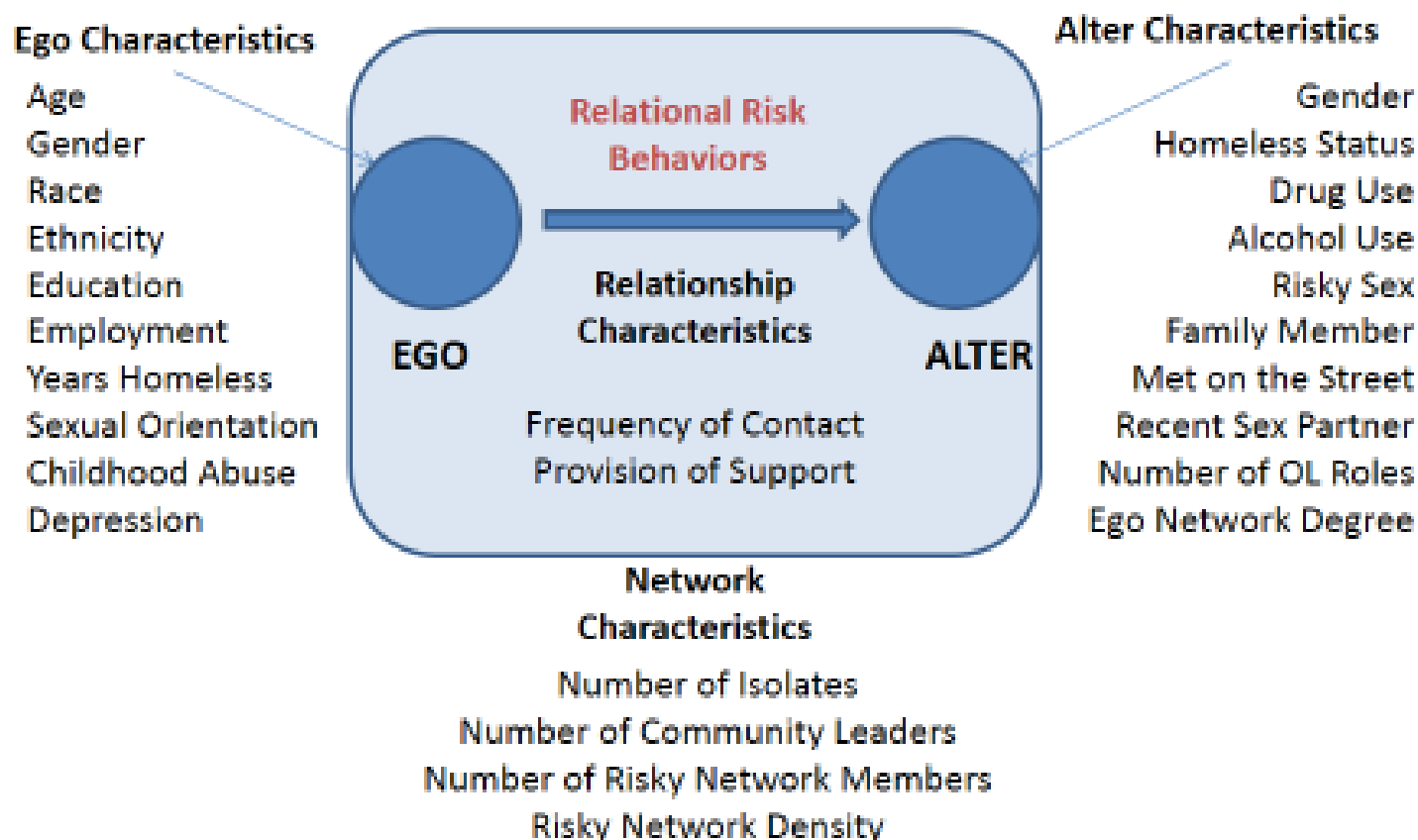
# Homeless Youth: Opinion Leaders

## Summary of Analyses

	Core Group	Opinions Matter	Opinion Leaders
Any Binge Drinking Past 30 Days	Drink to Intoxication	Drink to Intoxication	Drink to Intoxication
Frequency Binge Drinking Past 30 Days	Drink to Intoxication	Drink to Intoxication	Drink to Intoxication School
Marijuana Use Past 30 Days	Males Use Drugs	Employed Use Drugs	Employed Use Drugs
Number Sex Partners Past 90 Days	Family School Risky Sex Emotional Support	Family Risky Sex Emotional Support	Family Risky Sex

# Homeless Youth: Shared Risk Behaviors

## Our Dyadic Intuitions



# Homeless Youth: Shared Risk Behaviors

## Results of Dyadic Models

	Drink With	Drugs With
Individual	Education	
Alter	Male	Male
		Employed
	Homeless	Homeless
	Drug User	Alcohol User
	Sexually Risky	Sexually Risky
	Family	Family
	Met on Street	
	Recent Sex Partner	Recent Sex Partner
	Network Degree	Network Degree
	Sum of OL 'Roles'	Sum of OL 'Roles'
Relationship	Frequency of Contact	Frequency of Contact Provide Emotional Support
Network		Density
		Number of Opinion Leaders
		Number of Alters Met on Street
		Number of Alters who Drink

# *Now We Are Getting Somewhere*

- **These kinds of results, that are more specific, focus on the kinds of relationships that can be supportive or risky, or on the kinds of individuals in a network that encourage or discourage health behaviors have more direct intervention points**
  - **Negotiating the positive/negative aspects of relationships**
  - **Strengthening supportive relationships**
  - **Limiting the impact of risky relationships**
- **This kind of intervention has existed but now we have good empirical proof of why they may be effective**

# *A Focus on the Individual*

- **Once we are here, we can start to think about how peer selection and influence processes work**
- **This is where new statistical models have been most useful for us**
- **Far too many findings to discuss, but just to summarize, these models have been showing that influence and selection operate differently based on**
  - **Regional, neighborhood and school features**
  - **The behavior of interest: smoking is different from pot use**
  - **Whether the focus is on initiation or on escalation/frequency**
  - **Individual Features like gender, ethnicity, developmental stage, etc.**



# ***Our Efforts Are Paying Off***

- **The perfect combination of theoretical frameworks, new analytic strategies and statistical approaches and the wide range of studies at RAND was a huge catalyst**
- **The possibilities for applying network science are exploding**
- **The recognition of the utility of network research for intervention development and in social determinants research is growing (including general understanding of the methods which helps immensely)**

# *Keeping Ahead of the Curve*

How do social networks improve individual and community resilience?

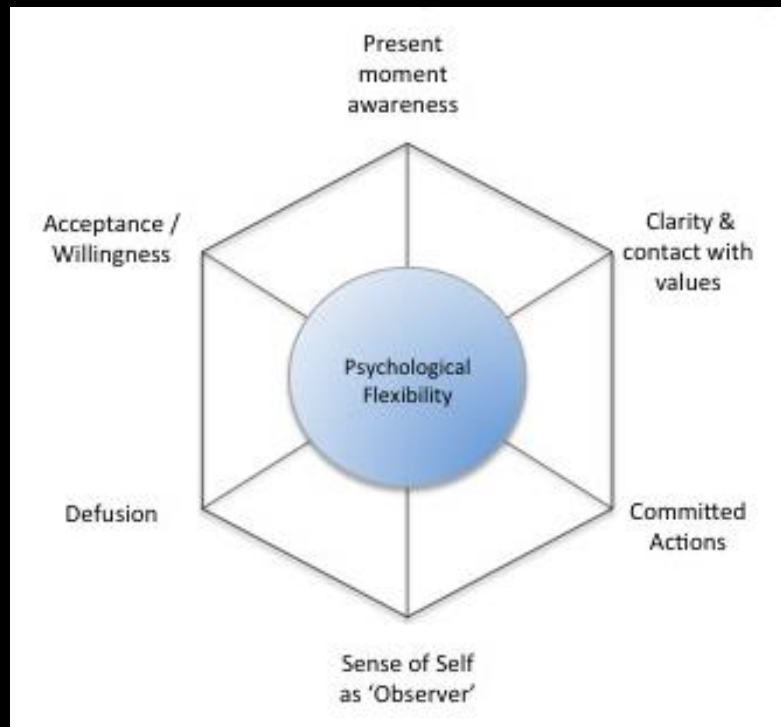
How are networks related to health outcomes and quality of care?

How can networks improve the health of our active duty and reserve military?

How can we leverage networks for effective interventions?

# Network Interventions and Contextual Behavioral Science

## Psychological Flexibility



## Relational Flexibility

- Assessment of current behavior and network structure/composition
- Goals for network and behavioral outcomes
- Network Intervention Options
- Awareness of Network as a system through which resources flow
- Recognition that the network is not static and can be actively modified (individual agency)
- Commitment to changes

## ***This Approach Can Work***

- **Individual Context**
  - **Homeless Women**
- **Group Context**
  - **Newlyweds**
  - **Afghan Community Schools**
- **Organizational Context**
  - **Food Aid Management Review**

## ***But Wait! There's More!***

- **All this rapid change is inspiring...**
  - **How can we improve our research strategies**
  - **How do we link personal network and complete network studies**
  - **How can we improve our behavioral models**
  - **How can we expand our application of network analysis (especially in the context of network-based interventions)**
  - **How can we apply new behavioral models within network-based interventions**

# *Linking Complete and Personal Network Studies*

- **Our longitudinal network study in IL (CARBIN) contains a personal network phase that will enable use to collect personal network data from all 2000 students and then compare their personal networks to their ego-centric networks generated from the complete network study**
- **Knowing how these networks are related to each other could facilitate research design, especially when a complete network study isn't feasible or a personal network type design would be more understandable for colleagues**

# *Evaluating Network Based Interventions*

- **We are exploring the costs and benefits of using network analytic approaches to evaluate the impact of network-based interventions**
- **Most evaluations are RCTs that don't collect nomination data that could give us information on the mechanisms by which network-based interventions might operate**
- **When in the intervention design process is the best to insert a network-based evaluation of the intervention?**

# ***The RAND Center for Applied Network Analysis and System Science***

- **Apply cutting edge network science in the service of improving the lives of individuals, communities, and populations in the U.S. and worldwide**
- **Primarily, RAND network researchers apply new theoretical perspectives in the service of improving public health**
- **Develop and extend existing software, tools and methodologies and investigate important methodological issues**



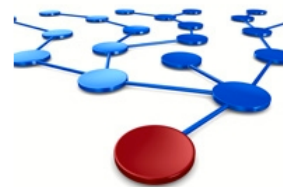
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# The RAND Center for Applied Network Analysis and System Science

The RAND Center for Applied Network Analysis and System Science applies **rigorous network research methods** to pressing policy challenges, providing **objective solutions** based on analytic results.



RAND's command of network analysis is both broad and deep. Agile project teams of interdisciplinary experts have used network science to examine a **diverse range of topics**, including:

- criminal hierarchies
- Air Force logistics
- HIV risk reduction in Africa and the Middle East
- substance use among at risk and high risk populations.

Similarly, RAND's **experts in network analysis** possess academic backgrounds that span a variety of fields and skill sets, including:

- policy analysis
- behavioral and social science
- medicine
- physics
- mathematics

**Researcher Spotlight**

**Hank Green**

Senior Behavioral and Social Scientist



Harold D. Green, Jr. (Hank) is a senior behavioral scientist at the RAND Corporation, a professor at the Pardee RAND Graduate School, and the director of the RAND Center for Applied Network Analysis and System Science. Green uses network analyses to understand the social and cultural...

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EgoWeb 2.0

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How It Works

Development Plans

Projects Applying EgoWeb 2.0

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# EgoWeb 2.0: Open-Source Software for Social Network Analysis

Social network analysis is a key methodology in modern sociological research and is used extensively in wide range of applications and other disciplines as well. Some common network analysis applications include data aggregation and mining, network propagation modeling, network modeling and sampling, user attribute and behavior analysis, community-maintained resource support, and more. Visual representation of social networks is important to understand the network data and convey the result of the analysis.



EgoWeb 2.0 is the result of an ongoing collaborative effort by non-profit research centers and universities to conduct social network analyses and present the data visually. The first version of EgoWeb was a modification to the open source personal/egocentric network data collection java-based software EgoNet, which was uploaded to the file sharing system SourceForge by Chris McCarty at the University of Florida in 2009.

Researchers at RAND Corporation started developing and expanding upon EgoWeb in 2010 to improve flexibility in administering egocentric/personal network data collection surveys and to expand the range of types of studies that could be conducted. Versions of the java-based EgoWeb are available on GitHub.

In 2013, RAND and researchers at UCLA collaboratively developed EgoWeb 2.0 with software

## Researcher Spotlight

**David P. Kennedy**  
Social Scientist



David Kennedy is a social scientist at the RAND Corporation and professor at the Pardee RAND Graduate School. Kennedy was trained as a medical anthropologist and received his Ph.D. in cultural anthropology from the University of Florida. He has conducted research on the intersection of culture...

[Explore Our People »](#)

# *Financial Support*

- **University of California Tobacco Related Disease Research Program**
- **National Institute for Child and Human Development**
- **National Institute on Alcohol Abuse and Alcoholism**
- **National Institute on Minority Health and Health Disparities**
- **World Food Program**
- **National Institute on Drug Abuse**
- **National Institute on Mental Health**
- **The Behavioral Sciences Division of the Army Research Office**
- **The MacArthur Foundation**
- **University of California Institute for Community Health Research**
- **National Defense Research Institute**

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- Heather Schwartz
- Craig Pollack
- Ryan Brown
- Greg Ridgeway
- Harmony Rhoades
- Stephen Martino
- Allison Ober
- The Uganda Study Team
- The Lebanon Study Team

# ***RAND's Mission***

- The RAND Corporation is a nonprofit institution that helps improve policy and decision making through research and analysis.
- RAND focuses on issues that matter most in health, education, national security, international affairs, law and business, the environment, etc. RAND has been expanding the boundaries of human knowledge for more than 60 years.
- As a nonpartisan organization, RAND is widely respected for operating independent of political and commercial pressures.
- Through high-quality and objective research and analysis and with sophisticated analytical tools, RAND engages in research to create knowledge, insight, information, options, and solutions that will be both effective and enduring.

# ***RAND Health***

- RAND Health's mission is to serve as the world's most trusted source of objective analysis and effective solutions for improving health and healthcare systems.
- RAND Health is dedicated to reducing the cost of healthcare while improving the health of individuals, communities, and populations in the U.S. and worldwide.