

# **The Spread and Utility of Social Network Analysis across a Group of Health Behavior Researchers**

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## **Abstract**

Social network analysis (SNA), both as theory and methodology, is a powerful framework for delimiting and studying health behaviors. Using SNA allows scholars to answer new research questions, innovatively investigate the social and systemic contexts of health and behavior, and collaborate on multi- or inter-disciplinary projects. As a result, SNA is growing in popularity within health behavior research and practice. Despite SNA's contribution and appeal, few health behavior researchers and practitioners have access to formal SNA education; much of the current training efforts occur outside degree-granting curricula. Therefore, the aims of this paper were to: 1) assess the diffusion of SNA, over time, among scholars presenting at AAHB annual meetings; and 2) determine whether AAHB can function as a professional venue for fostering development of SNA-related skills, especially by capitalizing on mentoring relationships. To assess the "spread" of SNA among AAHB scholars, we conducted a network analysis to capture the connections among those presenting research posters between 2016 and 2019. Results indicated sizeable increases in adoption of, and exposure to SNA within this network. Based on these findings, we recommend responding to the growing trends of SNA use by providing conference-based training and education in SNA. We also propose utilizing mentorship ties as leverage points in diffusing SNA within a system of professional scholars and, as a result, advancing health behavior research and practice.

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Social network analysis (SNA) represents a powerful framework – both in the form of methodological tools and theoretical assumptions – for researching the health of individuals and populations (Valente, 2010). SNA is one approach to “thinking in systems,” which entails the consideration of how elements within a system are interconnected and organized in a way that leads to various outcomes (Meadows, 2008). Core competencies required of all public health professionals now include systems thinking skills (The Council on Linkages Between Academia and Public Health Practice, 2014), and SNA meets the requirement for developing systems thinking skills. Further, SNA addresses calls for de-emphasizing intrapersonal-level explanations for health behaviors (Buchanan, 2000; Goodson, 2010), making it a valuable tool for health behavior researchers.

Given this growing emphasis on systems science and SNA, we wondered if health promotion research reflected the emphasis. Therefore, to assess whether SNA as a research tool and approach has “spread” over time among a group of health promotion professionals, we conducted a network analysis to examine the number of scholars presenting SNA research at annual meetings of the American Academy of Health Behavior (AAHB), a national, multidisciplinary organization of health behavior scholars. Through SNA, we can identify how many presentations using SNA research have been delivered from year to year within this

network, and also map the connections among scholars throughout the network that could be contributing to SNA’s diffusion.

Ultimately, our goal in conducting these analyses is to determine the popularity and use of SNA within this network of scholars, and to recommend ways to foster and capitalize on the growth of SNA within the AAHB, using mentorship as an important leverage point for advancing professional training in SNA and promoting innovative research in the field.

### Social Network Analysis in a Nutshell

Social network analysis (SNA) comprises a set of tools and theoretical premises aimed at examining and understanding the connections that make up a system (Valente, 2010). While SNA is not a new scientific approach (some researchers trace the use of networks to the early 20<sup>th</sup> century; Freeman, 2004), it is rather innovative within health research. SNA allows researchers to re-frame recurring health problems and answer new research questions within the field (Goodson, in press). See Table 1 for a list of key terms and definitions.

Table 1

#### *Social Network Analysis Terms and Definitions*

<b>Term</b>	<b>Definition</b>	<b>Example/Explanation</b>
<b>Node</b>	A single unit within the network	Each author in the network is a node.
<b>Edge</b>	A connection between two nodes	If Node A is connected to Node B, there is an edge between them.
<b>Degree</b>	The number of ties a node has	Typically, the higher degree, the more popular/powerful someone is within a network.
<b>Two-step Reach</b>	How many nodes are within two connections	Node A is connected to Node B, who is connected to Node C. Node A is one node, and two connections/steps away from Node C.
<b>Brokerage</b>	How many pairs of nodes connected through a given node	Node A is connected to Node B which is connected to Node C. Node B is a broker between Node A and Node C.

Network analysis focuses on the connections among elements in a system and assumes individual-level cognitions and even behavior choices are largely dependent on the connections and context of social networks. By analyzing these connections and interactions, SNA has the ability to: identify tipping points within networks that facilitate large-scale change (Patterson, Lemke, & Nelson, in press); determine how information, behaviors, beliefs, practices, and even diseases flow throughout a network (Valente, 1995), and measure structures and patterns within a network important to various outcomes (Valente, 2010).

Social network analysis adds, therefore, a unique perspective to framing, understanding, and intervening upon health problems. Studies of social networks have been successful, for example, in generating better understanding of compulsive exercise (Patterson & Goodson, 2017), drinking (Dumas, Graham, Maxwell-Smith, & Wells, 2015), stress (Kornienko, Clemans, Out, & Granger, 2013), substance use (Jacobs, Goodson, Barry, & McLeroy, 2016; Jacobs, Jeon, Goodson, & Valente, 2016), co-occurrence of risky behaviors (Jeon & Goodson, 2015), sexual behaviors (Swartout, 2013), social capital (Hanson et al., 2008; Whitham, 2012), and information seeking behaviors (Veinot, 2009), among others.

The purposes of this study were to: 1) assess the diffusion of SNA, over time (Rogers, 2003), among scholars presenting at AAHB annual meetings; and 2) determine whether AAHB can function as a professional venue for fostering development of SNA-related skills, especially by capitalizing on mentoring relationships. Specifically, we: 1) map the use and spread of SNA within a network of health behavior researchers — those presenting research posters at annual meetings of the AAHB between 2016 and 2019; 2) use SNA to describe longitudinal trends of SNA use within this network of scholars; and 3) discuss the importance of training, education, and increased knowledge of SNA for newer and more seasoned scholars alike, highlighting the role of mentorship in responding to growing trends in SNA use.

## **Methods**

### **Procedure**

We accessed AAHB conference records from 2016 through 2019 to conduct a network analysis of AAHB researchers. These dates were chosen because abstract and author data were available online only from the present time of the study back to 2016. These records documented every poster presentation given at each of AAHB's annual meetings, including title, authors, and a 300-word abstract describing the content. Over the four-year span, 1,024 authors delivered 491 presentations at AAHB.

Once we compiled the list of authors and presentations, we reviewed their abstracts to identify which presentations included SNA and, in turn, which authors had used SNA in their research. To be classified as a network analysis, the study had to employ SNA as a methodological/analytical strategy, not merely allude to its concepts/theories. After reviewing the abstracts, we created network files called "node-edge lists" for each year, as well as an overall node-edge list including all authors presenting between 2016 and 2019, and any connections created within that time frame. A node-edge list maps all authors (nodes) and how they are connected to one another (edges) in order to create a network graph (Borgatti, Everett, & Johnson, 2013). In this case, we documented every author who presented at AAHB and listed each person with whom they presented (or co-authored a presentation) each year.

### **Measures and Analysis**

We used UCINET network software (Borgatti, Everett, & Freeman, 2002) to calculate network measures. Specifically, we calculated two categories of network measures: egocentric and distance measures. Egocentric measures include how many direct connections each author had to other authors in the network (degree); how many people the authors were one person

removed from (two-step reach); and how many pairs each author served as a connection point between (brokerage).

In order to capture SNA “spreading” in the network, distance measures were calculated to determine how close each author was to those employing SNA. Distance measures included the number of direct connections individuals in the network had to authors using SNA, the number of two-step reach connections a person had to SNA (in other words, being one person removed from SNA), and the number of people somehow connected (through one or more network ties) to someone using SNA. After computing network measures, we used SPSS to calculate frequencies for each measure and conducted t-tests to determine differences among SNA authors compared to those not employing SNA.

## Results

From 2016 to 2019, the conference network consisted of 1,024 people and 8,452 connections. We created independent networks for each year, and one “cumulative” network reflecting any connections between and among AAHB authors over four years of time. We included the cumulative network to account for any connection to SNA between 2016 and 2019. Of the 1,024 authors, 40 (3.9%) presented some form of SNA in their work between 2016 and 2019 (See Table 2 for data from each year). The density of the cumulative overall network was 0.8% and the clustering coefficient was 0.87.

Table 2

### *Authorship and SNA trends within AAHB from 2016-2019*

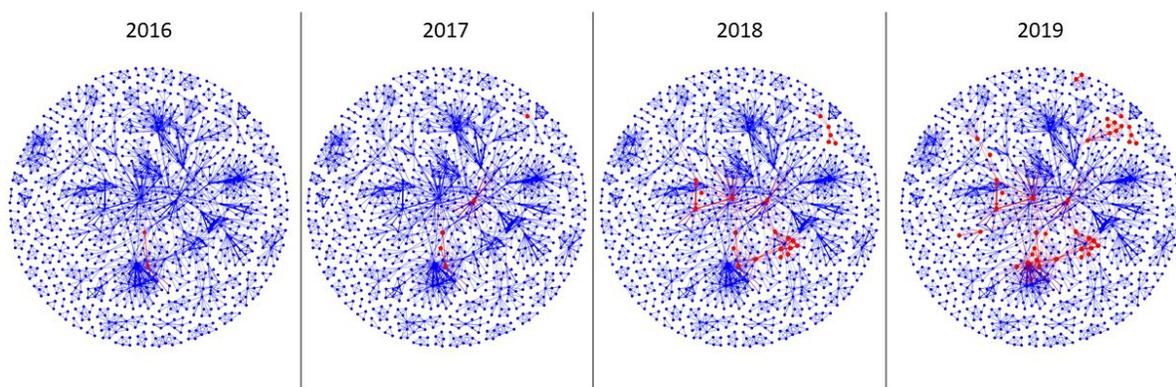
	Number of Authors	Number of SNA Authors	Direct Paths to SNA Authors	Two-Step Reach to SNA Authors	Network Connection to SNA Authors (+2 step reach)
2016	306	2 (0.7%)	4 (1.3%)	2 (0.7%)	4 (1.3%)
2017	338	5 (1.5%)	9 (2.7%)	9 (2.7%)	13 (3.8%)
2018	381	19 (5.0%)	47 (12.3%)	57 (15%)	65 (17.1%)
2019	362	23 (6.35%)	55 (15.2%)	76 (21%)	117 (32.2%)
2016-2019	1024	40 (3.9%)	207 (20.2%)	339 (33.1%)	646 (63.1%)

The average degree for each conference presenter was 6.15 ( $SD = 5.34$ ), ranging from 0 to 53 direct ties. Nodes had a mean two-step reach of 25.75 ( $SD = 24.51$ ), with scores ranging from 0 to 233. In other words, presenters were just one person away from an average of 25.75 people in the network. Nodes served as a broker for an average of 15.26 ( $SD = 75.14$ ) pairs (range 0-1183), meaning each presenter served as the connection point between 15.26 pairs, on average. Nearly two thirds of the network (63.1%,  $n = 646$ ) could access SNA through their network connections (i.e., more than half the network was connected to someone doing SNA either directly or through multiple connections). Approximately 200 presenters (20.2%,  $n = 207$ ) were directly connected to someone doing SNA, and 33.1% ( $n = 339$ ) were one person removed from an SNA presenter. Finally, SNA authors had significantly ( $p < .05$ ) higher degree (11.53 vs. 5.95), two-step reach (51.53 vs. 24.76), and brokerage (87.36 vs. 12.48) scores compared to

authors who did not use SNA. Please see Table 1 for terms and definitions, and Table 2 for distance measures from year to year.

### Changes in SNA-use and Exposure over Time

Over the course of four years, the number of authors using SNA grew from two authors in 2016 to 23 authors in 2019. In 2016, 1.3% ( $n = 4$ ) of AAHB presenters were directly connected to a presenter using SNA in their work and 0.7% ( $n = 2$ ) were one person removed from an SNA presenter, as compared to 2019 when 15.2% ( $n = 55$ ) were directly connected and 21% ( $n = 76$ ) were one person removed from SNA. This network experienced a 30.9% ( $n = 113$ ) increase from 2016 to 2019 in the number of people linked (through their AAHB connections) to an author using SNA. See Figure 1 for a visual of SNA's growth from year to year.



*Figure 1.* The spread of SNA through the AAHB network from 2016 to 2019. Connections and nodes highlighted in red indicate where SNA has reached within the network from year to year.

### Discussion

Our SNA of AAHB presenters at annual meetings from 2016 through 2019 demonstrated SNA is spreading across this network of health behavior scholars. Specifically, there are more people presenting network analyses each year and conference participants are becoming increasingly exposed to SNA through their network connections. This substantial and rapid increase suggests: a) it is reasonable to expect SNA will continue reaching new researchers across the network of AAHB scholars, and b) AAHB might be ideally situated to respond to the call for SNA use by providing training for students and professionals otherwise unexposed to SNA.

One unexpected finding from our analyses was how authors using SNA were more centrally and powerfully positioned in the AAHB network compared to those who were not presenting SNA. Limitations in our dataset do not allow for the exploration of potential mechanisms behind this finding, but we can speculate that scholars who are more central in the network might have assumed this position because they are early adopters or influencers (Rogers, 2010). Conversely, central positions in the network might have caused these researchers

to learn, earlier than others, about innovations such as SNA. Regardless of the causes driving this particular network's structure, this finding is important because once the centrally positioned and well-connected nodes adopt an innovation, diffusion expedites across a network (Valente, 1995; Valente & Davis, 1999).

### **The Conference Setting**

Offering SNA workshops or trainings within a conference setting creates a lower-cost opportunity to train researchers within the field, reaching all levels of professionals, including students. Because advancing research and practice is often a central goal or mission of annual meetings and organizations (American Academy of Health Behavior, 2019), pre-conference workshops or SNA-dedicated sessions at established meetings would provide an environment for anyone interested in SNA (experienced or not) to connect with experts. These connections can result in new collaborations and innovative, cutting edge research across the network.

Conferences offer a lower stakes and quicker dissemination route that may predicate upcoming trends in research publications<sup>1</sup>. Thus, conferences could be the ideal place to capitalize on an emerging trend in health behavior research and equip scholars to understand, apply, and interpret network analyses likely present in future publications. More importantly, even if uninterested in conducting SNA-type research primarily, senior scholars exposed to SNA in conference-based trainings can become better mentors for early-career professionals and graduate students who want to utilize SNA in their work. In the same vein, as SNA's influence in health behavior research grows, it is imperative for any health researcher or practitioner to have a basic understanding of the methods, findings, and implications from network studies.

### **Mentorship as Leverage in a System of Scholars**

What makes AAHB uniquely positioned to lead the field in fostering SNA use is its commitment to mentorship. According to their website, a "conceptual underpinning" of AAHB is "the need to mentor new health behavior researchers," and the organization mentions mentorship in their stated values and organizational goals (American Academy of Health Behavior, 2019). In 2014, AAHB launched a program called the Research Scholars Mentorship Program (RSMP). The RSMP is a 12-month mentoring opportunity for early-career professionals to work closely with an AAHB member who has an established research agenda. The purpose of the RSMP is to aid newer researchers in producing high-quality products addressing various health behavior-related research areas. In connecting scholars from different institutions and career statuses, the program itself is essentially creating new bridges and connections across the network that could lead to further spread of ideas and concepts, such as SNA (Valente, 1995).

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<sup>1</sup> Currently, SNA trends in health behavior journals do not seem to mirror the trends at the conference level. We did a review of three flagship health promotion journals and found only five SNA articles published between 2016 and 2019. We speculate this could be due to the lag time between research and publication (Powell, 2016), the fact that SNA is still fairly new in the field (Luke & Harris, 2007), or perhaps because seasoned researchers, who are likely to serve as editors and reviewers for flagship journals, may not be trained or equipped to review SNA articles.

The AAHB recognizes mentorship as a two-way relationship, where learning occurs in the dialogical exchange between mentee (early-career professional) and mentor (seasoned professional; Freire, 1974). In these relationships, the mentor provides knowledge, skills, or advice to the mentee based on their seniority and greater experience, but there are also instances where the mentee becomes versed in a given topic or methodology and teaches the mentor what they learned (Chen, 2013; Leh, 2005). When mentorship becomes an environment for mutual growth, it can result in collective accomplishments impossible to achieve outside the partnership (Klinge, 2015; Pfund, Byars-Winston, Branchaw, Hurtado, & Eagan, 2016). Because mentorship is grounds for learning and innovation, it can become an important leverage point for fostering new ways of thinking and conducting research, such as SNA.

Not only can mentorship facilitate continued spread of SNA, SNA-focused research is ripe for multidisciplinary collaboration (Miller & Page, 2009) and adds considerable value to mentorship ties. SNA is not unique to or reserved for one content area or research interest. Rather, SNA can diminish “language barriers” between different schools of research and, as mentioned earlier, reframe problems in order to answer new, intractable, or “wicked” health-related questions (Goodson, in press). Thus, SNA as a research approach can garner and sustain success within mentorship ties and create a positively reinforcing environment for the new and seasoned scholars alike (Klinge, 2015), resulting in advances in health behavior research.

## **Conclusion and Implications for Health Behavior Theory**

While AAHB is the focus of our analyses and recommendations, it is not unreasonable to suggest our conclusions might be equally valid for other professional bodies. While this paper only depicts the increased use of SNA at one conference as a “case study” of sorts, it highlights the growing popularity of SNA within health behavior research. Unfortunately, limitations in the available data precluded an in-depth examination of other potentially useful factors characterizing and shaping this network of scholars (e.g., knowing each author’s academic rank or if the author was a student might reveal if the direction of the spread is from senior to junior scholars, or the reverse). Further, factors such as the AAHB’s submission caps on abstracts for first authors (i.e., limiting each person to a select number of first-author abstract submissions) could influence how the network is structured, and which connections exist in the system.

Despite these analyses’ limitations, our findings suggest AAHB’s focus on mentorship, coupled with the recent increase in SNA presentations at its annual meetings, make AAHB an ideal venue to provide education and training in network analysis. In providing such training, AAHB could make important strides in advancing health behavior theory and research. As SNA and systems science in general become more prominent in the social sciences, professional development opportunities that are easily accessible to early career and established researchers will be needed. By providing training within an established setting, health behavior researchers could learn basic SNA principles that would foster interpretation and understanding of existing work, as well as create new collaborations among scholars. As new collaborations across network members are created, and mentorship ties are sustained, SNA could provide a means for advancing multidisciplinary research in the field. We hope this paper encourages readers involved in health research and practice to seek information and mentoring regarding SNA, and advocate for the opportunity to learn and apply it successfully to their own work.

## Discussion Questions

1. In what ways can mentorship support the spread of SNA use, specifically within a professional conference/meeting setting?
2. What are some examples of new research questions you could answer through the application of SNA?

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