Social Networks & Health

Dissemination, Implementation and Improvement Science
Webinar Series

Thomas W. Valente, PhD
Professor, Institute for Prevention Research
Preventive Medicine, Keck School of Medicine
University of Southern California

tvalente@usc.edu
Acknowledgements

• National Institutes of Health (NIH)
  – NCI:
    • Social networks and networking that put adolescents at high risk
    • Extending a School-based Cohort to Improve Longitudinal Modeling
    • The Global Diffusion of Tobacco Control
  – NIDA/OBSSR
    • Center for Prevention Implementation Methodology (Brown, PI, Northwestern University)
    • http://www.cepim.med.miami.edu/
Overview

1. What are networks & what do we know about them
2. How do networks influence behavior
3. How can we use network science to accelerate diffusion/adoption and improve organizational performance
Influenza Pandemic, 1957

Fig. 2.7(A) Spread of the world influenza epidemic, 1957–8. Source: Stuart-Harris (1965, p. 103). (B) Diffusion of same epidemic on a local scale in northern England. Source: Hunter and Young (1971, p. 647).
Social Network of 9-11 Hijackers

Figure 3 - All 2 step links from two known suspects

SOURCE: Valdis Krebs
http://www.orgnet.com/
Network of Sexual Contact - Colorado Springs

Rothenberg et al., 1998
A romantic network for a single high school
(Courtesy James James Moody)
Global Map of Science, 2007

Rafols, Porter and Leydesdorff (2009)
What do we know about Networks?

• Homophilous
• Reciprocal
• Transitive
• Scale Free
• Clustered
a) Networks are Homophilous

- Like sorts with like
- People tend to be connected to others like themselves
- Homophily occurs for socio-demographic and behavioral characteristics
Friendships Among Students in One Classroom (12 year olds)
Relationships of 10th graders
The Social Structure of “Countryside” School District

By James Moody
b) Networks Are Reciprocal

- Networks are reciprocal:
  - Bob is friends with Mark
  - Mark is often friends with Bob

- Some relations, however, are inherently asymmetric, e.g., advice seeking
c) Networks Are Transitive

- Networks are transitive:
  - Bob knows Mark
  - Mark knows John
  - Bob meets John

- Friends of friends become friends
MAN (Mutual, Asymmetric, Null) Census
d) Scale Free: Centralized (e.g., some people are popular)
Some People are Very Central
e) Networks are clustered
How do networks influence behavior?
Exposure is Associated with Adoption
A Person with Less Exposure is Less Likely to Engage in the Behavior
Structural Equivalence is Associated with Influence
Variety of Network Exposures

Ego

A

B

C

D

E

F

G

H

G

G

F

E

A

B

Ego

C

D

E

F

G

H

G

G
Selection versus Influence

A → B → C

Ego

D → C

E → D

A → B

F → E → C

Ego
If networks are so important, how can we use them to make things better?
Network Interventions

“Network interventions are purposeful efforts to use social networks or social network data to generate social influence, accelerate behavior change, improve performance, and/or achieve desirable outcomes among individuals, communities, organizations, or populations.”
Network Interventions
Thomas W. Valente
Science 337, 49 (2012);
DOI: 10.1126/science.1217330
Principle 1: Program Goals Matter

• In some cases want to increase cohesion in others increase fragmentation
• Increase/decrease centralization
• E.g., slowing spread of STDs requires different strategy than accelerating adoption of office automation
• Network Interventions Are not Agnostic to Content.
Principle 2: Theory

• The type of change desired will be guided by theory (Behavior v Attitude)
• Understanding motivations for and barriers against behavior change is critical.
• A well-articulated theory of the behavior is often critical for successful interventions.
Principle 3: Learn As Well As Induce

• The interventionist should use network methodology to learn from the community as much as try to influence it.

• Programs which meet the needs of their audiences are better received than those designed asymmetrically.
<table>
<thead>
<tr>
<th>Network Interventions</th>
<th>Strategy</th>
<th>Tactic</th>
<th>Operationalization</th>
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<tbody>
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<td></td>
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<td>Degree, Closeness, etc.</td>
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<td>Deleting/Adding Nodes Deleting/Adding Links Rewiring</td>
<td>Vitality On Cohesion, Others On Network, On Behavior</td>
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1. Identify Key Change Agents Using Network Data

- Many different network positions that can be identified:
  
  A. Leaders
  B. Key Players
  C. Bridges
  D. Marginals – Peripherals – Isolates
  E. Low threshold adopters
Opinion Leaders

• The most typical network intervention
• Easy to measure
• Intuitively appealing
• Proven effectiveness
• Over 20 studies using network data to identify OLs and hundreds of others using other OL identification techniques

(Valente & Pumpuang, 2007; Flodgren, 2011)
Network Positions

Central Members

Bridges

Group Members

Peripherals

Isolate
Role of Leaders / Influentials in the Adoption Process

Six Stages in the Adoption Process

1. Awareness
First learns of new product, but unaware of benefits

2. Interest
Searches for information about the new product. Talks to trusted friends & experts

3. Persuasion / Evaluation
Talks to others to gather information and mentally considers use

4. Decision to Try
Convinced to trial to see if it will be useful

5. Adoption
Compares personal experience with expectations and considers future use

6. Confirmation
Ongoing experience confirms decision to adopt. May move to be an advocate

Network Effects
- Local OLs
- Peers
- Regional Opinion Leaders
- National Opinion Leaders

National Opinion Leaders
Regional Opinion Leaders
Network Effects
Peers
Local OLs
# Network Interventions

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Graphical Displays of Intervention Choices
II. Segmentation

A. Some behaviors are adopted at the group level, for example a work process may be only useful if used by the whole group.

B. Groups can reinforce adoption
III. Induction

• Beyond identifying individuals or groups, it is important to use the network structure.

• Induction interventions acknowledge the importance of the dyad(s).
Central Members act as Opinion Leaders
Network Influence is Proximal
Matching Leaders to Their Nominees

Sociogram based on ties

Optimal leader/learner matching

1(a)

1(b)
IV. Alteration (Manipulation)

• Within an existing network we might reconfigure the links to create optimal networks
• Can optimize on network metrics (e.g., centralization, clustering, transitivity).
• We can use different network metrics to create more effective communities.
Graphical Displays of Intervention Choices
# Intervs_v5


# Thanks to Kayo Fujimoto for help with some of the programming.

# Users may want to set the working directory (setwd) path to a location appropriate for their computing environment

```
package 'sna' version 2.2-0

Documentation for package 'sna'

- DESCRIPTION file

Help Pages

--- A ---

add_isolates
An add_isolates to a Graph
```
Selecting a NI

• Availability and type of data
  – Types of networks
  – Existing network structure

• Behavioral characteristics
  – Existing prevalence
  – Perceived characteristics such as cultural compatibility; cost; trialability; etc.
Linking Theory to Intervention Strategy

• There are several theoretical mechanisms that drive contagion and behavior change
• Evidence for a particular mechanisms suggests choice of intervention strategy or tactic
# Influence Mechanisms Aligned with Interv. Choices

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<td>Conflict</td>
<td>Bridges</td>
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<td>Hard to reach populations</td>
<td>Snowball</td>
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<td>Structure!!</td>
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# Social Network Analysis for Program Implementation (SNAPI)

## Stage of Implementation

<table>
<thead>
<tr>
<th>Exploration (Needs Assessment)</th>
<th>Adoption (Program Design)</th>
<th>Implementation</th>
<th>Sustainment &amp; Monitoring</th>
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<td>Network Interventions</td>
<td>Network Diagnostics</td>
<td>Network Surveillance</td>
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## Concept

- **Document network position and structure of those providing input into problem definition.**
- **Select network properties of intervention design.**
- **Use network data to inform and modify intervention delivery.**
- **Ensure continued program use by important network nodes.**

## Citation

- Valente 2012
- Gesell et al 2013
- Iyengar et al. 2010
Conclusions

• Network theories and methods can be used for behavior change interventions.
• SNA tools are better than ever and keep getting better.
• Massive/passive data are becoming available.
Prospects

• SNA is a “hot” topic now and many people in organizations, communities, and other settings interested in using the method.

• Funders are now willing to pay for SNA research and application.

• Experiments provide an opportunity to learn how networks work.
A New Paradigm

• Science of networks and behavior starting to develop.

• This science can be applied to many arenas in health care delivery and public health.
More reading and information: www-hsc.usc.edu/~tvalente/

Network Models of the Diffusion of Innovations

Social Networks and Health
Models, Methods, and Applications

THOMAS W. VALENTE