



Program on \_\_\_\_\_  
**Networked  
Governance**

## **How do networkers network?**

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**Abstract:** This study was conceived during the 2005 INSNA (International Network for Social Network Analysis) conference by attendees who were interested in the evolving patterns of relationships among social network academics and consultants, and in how junior researchers were being integrated into the existing community. The study was also intended as a session- and space-planning aid for the 2006 conference organizers. Specifically, this paper describes a study of networking among social network professionals who attended the 2005 INSNA “Sunbelt” Conference. The attendees were asked to respond to a web questionnaire regarding their experiences, interests, and both collaborative and mentoring relationships. We employ homophily arguments as well as theories of status and career/life cycle to determine what factors led to the establishment of ties from interactions at the conference. As well as applying the results of this study to the understanding of social network dynamics, we hope our findings will further the integration of new members into the existing community.

**Keywords:** homophily, multidimensional scaling (MDS), network dynamics, egocentric networks, academic networks

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## 1. INTRODUCTION

Around the room there are people pasted to the wall, occasionally mingling with each other, but often just staring at the commotion going on in the center of the room while munching on their hotel quiches at the conference-sponsored happy hour. A number of senior network researchers are mingling with their colleagues and surrounded by their attendant graduate students. Two of them notice and approach each other, grad students still in tow. Like the fusing of two atoms to form a molecule, the senior researchers begin to chat. Around them, a whirring of activity as their graduate students introduce themselves to each other. The senior researchers' conversation goes on for about four minutes before they say their farewell. Again, forces unseen rip the newly-formed molecule back into two atoms – a nucleus surrounded by an electron cloud of junior researchers. The discussions along the wall seem undisturbed by the forces at work.

Conferences are often lauded by academics as a valuable tool for collaboration, network development, and knowledge transfer. So integral are conferences to the process of discovery, that funding agencies like the National Institutes of Health and the National Science Foundation have developed mechanisms to support researchers wishing to host conferences on topics of interest. Meetings are commonly convened to showcase the latest innovations in research and explore emerging best practices in both research and program delivery. Academic meetings are marketplaces for knowledge exchange and provide opportunities to create new ties with other researchers (Friedkin 1984; Liberman and Wolf 1997).

In order to understand how researchers network, we have chosen the annual meeting of the International Network for Social Network Analysis (INSNA) – a niche academic meeting of highly specialized researchers and consultants who develop social network analysis theories and methods and apply them to specific empirical phenomena. In addition to this very specialized event, most of the attendees also participate in larger national or international meetings in their specific fields of interest, such as those organized by the Academy of Management, the American Sociology Association or AcademyHealth.

Within INSNA, the subject of academic networks and networking is a common one. Studies focused on co-authorship and co-citation patterns have been a topic of interest among members of INSNA (see for example Hummon and Doreian 1989; Newman 2001). Others have become interested in the dynamics of conferences in the context of communities of practice – self-organized, voluntary, focused communities of people and organizations working toward common understanding on a given issue (Wenger 1998; Wenger 2000). This is, in fact, not the first time that a study of the INSNA community was undertaken. In 2003, social networking software was linked to the registration process at that year's conference to allow researchers to visualize their research networks. Research on academics' behavior is all the more poignant among social network researchers and consultants, simply because networks are the focus of this research community.

This paper focuses on a number of networking questions informed by theories of homophily. At its core, we seek to understand how sameness creates or encourages the creation of relationships. In some cases, similarity of interest is the object of study. In other cases, it is organizational affiliation, or gender.

## 2. LITERATURE REVIEW

The literature on homophily and similarity suggests that people with similar backgrounds with regard to their socio-demographic, behavioral and intrapersonal characteristics tend to have homogenously-composed individual personal network structures (for an overview see: McPherson, Smith-Lovin et al. 2001). Homophily – the tendency for people to connect with others who have similar attributes and behavior – would seem central to the phenomena of relationship-building in conference situations; in McPherson/Smith-Lovin's words: "Similarity breeds connections" (2001:415). This theory has clear implications for behavioral choices, resources and information each person receives and the extent to which relationships can be maintained or are dissolved over time. We detail these implications in our hypotheses, found in subsequent sections.

Homophily expresses the degree to which individuals interact based on similar characteristics and attitudes. This similarity or dissimilarity can either lead to segregation or differentiation between individuals and has been found to be related to network closeness or network distance (Barnlund and Harland 1963) – expressed as the number of relationships through which a piece of information must travel to connect two individuals. The network structure and opportunities embedded in the structure have an influence on the outcome of social processes: the probability of a newly established or existing tie is higher among individuals who are similar to each other or homophilous (Fischer 1982).

We follow McPherson's approach and distinguish between status homophily and value homophily characteristics (2001:422f.). Status homophily is based on the informal, formal and ascribed status of an actor and is derived from socio-demographic dimensions, such as gender, sex, age, race/ethnicity or acquired characteristics such as religion, education, and behavior patterns. In contrast, value homophily is based on values, beliefs and attributes that include internal states that shape individual behavior.

In our study, we focus on the most obvious and "collectable" dimensions of homophily, such as professional interests (interest homophily), affiliation (institutional homophily), career status (in form of seniority homophily within the professional field), gender, and professional involvement (community homophily).

In the context of interest homophily, we draw on the concept of equivalence. The literature proposes that two individuals with identical relationships with other individuals in that system are said to be structurally equivalent (Lorrain and White 1977; Borgatti and Everett 1992). However, from a systems point of view it is also possible for different actors to exhibit structural equivalence in completely isolated networks. For example, if two organizations or individuals engage in exactly the same set of activities (out of a larger set of potential activities), they can be said to be functionally equivalent within the system because they are likely to fill equivalent roles. It is in this latter sense that structural equivalence is used in this paper.

The distinction has important implications for the type of data needed for analysis. Network analysis of equivalence requires information about how actors interact (reciprocal data). In contrast, systems analysis of structural equivalence only requires information about how individuals act on a common set of activities, regardless of whether they are interacting with each other. For instance, when discussing structural equivalence and position within a network, Wasserman and Faust (1994:348) point out:

Actors occupying the same position need not be in direct, or even indirect, contact with one another. For example, nurses in different hospitals occupy the position of “nurse” by virtue of similar kinds of relationships with doctors and patients, though individual nurses may not know each other, work with the same doctors, or see the same patients.

This paper adapts methodologies typically used to assess equivalence in social network analysis and uses them to infer system-level equivalence based on common interest patterns. In this case, homophily of interest is defined by comparing the totalities of individuals’ preference profiles rather than on an issue-by-issue basis. Using a holistic model to define shared interests means this analysis is much more sensitive to similarities and differences than models used by traditional categorical homophily studies. Detailed later in this paper, we study individual professional interests using multidimensional scaling (MDS). This approach not only more closely links people with common interests, but also distributes those with opposing interests. Individuals with identical interests are said to be equivalent.

Using visual methods drawn from network analysis, this method develops the concept of system-level functional equivalence. In so doing, this paper also documents a new method for studying how systems create patterns of activities that emerge from the interactions in which they are embedded. It illustrates how methods from social network analysis might be relevant to understanding system-level dynamics and is offered as a way to suggest the potential fruitfulness of more detailed and rigorous future study with social network analysis approaches (Knoke and Kuklinski 1982; Nohria and Eccles 1992; Wasserman and Faust 1994).

## *2.1. Interest Homophily*

Prior research suggests that peer groups – in our case, researchers at academic meetings such as the INSNA annual meeting – are important sources of influence on people’s behavior (Lazarsfeld and Merton 1954). The social influence of peers can both have a positive as well as a negative impact on the establishment and maintenance of relationships. As Lazarsfeld/Merton (as quoted in: Burton 1927) state, “birds of a feather flock together”; relationships are established because of similar interest and group people together or exclude them from access to other peers. Relationships with people who share common interests are therefore easier to establish or reinforce at conferences than new relationships and contacts with actors whose interests are different or unknown.

In our study, we look at two different types of relationships. Existing relationships are those that were established before the actual event of the conference. Newly-established relationships are those reported as having come into existence as a result of people meeting at the INSNA conference. In so doing, we are able to distinguish the impact of the conference on the creation of new relationships.

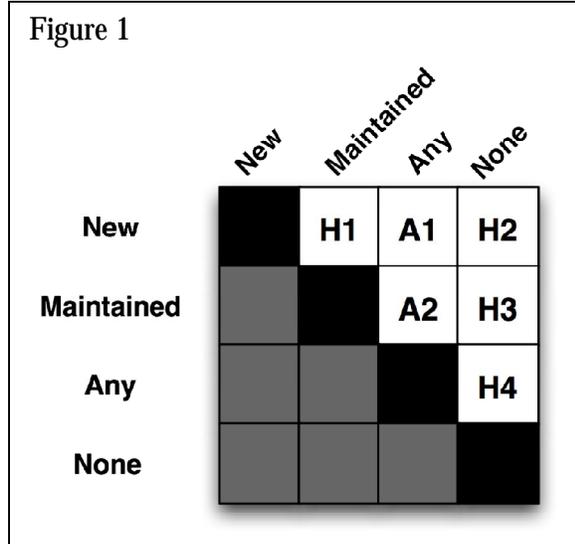
We have identified four substantive relational variables that allow for tests along the lines of the homophily argument:

- Ego-new relationships
- Ego-existing (maintained) relationships
- Ego-any relationship (including both new and existing)
- Ego-no relationships

Using those variables, six hypotheses could be tested, in theory. These are outlined in Figure 1 below. The table in Figure 1 has identity elements blacked out to indicate when no such analysis is possible. Most important here, A1 and A2 would suffer from analytic problems. Simply put, because “any relationship” includes both new and maintained relationships, the problem of multicollinearity and the absence of mutual exclusivity make these analyses problematic. As a result, we have foregone such analyses.

<sup>1</sup>

Homophily theory suggests that the composition of one’s personal network is very much influenced by similarity of individual professional interests and reinforced by those people who are currently members of one’s personal network (McPherson, Smith-Lovin et al. 2001). We therefore assume that the similarity or difference in interests, as expressed in terms of the distance or proximity to other actors’ interests, will be smaller in existing networks.



H3: The average MDS-Euclidean distance between ego and pre-existing ties within ego’s network will be significantly less than the average distance to those outside ego’s network.

When it comes to additional or newly-created contacts, the homophily argument in terms of personal interests comes into play again: personal relationships are also more likely to arise with actors who have similar interests, to whom ego can relate based on professional interests such as indicated by membership in a specific sub-field (Lieberman and Wolf 1997).

H2: The average MDS-Euclidean distance between ego and new ties within ego’s network will be significantly less than the average distance to those outside ego’s network.

The alters who are already existing within one’s network exert influence that is likely to affect one’s choice of new alters (Newcomb 1953; Heider 1958; Newcomb 1961). We expect that these influences narrow the range of interest profiles to which one is attracted (see our review of the literature on seniority homophily in subsection 2.3, below). In addition, because of the costs involved in creating a new tie (e.g., time invested into getting to know somebody, negotiating similar interests, building trust with the new contact, and

<sup>1</sup> Further, we have chosen not to focus on the implications of confirmed ties versus unconfirmed ties. In this study, we use the decision rule that says a relationship exists if ego perceives such a relationship, without regard for alter’s similar identification of the relationship.

thinking about future actions such as potential collaborations or even simple knowledge transfer) we expect individuals to attempt to minimize costs by building relationships with others who are most similar to them.<sup>2</sup>

H1: The average MDS-Euclidean distance between ego and new ties within ego's perceived network will be the same or less than the average distance to those within ego's pre-conference network.

Given the above, we expect both new and existing relationships to be based on similarities of interest, and therefore the distances between them to be less than to those outside ego's personal network.

H4: The average MDS-Euclidean distance between ego and the others declared within their networks at a time after the conference will be significantly less than the average distance to those outside ego's network.

## 2.2. *Institutional Homophily*

Following our homophily argument, we suspect that conference attendees are more likely to create new ties to those people with whom they attend similar paper sessions and therefore those with whom they perceive themselves to share academic interests. This co-attendance behavior can indicate similar interests and, as we argue in the previous section, people are more likely to trust each other and build relationships with each other when they have similar interests. Different authors have called this behavior institutional homophily (Burt 1992; Ibarra 1997; Burt 2000). Another argument is made by Mehra/Kilduff (1998), saying that underrepresented groups, for example government employees or consultants in our case, also flock together because they feel a higher similarity to, and therefore trust, those who are like themselves.

Lawrence also adds that sharing the institutional framework and context increases the perception of belonging together and the understanding that people with a similar institutional background share a social frame of reference (Merton 1968; Lawrence 2003). We argue that these organizational reference groups through which individuals receive information, interpret work-related experiences or make decisions can be applied with regard to new relationships:

H5: The number of new relationships among individuals in similar institutions is greater than among those in dissimilar institutions.

## 2.3. *Seniority Homophily*

Weber (1968) advanced ideas of social stratification in his discussions on the relationship between class, status and party. From a homophily perspective, people who are structurally

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<sup>2</sup> We will discuss the specific method for calculating the MDS distances in the Methodology section of this paper (see chapter 3).

similar to one another are more likely to have issue-related interpersonal communication and to attend to each others' issue positions, which in turn can lead them to have more influence over one another. As a result, we would expect that individuals will seek to create relationships with those they perceive as similar in status and standing within a community (Verbrugge 1977; Fischer 1982; Verbrugge 1983).

Especially among researchers and members of universities, there is evidence that people tend to communicate more frequently with those colleagues who are in their own tenure group (McCain, O'Reilly et al. 1983). This tendency is reinforced by the fact that people tend to interact and communicate more easily and more frequently with those individuals who speak the same language or use the same jargon (March and Simon 1958; Zenger and Lawrence 1989), reflecting how they interpret, understand and therefore are able to respond to their counterparts. Young scholars in the field, newcomers or students may not have the ability and repertoire of their senior colleagues and might therefore not be able to share the same amount of vocabulary: misinterpretations and misunderstandings would therefore keep them from communicating effectively across seniority levels. The opposite may also be true: senior community members may not share the newer expressions of students, with similar results.

When it comes to the possibility of establishing new relationships, the ascribed age of an individual implies newness or tenure within the field, independent of the actual position and reputation of the researcher. The anticipation of shared experience or history can lead to a higher possibility of interaction.

H6: The percentage increase of new relationships among individuals of similar seniority is different than among those of dissimilar seniority.

#### *2.4. Gender Homophily*

Different studies of gender provide evidence that supports the segregation of men and women into different jobs, occupations, firms, and industries (Baron and Bielby 1985; Baron and Bielby 1986), patterns of selective recruitment and advancement (Baron, Davis-Blake et al. 1986), and salary differentials (Treiman and Hartman 1981; Drazin and Auster 1987). In an equally distributed group, women tend to choose female friends and men tend to have even more sex-homogeneous networks than women (Brass 1985; Ibarra 1992; Ibarra 1997). Prior research has also shown that – especially in instrumental and status-loaded networks, such as advice, respect, mentoring and support networks – this tendency is naturally supported when there is a strong majority in either direction. We assume that this tendency will also be replicated and reinforced when it comes to newly-established relationships at professional/academic conferences:

H7: The number of new relationships reported is affected by gender.

#### *2.5. Community Involvement Homophily*

Researchers in academic meetings can be divided into two natural groups: a) People who presented papers, and b) people who didn't present papers. Our assumption is that

researchers who have presented a paper are exposed to a wider audience (by being seen to be on the program and by the actual audience who attends their presentations) and have therefore the advantage of being able to make more contacts, and perhaps more intensive contacts, than people who are not presenting papers at a conference (Lieberman and Wolf 1997). The likelihood that they are making new contacts because of their active participation in the program is higher compared to their colleagues who are “only” attending, but not presenting:

H8: Those whose papers were accepted for presentation increased the size of their ego networks proportionately more than those who did not submit papers or whose papers were not accepted.

### 3. METHODOLOGIES

We are using two distinct methodologies to understand relationship building within academic conference settings: a) Multidimensional Scaling (MDS) to show how relationship building is influenced by overlapping interest areas (chapter 3.1) and b) mapping of network data (chapter 3.2).

#### 3.1. *Multidimensional Scaling (MDS)*

MDS allows the discovery of relationship among elements by representing their similarities in a spatial map (Schiffman, Reynolds et al. 1981). Typically, an array of data points in  $n$ -dimensional space (where  $n$  equals the number of variables) is remapped into a lesser number of dimensions for easier interpretation. In this way, MDS mirrors cluster and factor analysis. As complexity is reduced through the reduction in the number of dimensions, the relative positioning of two data points differs somewhat from their “true” proximities. This process generates “stress” in the model which can be measured to provide goodness-of-fit where lower values are better (Kruskal and Wish 1978).

MDS has the advantage of comparing similarities in a broader context. It is among a group of techniques used to explore the underlying structure in a data set. MDS relies on a transformation of the original observations into “proximity” data, evaluating the similarity or dissimilarity of all possible pairs of elements. This approach allows natural groups to emerge from the data. A balance must be struck among the desire for a small number of dimensions (for interpretability), explanation of a large amount of variance within the data set, and low stress in the model (McCain 1990). We employ two-dimensional non-metric scaling to create a dynamic that allows the data to be visualized in two dimensions. The literature in network analysis has suggested that the process of mapping networks and returning that map to the subjects provides significant value (Cross, Borgatti et al. 2002).

Consider  $N$  agents, labeled  $A_1$  through  $A_N$ , which are engaging in a number of activities within a given boundary condition. Let the conduct of  $H$  specific activities be defined by dichotomous variables  $F_1$  through  $F_H$  and held in a matrix of size  $N$  by  $H$  which will be called the data matrix. A square, symmetric,  $N$  by  $N$  co-occurrence matrix can be derived by counting the number of identical occurrences in  $F$  among all permutations of  $A$ . The resulting co-occurrence matrix is then the number of similar activities between all pairs of  $N$  and takes a value from 0 to  $H$ . Functional equivalence is determined through non-metric

multidimensional scaling (MDS), and can be visualized by using Euclidean positioning in two-dimensional space (see for example: Laumann 1973; Laumann and Pappi 1976). Relative functional equivalence is determined as the Euclidean distance between two actors in two-dimensional space (McCain 1990; Huerta, Clark et al. 2006).

Figure 2. Data matrix.

	$F_1$	$F_2$	$F_3$	$F_4$	$F_5$	$F_6$
$Ind_A$	0	0	1	1	0	1
$Ind_B$	1	0	1	0	0	1
$Ind_C$	0	0	0	0	0	1
$Ind_D$	0	1	0	1	1	0
$Ind_E$	0	1	1	0	1	0

Consider 5 individuals who have identified an interest in 6 possible areas. Individuals were queried as to the nature of their participation in each area. The data matrix indicates which individuals are interested in what areas, where a 1 is indicative of a positive interest in a particular activity. For example, Individual A has indicated an interest in areas 3, 4 and 6 and is not interested in 1, 2 and 5.

Figure 3. Dyadic examination.

$$\begin{array}{r}
 Ind_A \quad 0 \ 0 \ 1 \ 1 \ 0 \ 1 \\
 Ind_C \quad 0 \ 0 \ 0 \ 0 \ 0 \ 1 \\
 Ind_A \times Ind_C \quad 1 \ 1 \ 0 \ 0 \ 1 \ 1 \\
 \sum Ind_A \times Ind_C = 4
 \end{array}$$

This matrix is converted to a co-occurrence matrix by pair-wise comparison. For example, in Figure 3, Individual C has indicated they only have an interest in area 6. It can then be said that Individual A and Individual C demonstrate 4 co-occurrent conditions in that neither has an interest in areas 1, 2, and 5, and both do in area 6. The resultant co-occurrence matrix, found in Figure 4, shows all pair-wise combinations, is symmetric and is square:

Figure 4. Co-occurrence matrix.

	$Ind_A$	$Ind_B$	$Ind_C$	$Ind_D$	$Ind_E$
$Ind_A$	6	4	4	2	2
$Ind_B$	4	6	4	0	2
$Ind_C$	4	4	6	2	2
$Ind_D$	2	0	2	6	4
$Ind_E$	2	2	2	4	6

We performed a non-metric MDS on this dataset, and positioning in two-dimensional space is successful with a stress of 0.000, producing the following non-metric MDS coordinates:

Figure 5. Non-metric MDS Coordinates.

	X	Y
Individual A	0.327	0.332
Individual B	0.616	0.834
Individual C	0.848	-0.002
Individual D	-0.495	-1.020
Individual E	-1.296	-0.145

This use of MDS is common in social network analysis methodology (Scott 1991). Although MDS is a general data analysis technique, it has been used in social network analysis for the more specific task of representing equivalences among actors (Wasserman and Faust 1994). Subsequent auxiliary analyses and data displays (maps) are used to identify and explore the implicit network structures suggested by the n-dimensional arrangement.

### 3.2. Map of the Networks

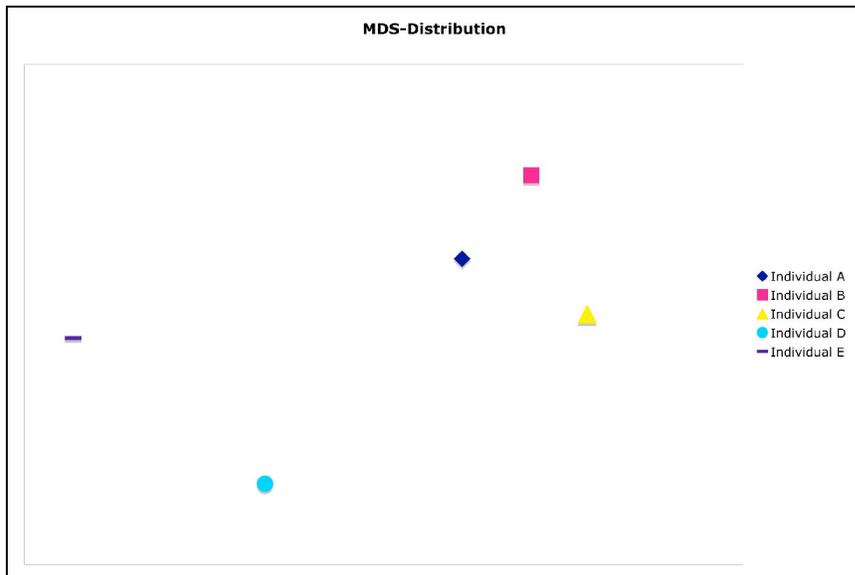
The map is a relational or proximity structure—there is no a priori interpretability to the specific directional location of any point. The map could be flipped or rotated any amount while still preserving the relative distances among points. Thus, there is no special significance to a point being on the top or bottom of the map or the left or right side, outside its proximity to neighboring points. Relative positioning within the graph, however, is interpretable. This is significant in that our intent is to understand how underlying system structure contributes to the creation of new relationships based on similar interest profiles. To that end, this methodology is uniquely valuable. By studying relative positioning between and among actors, we are providing a visual representation of interest profile similarity in Figure 7.

Figure 6. Interest profile distances.

	$Ind_A$	$Ind_B$	$Ind_C$	$Ind_D$	$Ind_E$
$Ind_A$	0	0.58	0.62	1.58	1.69
$Ind_B$	0.58	0	0.87	2.16	2.15
$Ind_C$	0.62	0.87	0	1.69	2.15
$Ind_D$	1.58	2.16	1.69	0	1.19
$Ind_E$	1.69	2.15	2.15	1.19	0

These data were mapped in Euclidean space along X- and Y-axes and the distance between each pair-wise point was calculated. The data provide relative distances between profiles. For example, the pair of Individual B and D represents the two individuals with the least similar configurations. In contrast, the pair of Individual A and B provides the most similar interest profiles. This illustrates the power of this type of analysis. Although Individual C had two interests in common with D and E, and four in common with A and B, it is the specific interests that are in common that make C closer to D than E.

Figure 7. MDS mapping.



By studying relative positioning between and among individuals, we are availed both a visual and analytical representation of functional similarity. These data were mapped in Euclidean space along X- and Y-axes and the distances between each pair-wise point were calculated, providing relative distance between profiles. For example, the pair of Individual B and D represents the two individuals with the least similar configurations. In contrast, the pair of Individual A and B provides the most similar profiles. This illustrates the power of this type of analysis. Although Individual C had two interest areas in common with D and E, it is the specific interests that are in common that make C closer to D than E.

## 4. DATA

To test our hypotheses, we collected demographic and network data on all attendees of the 2005 INSNA conference (“Sunbelt 25”). With the cooperation of INSNA, we obtained the list of 407 registered participants. While this list had its flaws, it appeared to include the vast majority of actual participants.<sup>3</sup> The list provided each registrant’s first and last name, email address, and department, organization, or job title (registrants provided some sort of information on the latter three items in approximately 75% of cases). In order to keep our subsequent survey as brief as possible, we chose not to ask demographic questions that could be otherwise determined.

### 4.1. *Demographic Data*

When the registrant’s organization was not provided, we imputed it based on his or her email address or, when that was not informative, by a Google search of the registrant’s name. When the organization could not be determined, this variable was coded as missing. We then classified the organizations into four categories: academic, commercial,

<sup>3</sup> The INSNA list included neither those who had registered on-site during the conference nor those who attended without registering, and included those who had registered but did not attend.

government, and non-profits/institutes.<sup>4</sup> We defined academic organizations strictly as universities or colleges; commercial organizations as for-profit entities; government organizations as those organizations clearly associated with a regional (country, state, or local) government; and non-profits/institutes as government-funded or independent research or service organizations.

Geographic location was imputed based on the city, state/province and country where the registrant's organization was located. When the organization had offices in more than one city or was coded as missing, we attempted to determine in which city the registrant was located, via a Google search. When the registrant's location could not be ascertained, this variable was coded as missing.

We imputed gender based on the registrant's first name, with ambiguous names subject again to a Google search. Gender was coded as missing when it could not be assigned with confidence.

We used the Sunbelt 25 program,<sup>5</sup> especially the author index, to create a dummy variable measuring community involvement in terms of paper acceptance. We included individuals who were listed as conducting workshops before and during the conference, even if they were not presenting a paper.

#### *4.2. Self-Reported Data (including Network Data)*

Our other variables were collected via an on-line survey using Survey Monkey (<http://www.surveymonkey.com>). In addition to the initial request to participate, two reminders were sent out.

We created a list of 36 areas of interest and specialization based on the Sunbelt 25 session titles, and asked respondents to choose from the list as many areas as they felt exemplified their interests in social networks. These data were used to create individual interest profiles for each participant, and these interest profiles were the data used for our MDS analysis of areas of interest.

The survey asked whether or not the respondent actually attended the Sunbelt 25 conference, and how many Sunbelt conferences the respondent had attended, including the one in 2005. It also contained questions about respondents' career status, asking them to identify their current career stage (first, second, or third stage of their professional career), and to characterize their involvement in the network community (as a junior, established, or senior member).

Finally, the survey contained a network component: We provided the list of all the registrants' names and asked respondents to identify four types of relationships: (1) pre-conference relationships (individuals they had either met face-to-face or had one-on-one email contact with prior to the conference), (2) new relationships (individuals with whom they had engaged in activities that could result in a continued relationship, provided they had

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<sup>4</sup> Efforts were made to discern ambiguous organizations' types; for example, some institutes that appeared to be part of a country's government were, upon closer examination, found to be merely government-funded and hence coded as non-profit/institute.

<sup>5</sup> Sunbelt 25 program: <http://www.socsci.uci.edu/%7Essnconf/conf/SunbeltXXVProgram.pdf>.

not already identified them as a pre-conference relationship), (3) mentee relationships (any mentee(s)/advisee(s) they brought to the conference), and (4) mentor relationships (any mentor(s)/advisor(s) who brought them to the conference).

### 4.3. *Descriptives*

From the 407 individuals invited to participate in the on-line survey, we received 172 consenting responses,<sup>6</sup> for a response rate of 42%.

About 60% of registered individuals were male, while 40% were female. Of consenting respondents, we found proportionally fewer women (only about 35% of the total).

Approximately three-quarters of registrants worked in academic settings, with the remaining quarter split evenly between those working in a commercial setting and those in non-profit/institute or government settings. Of consenting respondents, we saw the same percentage from academic sources as in the general population of registrants, but proportionally fewer from commercial settings than from the non-profit/institute and government sectors.

Table 1. Respondents by Institution Type.

Coded Organizations	Number
Academic	130
Commercial	16
Government	14
Non-profit/Institute	11
Blank/Unknown	1

Of all registered individuals, 65% worked in the United States, 20% in Europe, 9% in Canada or Mexico, and 2% in the Pacific Rim/Oceania. Virtually the same proportions were represented in the pool of consenting respondents. As the conference was held in California, it is not surprising to see the predominance of U.S. attendees. Aside from Americans, the largest single contingent came from Canada, followed in number by U.K. attendees.<sup>7</sup>

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<sup>6</sup> The process of obtaining human subjects research approval from three different institutions took longer than expected. Since the network portion of the first round of the survey was time-sensitive (people's memories being less accurate as time wears on), we went back to initial respondents to confirm their informed consent once all three institutes had provided their written approval. Not all initial respondents confirmed their consent; hence, in this paper, we do not analyze data obtained from those who did not provide us with their informed consent in writing.

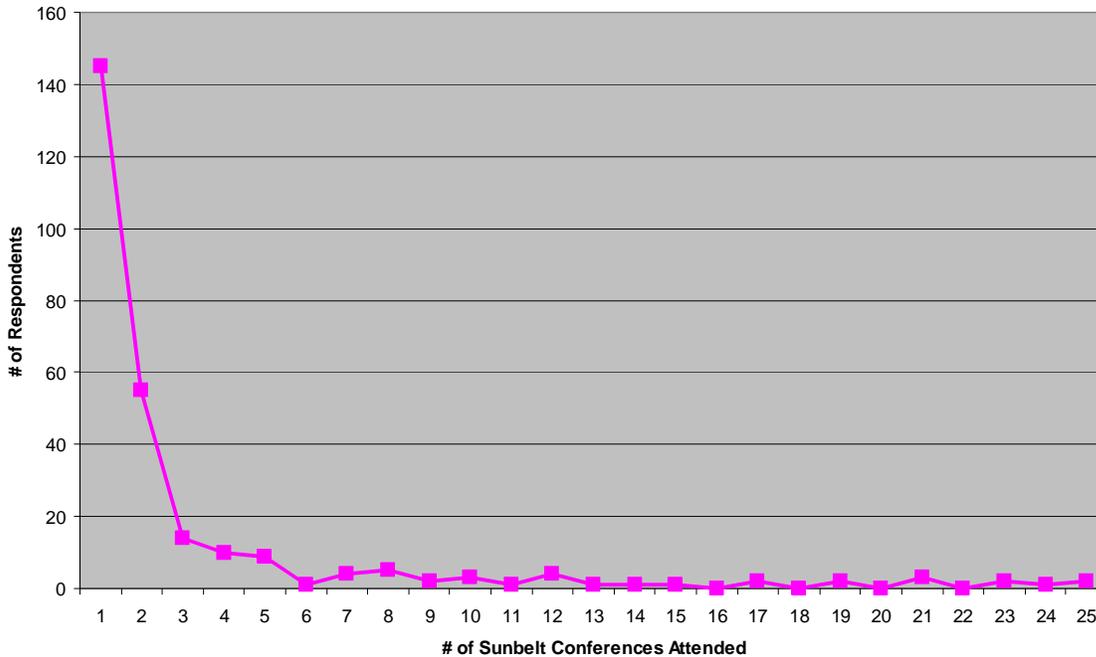
<sup>7</sup> It would be interesting to compare these statistics to the attendance statistics for Sunbelt 24, held in Slovenia (if such figures were available).

Table 2. Respondents by Geographic Location.

Country	Total	Country	Total
Australia	2	Japan	2
Austria	1	Mexico	2
Belgium	1	Netherlands	6
Canada	14	Slovenia	3
Finland	1	Sweden	1
France	2	Switzerland	3
Germany	6	UK	9
Italy	2	USA	112
		Blank/Unknown	5

As one might expect, almost all (95%) of the respondents attended Sunbelt 25; the rest had registered but did not attend. For more than half of the responding attendees, Sunbelt was their first Sunbelt conference. Another 25% had only been to two Sunbelt conferences.

Figure 8. Respondents' Attendance at Previous Sunbelt Conferences.



Of the respondents, 65% submitted a paper or presented a workshop (no significant difference from all registered individuals).

From the list of 36 areas of interest and specialization, respondents were to choose as many areas as they felt exemplified their interests in social networks. The average respondent chose seven different areas of interest. The five most-often selected interest areas were:

1. Network Dynamics/Processes in Networks/Diffusion
2. Communication/Information/Knowledge
3. Methods/Models/Simulations
4. Organizations
5. Social Capital/Attainment/Selection

With respect to careers, nearly three-quarters of consenting respondents identified themselves as being in the first (early) stage of their careers; only 6% said they were in the third (late) stage of their careers, with the remainder in the middle stage. The vast majority (96%) of consenting respondents self-identified as junior members of the networking community and the remainder identified themselves as established members; none of the respondents saw themselves as senior members of the community.<sup>8</sup> While clearly intuitive and evident in the results, the distribution of individuals in career place-time is not random ( $X^2=105.50$ ,  $p<0.001$ )

Table 3. Respondents by Career.

Career Place	Career Time				Grand Total
	First	Second	Third	(blank)	
Junior	92	4			96
Established	27	20	1		48
Senior	7	5	12		24
(blank)	1			3	4
Grand Total	127	29	13	3	

In answer to the mentor/mentee questions, 17% of respondents indicated that someone brought them to the conference. Conversely, 15% of respondents indicated that they brought a mentee/advisee to the conference. This slight discrepancy was expected; as mentioned, we believe that a larger percentage of junior networking community members responded to the survey than did senior community members.

We created a visualization of the Sunbelt 25 network using ties and career place reported by survey respondents (Figure 9). Nodes are colored based on the level of seniority; red nodes represent senior members of the networking community, green nodes denote established members, and blue nodes symbolize junior members. The nodes of those few members who did not report their career place are shown in gray. Distance between the nodes represents the number of common ties among the nodes. From observing the distribution of nodes in the network map, one can see that the most central individuals are also generally the most senior, while the most peripheral individuals are also generally the most junior.<sup>9</sup>

<sup>8</sup> We expect that the respondents are somewhat skewed to the junior end of the spectrum, as we received correspondence from senior members of the community indicating that they preferred not to participate.

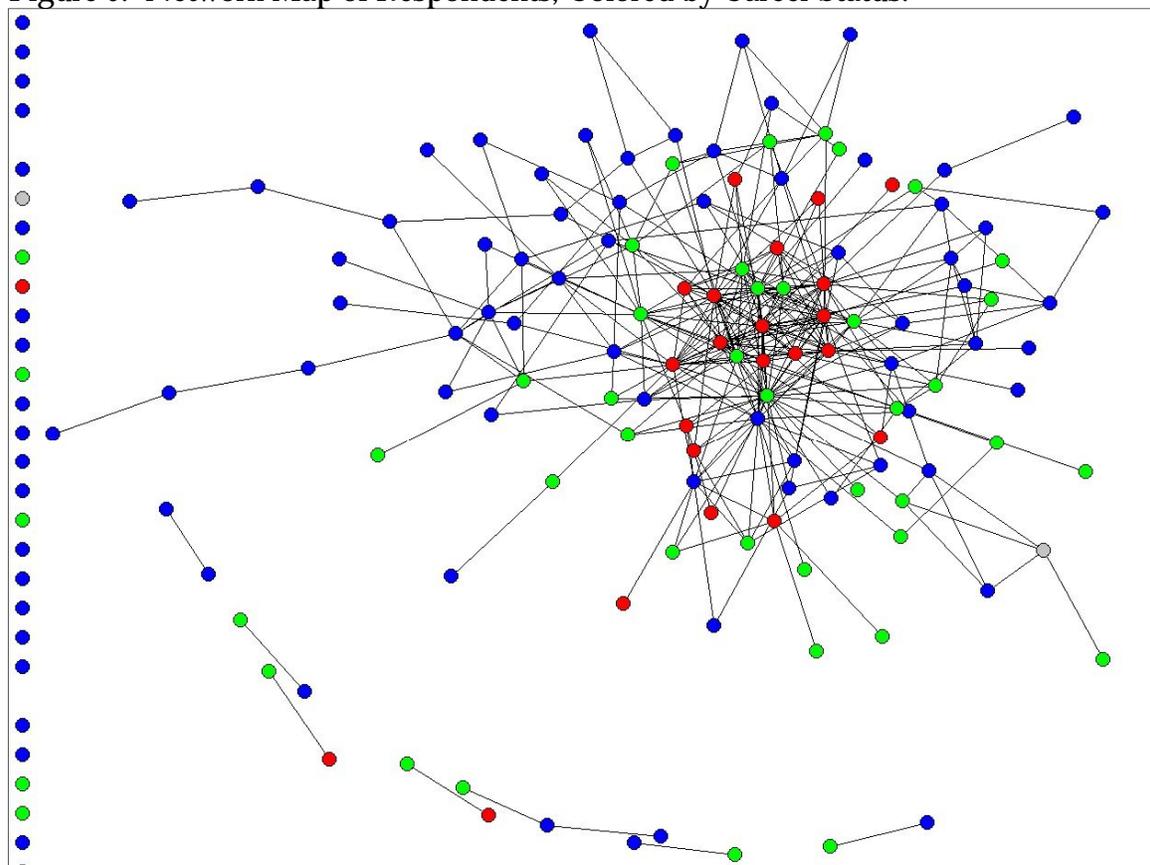
<sup>9</sup> A core-periphery structure can be observed in the network map; while we find this interesting, it does not take center stage in this particular paper and we consequently have not generated core-periphery measures to describe it statistically.

The network has an overall density of 0.36 and a mean degree of 3.354 with an average distance of 1.08, a distance-based cohesion (“compactness”) of 0.962, which indicates a fairly high cohesiveness (Borgatti, Everett et al. 2002).

The network map illustrates the more general notion that seniority correlates with centrality, though not perfectly (Ibarra 1993). One should bear in mind that career place was self-reported; it is possible that an individual’s seniority as perceived by the community might correlate more closely with centrality than self-reported seniority would (as centrality is measured both by ties from community members to the individual as well as ties from the individual to community members). We did not attempt to obtain community measures of individual seniority.

There are means by which the attendees’ network could be strengthened. Prior to plans being made for the 2006 Sunbelt conference, we suggested various measures to the conference organizers. These included fostering relationships among junior members with programmed options aimed specifically at this demographic (a bottom-up strategy); providing incentives for more senior members/mentors to attend (a top-down strategy); and connecting isolates and pendant nodes by increasing the number of orientation events and mixers. We detail our presentation of these assorted ideas in Appendix 1.

Figure 9. Network Map of Respondents, Colored by Career Status.



Color-coded by career place: red actors = senior members; green = established members, blue = junior members of the INSNA community of researchers. Grey nodes indicate those respondents who did not check their career status.

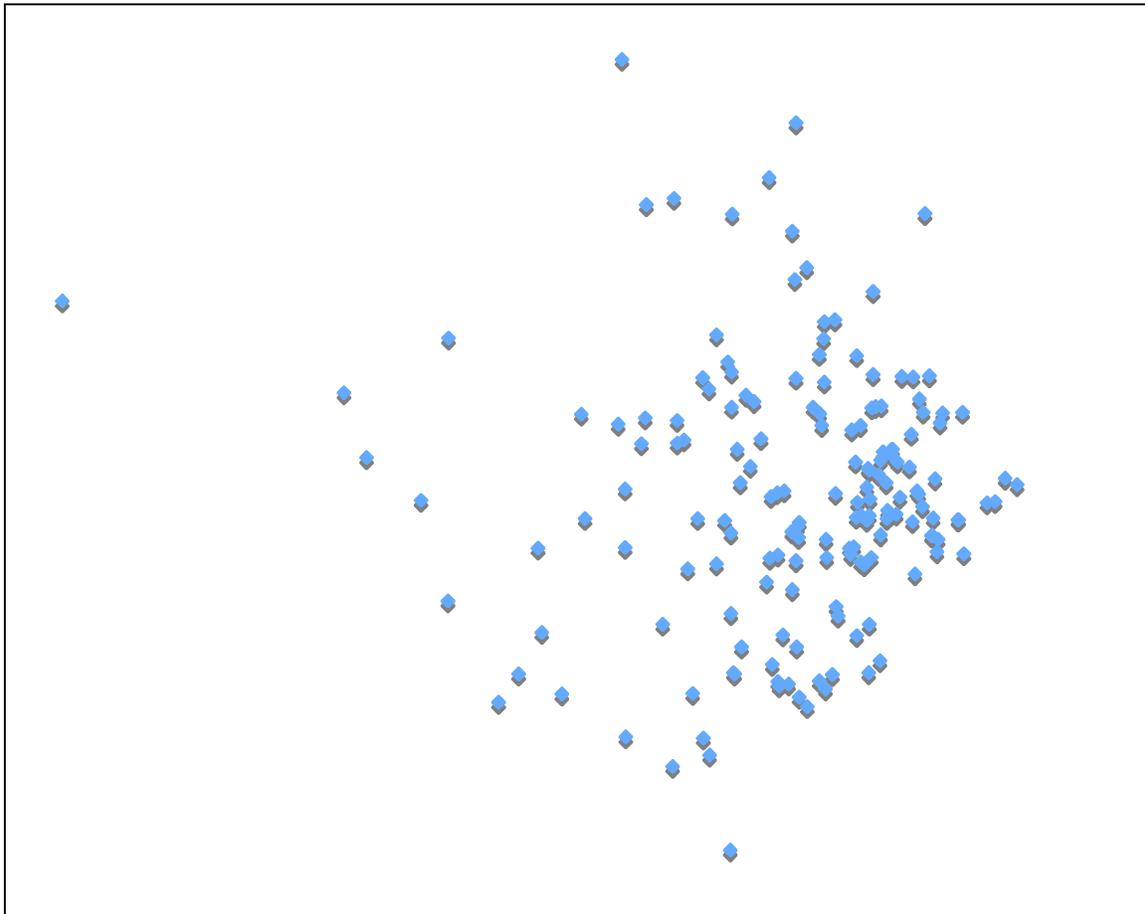
## 5. RESULTS AND INTERPRETATION

### 5.1. *Hypotheses 1, 2, 3 and 4: Homophily and Knowledge Networks*

Our first four hypotheses deal with homophily among participants based on their knowledge profiles; that is, we created profiles of each respondent based on the areas of interest that they reported, and then compared the individuals in their networks to those with whom they were not linked.

Using the interest data provided by the 172 respondents, a 36-item interest pattern code was developed for each participant, resulting in a 172x36 binary matrix with interest indicated through a coding of 1. Drawing on the methodology described earlier, these data were used to create a 172x172 square co-occurrence matrix. This matrix was subjected to a two-dimensional non-metric MDS analysis and generated x- and y-coordinate values for each subject. These data are mapped in Figure 10:

Figure 10. MDS map of distances between respondents' interest profiles.



Using these data, pair-wise distances for individuals in the sample were calculated using the following equation:

$$d_{ij} = \sqrt{(y_i - y_j)^2 + (x_i - x_j)^2} \quad (1)$$

These data were further categorized as belonging to either an existing or new relationship.

The average MDS distance for those individuals identified by each participant as part of a pre-existing relationship as well as those who were not part of the relationship were determined. It should be noted that the number of observations in several of these analyses is lower than the total number of observations for the study because the hypothesis compares the relative distance of current “in-group” with current “new group”. As a result, the analysis is only possible where there are indications of relationships with consenting subjects. Dependent t-tests were used because interests are ego-specific.

Hypothesis 1 asks if the interests of new relationships are substantively different than the existing pre-conference network. A dependent t-test (H1:  $t=-0.76$ ,  $\bar{X}=-0.063$ ,  $s=0.802$ ,  $n=95$ ,  $p=0.45$ ) shows no difference between the interest profiles of new and existing members of each subject’s network. As a result, we see that the hypothesized effect of homophily is supported in that the profiles of current contacts within the network are substantively not different than the profiles of new members of the network. This would indicate that egos at the conference are seeking alters that are patterned after the alters already identified.

Hypothesis 2, similar to our first hypothesis, tests only new links against those not linked to ego, instead of ego’s pre-conference links. A dependent t-test (H2:  $t=3.48$ ,  $\bar{X}=0.177$ ,  $s=0.538$ ,  $N=112$ ,  $p=0.0007$ ) indicated that there was indeed a difference in the interest profiles of people who were in someone’s social network and those who were not in their network. It should be noted that there was slightly less variation in the differences than what is seen among pre-existing relationships, which may be an indication that attempts to build relationships are more targeted at conferences than in the relationships that more generically exist. These findings support our homophily argument that “birds of a feather flock together.”

Similar results to those of Hypothesis 2 were found when comparing maintained relationships with those for which there is no relationship (H3:  $t=3.08$ ,  $\bar{X}=0.164$ ,  $s=0.621$ ,  $n=135$ ,  $p=0.0027$ ), as well as the broader hypothesis, which looked at the combined pool versus outsiders (H4:  $t=3.25$ ,  $\bar{X}=0.135$ ,  $s=0.515$ ,  $n=153$ ,  $p=0.0014$ ).

## 5.2. *Hypothesis 5: Demographic and Status Homophily*

We conceived of three hypotheses that make predictions based on homophily of specific characteristics: institutional type, status (seniority), and gender. Below, we deal with each hypothesis separately.

Our fifth hypothesis suggests that the percentage increase of new relationships among individuals in similar institutions is greater than among those from dissimilar institutions. In other words, we expect to find homophily by workplace type. This proved not to be the case.

In tallying the number of relationships, we did see differences. For example, academics, it seems, report many more collaborative connections at the conference with each other than with others. Still, a cross tabulation of these new relationships shows that there is no significant difference in the percentage of new relationships made between those of the same institutional type and those from different types of institutions ( $X^2=0.177$ ,  $p>>0.10$ ). It may be that interests matter far more than institutional affiliation at a niche conference such as Sunbelt.

Table 4. ANOVA of Institutional Homophily.

	AC	CO	GO	IN	NO	Total
AC	180	12	13	0	6	211
CO	20	1	4	1	2	28
GO	22	1	2	0	1	26
IN	1	0	1	0	0	2
NO	10	2	1	0	0	13
Total	233	16	21	1	9	280

### 5.3. Hypothesis 6: Seniority

In our sixth hypothesis, we predict that the number of new relationships among individuals with similar seniority is different than among those with other seniority. Pursuant to our discussion earlier, we focus on the marginal percentage of relationships added to ego's networks. This approach suggests that there are no significant differences by seniority:

Table 5. ANOVA of Seniority Homophily.

ANOVA				
Source of Variation	SS	df	MS	F
Between Groups	0.000297464	2	0.000148732	1.240
Within Groups	0.019911843	166	0.000119951	
Total	0.020209307	168		

( $p>0.10$ ,  $F\text{-crit}=3.05$ )

It may be that our results were skewed by having so few senior respondents. Alternatively, perhaps the conference attendees represent such a specialized group that the effect of seniority homophily does not rise to the level of significance.

### 5.4. Hypothesis 7: Gender

Our seventh hypothesis is predicated on gender; we expected that the number of new relationships would be dependent on gender. In this case, we felt that several issues impacted our ability to analyze this data. First, we limited our analysis to those who gave consent but did not limit the recognition of new relationships to those who gave consent. In this way, a relationship is counted for the purpose of this analysis if someone giving consent reported it as a new relationship. Another issue is that there seemed to be a number of people who made no relationships whatsoever. Since our goal was to look at new

relationship formation, we chose to exclude those people, which results in an operational hypothesis:

Among those in the study who reported new relationships, the number of relationships is significantly different between genders.

In this case, we found that women formed fewer new relationships ( $x=4.63$ ,  $s=4.56$ ,  $n=35$ ) than men ( $x=5.43$ ,  $s=3.90$ ,  $n=46$ ), but the difference was insignificant ( $t=0.84$ ,  $p>0.10$ ). We then modified our search to include those who reported no new relationships, which aligns with the original Hypothesis 7. In that case, women reported more relationships ( $x=2.65$ ,  $s=4.13$ ) than men ( $x=2.25$ ,  $s=3.67$ ). While this was also not significant ( $t=-0.64$ ,  $p>0.10$ ), it is notable that individual men report a higher probability of making no new relationships among conference attendees.

We believe that this result is indicative of the substantive effect of other factors on relationship-building that may carry more weight in this community. For example, the effect of mentor-mentee relationships may provide a more powerful effect, creating a dilution of gender issues.

### *5.5. Hypothesis 8: Community Involvement*

In our eighth hypothesis, we propose that those whose papers were accepted for presentation or who conducted a workshop increased the size of their ego network proportionally more than those who did not participate in this way. Again, because this data simply required that the consented identify the number of new relationships, we used new relationship data rather than limiting it to the consent pool.

Similar to the process used in Hypothesis 7, we excluded those that reported no new relationships. We found that the average number of new relationships formed by people presenting papers or workshops ( $x=5.65$ ,  $s=4.64$ ,  $n=51$ ) was higher than those who did not ( $x=4.13$ ,  $s=3.17$ ,  $n=30$ ), but that difference was not significant. We find it surprising that a higher level of community involvement does not signify an increase in the number of new relationships made. It may be that the time involved in preparing for a presentation or workshop takes away from the time available to socialize, resulting in no significant net gain to community exposure. Additional research on this topic is called for.

## 6. CONCLUSIONS, LIMITATIONS, AND NEXT STEPS

In this research, we set out to study the evolving patterns of relationships among social network conference attendees. We intend our work to contribute to the understanding of social network dynamics, and to further the integration of new members into the existing community of social network researchers, as well as informing certain aspects of conference planning.

In the current study we employ MDS and other methodologies to explain some of the basis for current and newly-established relationships among conference attendees. The analysis described in this paper is intended to illustrate the idea of functional equivalence and show that it is possible to apply methods used in network analysis to existing data about the activities of individuals and organizations in the study of homophily. In this case, MDS relies on a transformation of the original observations into “proximity” data, evaluating the

similarity or dissimilarity of all possible pairs of elements. This approach allows natural groups to emerge from the data. It should be noted that when dimensionality is reduced, the error within the map presented is likewise increased. Yet, in term of explanatory power, the MDS approach offers a much more visual engagement of the data than traditional statistical analysis.

Substantively, we find that various conceptions of homophily have differential explanatory power when tested with our data. With regard to the dimension of professional interests, we show that the desire for homophily in one's knowledge network appears to drive tie maintenance and acquisition among conference attendees. With regard to the demographic characteristics of sending-institution type, seniority, and gender, there seem to be no significant differences of tie formation among similar versus dissimilar categories of individuals in our sample. We also do not find that community involvement provides network benefits to those who participate. Clearly, based on our study, the primary explanation for tie formation and maintenance at academic conferences rests in the similarity of individuals' interest profiles – their common patterns of both interest and disinterest. Such profiles appear override any simple demographic or status-based homophily in building and maintaining relationships.

There are a number of ways in which this study could have been stronger. While a methodological issue, one of the challenges to this analysis was the calculation of a metric for shifts in new relationships. Consider the case of a person who has no relations established in the community. The addition of a new relationship is, in effect, an infinite increase. To manage these issues, we take a total network approach that calculates the number of new relationships and divides that by the number of individuals not already part of ego's network. In this approach, a person adding 5 people to a network of 50 members is increasing access and thereby reaching 4.1% of the remaining network, whereas a person without an existing network is only reaching 2.9% of the network when they add 5 people.

More generally, we might have increased our response rate (though 42% is decent by some standards) by providing an incentive, such as a discount for the following year's conference. A larger sample would have given us greater statistical power. Also, we realize that individuals' memories are never entirely dependable, and hence survey answers based on respondent recall can be considered suspect. Had we been able to conduct the survey closer to the conference's end date, the responses might have been more reliable.

Boundary issues also challenged us – individuals in the survey challenged the validity of the instrument based on the absence of specific individuals who were seen at the conference but not included in the network survey. The authors found that several non-presenting researchers didn't register but used the conferences as a venue for meetings with collaborators. As a result, while they were seen at the conference, they were not included in the survey. The community perceived this as an exhaustiveness issue and offered solutions which included resending the survey to the entire sample including the missing individuals and creating a special survey for those who had already completed the survey to "fill in the missing data." We submit that the application of such interventions is inappropriate. In cases where the boundaries are defined by a set of inclusion criteria, researchers have an obligation to clearly delineate the criteria and any factors that may have impacted the survey's inclusivity through full disclosure. Given the community's concern over inclusivity issues, increased discourse on this issue is necessary.

In retrospect, we erred in trying to make our survey more palatable to respondents by not asking them to provide demographic data such as their gender, age, race, geographic location, and items such as their job title and organizational type. By attempting to impute these data based on independent biographical research, we may have introduced a level of inexactness that negatively affected our results. We have corrected some of these problems in the 2006 survey round; respondents are asked their gender, their employer's organizational type, and we have received from the organizer each attendee's geographic location.

We are currently conducting longitudinal data collection of multiplex network ties of the respondents in our first study: We would like to understand how patterns of homophily get stronger as more types of relationships exist between two people, indicating that homophily on each type of relation cumulates to generate greater homophily for multiplex than for simplex ties. Moreover, we are seeking insights on the impact of newly-established relationships and how they might get stronger or decay over time.

Therefore, we are surveying attendees to ascertain potential outcomes of meeting at formal conferences: informal face-to-face interactions that can be translated into formal collaborations, such as refereed journal articles, joint research grants, or job offers, that could validate the knowledge that people developed together. Some of the additions to our 2006 post-conference survey are items asking participants about their goals for attending the conference, the type of collaborations they may have begun, and a name generator for identifying collaborators. We have also included certain questions to obtain basic personality-style data on participants, such as their tendency towards introversion or extroversion.

One of the most significant changes to the 2006 survey instrument format concerns the method for obtaining the names of mentors/advisors and mentees/advisees. The original (2005) instrument listed all the names of the registrants and asked respondents to check off those whom they had brought and, separately, those who had brought them. In the 2006 instrument, a name generator is used for eliciting the names of mentors/advisors and mentees/advisees. This will reduce the overwhelming number of names that respondents need to page through. We believe that the quality of the data collected will not be impacted, as we feel individuals are quite likely to remember the names of the mentors/advisors who brought them to the conference or the mentees/advisees whom they brought.

We presented an earlier version of this paper at Sunbelt 26 to an audience of respondents and other networking community members. Responses were primarily positive; we received positive feedback related to the planning value of this resource. Some found the explanatory power of our techniques of interest, while others questioned the use of MDS in this context. One community member suggested that MDS was an additional, and unnecessary, step, and suggested that we simply calculate differences mathematically. As put forth earlier, we believe that the explanatory power gained compensates for the information lost in the analysis.

As mentioned previously, certain senior members of the community indicated that they did not participate because they, for example, are "not a big fan of studying ourselves". However, other senior members of the community who could not attend our presentation specifically asked for a copy of the manuscript and expressed, after reading it, that they felt this would inform planning of a future conference.

An expected result of presenting this paper to the networking community was that we received many comments on our work. Among other things, the community requested more network visualizations. In future work, we plan to link additional attribute data to the network data and generate new network visualizations similar to the one featured in Figure 9 but along different dimensions (for example, attendance patterns – perhaps those who are central in the Sunbelt attendee network are those who have attended prior Sunbelt conferences, or who attend many other conferences as well).

We are especially keen to investigate issues that the community itself identified as being of importance. One question that was asked repeatedly by listeners was how an annual event that has passed the quarter-century mark attracts so many (50%) first-timers and so few regularly-returning attendees (even stretching the definition of “regularly-returning”, only 25% had returned more than once). As one of the aims of our study is to further the integration of new members into the existing community, we take this issue very seriously. Our initial impression is that advisors/mentors encourage their students to attend the conference (as a means of socialization, perhaps) but do not attend themselves. The students may or may not return – and we wish to discover what drives their attendance choices – but because the advisors continue to have new students, each new cohort sends some of its members, thus maintaining the proportion of first-time attendees. In the survey after the 2007 conference, we plan to collect data on what other conferences Sunbelt registrants attend. At that time we also plan to contact those registrants from 2005 who did not attend in 2006, and those from 2006 who do not attend 2007, in an attempt to understand why attendee turnover is so high.

Studies such as ours appear to increase participants’ awareness and interest in community engagement. For example, after the 2006 Sunbelt conference, at the request of many participants the main organizer made available to registrants a list of (consenting) participants and their email addresses. We believe this occurred as a consequence of our study having increased community members’ awareness of and personal interest in social networking. In addition to contributing to the understanding of social network dynamics, it appears that analyses like the one offered here can also function as an instrument of social change. Fay (1987), among others, argues from a critical social science perspective that the strictures of custom, social norms and tradition limit our ability to see opportunities. From this perspective, engagements like appreciative inquiry (Scott 2006) and network analysis offer individuals the ability to see beyond the current, to the possible.

## Appendix 1. Presentation to 2006 Sunbelt Conference Organizers.

Our preliminary findings were presented to the INSNA administration in fall of 2005, as the planning for the 2006 conference got underway. In addition to providing descriptions of the aggregate data, we made some recommendations based on our findings. For instance, we provided conference organizers with the table of respondents' rankings of their topics of interest, and suggested that the popularity levels of these various subject areas be taken into account when planning and distributing space for sessions in the 2006 conference.

A subset of our recommendations to the 2006 conference planners concerned first-time attendees and junior members of the network research community, as they comprised – based on response rates – the majority of attendees. Given that more than half of the respondents were attending their first Sunbelt conference in 2005, we advised the conference planners to hold a mixer for first-time attendees on the first night of the 2006 conference. This would provide an orientation for the new attendees as well as allowing them to get to know each other and the conference organizers. Likewise, we urged the organizers to hold a mixer for the junior members of the networking community – who comprised more than half of respondents – and suggested several workshops aimed at this demographic, including a “Getting started in publishing” workshop that would be specific to the networking community and its publication venues, and a careers workshop with the same specificity. We also proposed that the 2006 conference planners allow the posting of CVs on a conference webpage, set aside time and space for job interviews, and recommended that they advertise these various activities to the appropriate constituencies.

Finally, we suggested that conference organizers advertise to or provide incentives for mentors and their mentees to attend the 2006 Sunbelt conference together. Given that at least 15% of respondents indicated that they brought, or were brought by, someone with whom they have a mentor/mentee relationship, we felt that this was a demographic that could be tapped to draw a larger percentage of senior network community members to future Sunbelt conferences.

We hope that the recommendations that were implemented accrued to the benefit of the 2006 conference attendees.

## Bibliography

- Barnlund, D. C. and C. Harland (1963). "Propinquity and Prestige as Determinants of Communication Networks." Sociometry 26(4): 467-479.
- Baron, J. N. and W. T. Bielby (1985). Organizational Barriers to Gender Equality: Sex Segregation of Jobs and Opportunities. Gender and the Life Course. A. Rossi. New York, Aldine: 233-251.
- Baron, J. N. and W. T. Bielby (1986). "The Proliferation of Job Titles in Organizations." Administrative Science Quarterly 31(4): 561-586.
- Baron, J. N., A. Davis-Blake, et al. (1986). "The Structure of Opportunity: How Promotion Ladders Vary Within and Among Organizations." Administrative Science Quarterly 31(2): 248-273.
- Borgatti, S. P. and M. G. Everett (1992). "Notions of Position in Social Network Analysis." Sociological Methodology 22: 1-35.
- Borgatti, S. P., M. G. Everett, et al. (2002). Ucinet for Windows: Software for Social Network Analysis. Harvard, MA, Analytic Technologies.
- Brass, D. J. (1985). "Men's and Women's Networks: A Study of Interaction Patterns and Influence in an Organization." Academy of Management Journal 28: 327-343.
- Burt, R. S. (1992). Structural Holes: The Social Structure of Competition. Cambridge, Harvard University Press.
- Burt, R. S. (2000). The Network Structure of Social Capital. Research in Organizational Behavior. New York, Jai Press Ltd. 22: 345-423.
- Burton, R. (1927). The Anatomy of Melancholy. New York, Farrar & Rinehart.

- Cross, R., S. P. Borgatti, et al. (2002). "Making Invisible Work Visible: Using Social Network Analysis to Support Human Networks." California Management Review 44(2): 25-46.
- Drazin, R. and E. Auster (1987). "Wage Differences Between Men and Women: Performance Appraisal Ratings Versus Salary Allocation as the Locus of Bias." Human Resource Management 26(2): 157-168.
- Fay, B. (1987). Critical Social Science. Ithica, NY, Cornell University Press.
- Fischer, C. S. (1982). To Dwell among Friends. Chicago, Chicago University Press.
- Friedkin, N. E. (1984). "Structural Cohesion and Equivalence Explanations of Social Homogeneity." Sociological Methods & Research 12: 235-261.
- Heider, F. (1958). The psychology of interpersonal relations. New York, Wiley.
- Huerta, T. R., P. Clark, et al. (2006). "Functional Equivalence: An Application of Equivalence to Non-Network Data." Social Networks, (under review).
- Hummon, N. P. and P. Doreian (1989). "Connectivity in a Citation Network: The Development of DNA Theory." Social Networks 11: 39-63.
- Ibarra, H. (1992). "Homophily and Differential Returns: Sex Differences in Network Structure and Access in an Advertising Firm." Administrative Science Quarterly 37.
- Ibarra, H. (1993). "Personal Networks of Women and Minorities in Management: A Conceptual Framework." The Academy of Management Review 18(1): 56-87.
- Ibarra, H. (1997). "Paving an Alternative Route: Gender Differences in Managerial Networks." Social Psychology Quarterly 60(1): 91-102.
- Knoke, D. and J. H. Kuklinski (1982). Network Analysis: Quantitative Applications in Social Sciences. Newbury Park, Sage Publications.
- Kruskal, J. and M. Wish (1978). "Multidisciplinary Scaling."

- Laumann, E. O. (1973). Bonds of Pluralism: The Form and Substance of Urban Social Networks. New York, Wiley.
- Laumann, E. O. and F. U. Pappi (1976). Networks of Collective Action: A Perspective on Community Influence Systems. New York, Academic Press.
- Lawrence, B. S. (2003). Organizational Reference Groups: Resolving the Problem of the Assumed Group. University of California Los Angeles: 1-45.
- Lazarsfeld, P. F. and R. K. Merton (1954). Friendship as Social Process: A Substantive and Methodological Analysis. Freedom and Control in Modern Society. M. Berger. New York, Van Nostrand: 18-66.
- Liberman, S. and K. B. Wolf (1997). "The Flow of Knowledge: Scientific Contacts in Formal Meetings." Social Networks 19: 271-283.
- Lorrain, F. and H. C. White (1977). "Structural Equivalence of Individuals in Social Networks." Journal of Mathematical Sociology 1: 49-80.
- March, J. and H. Simon (1958). Organizations. New York, Wiley.
- McCain, K. W. (1990). "Mapping Authors in Intellectual Space." Journal American Social Information Sciences 41: 433-43.
- McCain, K. W. (1990). "Mapping authors in intellectual space." Journal American Social Information Sciences 41(433-43).
- McCain, K. W., C. A. I. O'Reilly, et al. (1983). "The Effects of Departmental Demography on Turnover: The Case of a University." Academy of Management Journal 26: 626-641.
- McPherson, M., L. Smith-Lovin, et al. (2001). "Birds of a Feather:: Homophily in Social Networks." Annual Review of Sociology 27: 415-444.

- Mehra, A., M. Kilduff, et al. (1998). "At the Margins: A Distinctiveness Approach to the Social Identity and Social Networks of Underrepresented Groups." The Academy of Management Journal 41(4): 441-452.
- Merton, R. K. (1968). Contributions to the Theory of Reference Group Behavior. Social Theory and Social Structure. R. K. Merton. New York, Free Press: 279-334.
- Newcomb, T. (1961). The acquaintance process. New York, Holt, Reinhard & Winston.
- Newcomb, T. M. (1953). "An approach to the study of communicative acts." Psychological Review 60: 393-404.
- Newman, M. E. J. (2001). "Scientific Collaboration Networks." Physical Review E 64(016131): 1-8.
- Nohria, N. and D. Eccles (1992). Networks and Organizations: Structure, Form, and Action. Boston, Harvard Business School Press.
- Schiffman, S., M. Reynolds, et al. (1981). Introduction to Multidimensional Scaling: Theory, Methods and Applications. Orlando, Fla., Academic Press.
- Scott, J. (1991). Social Network Analysis: A Handbook. London, Sage Publications Inc.
- Scott, N. T. (2006). "Why the real self is fundamental to intentional change." The Journal of Management Development 25(7): 643.
- Treiman, D. J. and H. I. Hartman (1981). Women, Work, and Wages: Equal Pay for Jobs of Equal Value. Washington, DC, National Academy Press.
- Verbrugge, L. M. (1977). "The Structure of Adult Friendship Choices." Social Forces 56: 576-597.
- Verbrugge, L. M. (1983). "A Research Note on Adult Friendship Contact: A Dyadic Perspective." Social Forces 62: 78-83.

- Wasserman, S. and K. Faust (1994). Social Network Analysis: Methods and Applications. Cambridge, Cambridge University Press.
- Weber, M. (1968). Economy and Society. London, Routledge & K. Paul.
- Wenger, E. (1998). Communities of Practice: Learning, Meaning, and Identity. Cambridge, UK, Cambridge University Press.
- Wenger, E. (2000). "Communities of Practice and Social Learning Systems." Organization 7(2): 225-246.
- Zenger, T. R. and B. S. Lawrence (1989). "Organizational Demography: The Differential Effects of Age and Tenure Distributions on Technical Communication." The Academy of Management Journal 32(2): 353-376.