Measuring Sense of Community in Groups that Use Social Networking Sites to Promote Collaboration

Maria Plummer
IS Department, NJIT
mmp36@njit.edu

Starr Roxanne Hiltz
IS Department, NJIT
roxanne.hiltz@njit.edu

Nancy Steffen Fluhr
Humanities, NJIT
nancy.l.steffen@njit.edu

Roberto Muñoz Rosario
IS Department, NJIT
ram75@njit.edu

Abstract

This paper describes a scale for measuring “sense of community” efficiently and effectively in order to explore the relationship between online social networking group activities and sense of community. Scales developed to measure sense of community in prior research are usually lengthy and community specific. They are therefore not suitable or directly applicable to the context of our study in which we plan to use a virtual community to promote interdisciplinary research collaboration at a university. Our scale is relatively short, and exhibits good internal consistency at both the departmental level and the campus level. At the departmental level, this scale correlates with the number of tenure track faculty members that individuals are likely to list as friends or research colleagues. We discuss the use of our scale in future research.

1. Introduction

Social networking sites (SNS), widely known for their recreational uses, are increasingly becoming an integral part of the work environment. In an InformationWeek survey conducted in early 2007, 48% of responding companies indicated that they used social networking sites for viral marketing, employee recruitment, peer networking, collaboration, emergency coordination and communication [1]. Many researchers, intrigued by the phenomenal increase in popularity of these sites, are pursuing scholarship on a wide range of pertinent topics such as privacy, networks and network structure, impression management, and online/offline connections [2, 3]. However, there are issues yet to be explored in great depth such as the effective evaluation of the impact of these sites on online communities that they are sometimes intended to support.

In this paper, we report on the preliminary stage of research in progress, which aims to examine relationships between SNS “group” activities and changes in “sense of community” and the extent of collaboration among members of its corresponding offline community. This research is being conducted within the context of a project aimed at advancing the careers of female faculty members (who are often the only woman in their departments) by increasing their opportunities to find research collaborators. The main strategy being used to fulfill the mission of this project is to tackle the problem of isolation by providing opportunities and incentives for women to get involved in more interdisciplinary collaborative research. The establishment and maintenance of a virtual community using the Facebook “group” feature is one initiative being undertaken as part of this strategy.

In order to justify continued investment of time, effort and finance in the online community initiative, it is necessary to assess its effectiveness. Since the study described here is a field study, it is inherently difficult to isolate the effect of the online community activities from the effect of other factors influencing changes in degree of collaboration. Therefore, at the very basic level, one must demonstrate that there are positive associations between online community activities and indicators of extent of collaboration.

We propose the concept of “sense of community” as an indicator of extent of collaboration in the community. Sense of community is defined as “a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members’ needs will be met through their commitment to be together” [4] (p. 9).

A number of “sense of community” scales were developed in prior research. However, many of these scales were lengthy and specific to the setting in which they were applied. For this study, however, we needed a scale that was relevant to our context as well as short, and therefore could easily and quickly be completed by participants with very busy schedules.

The primary objective of this paper is to discuss the reliability and validity of our sense of community scale and to demonstrate that, for relatively small communities such as departments within the university being studied, an individual’s sense of community is an estimator of the number of research collaborators and friends that individual would list if asked to do so.
The next step in our research is to explore possible relationships between online group activities and “sense of community” in the corresponding offline community.

In the remainder of this paper, we define sense of community and present an overview of prior research. We describe the context in which this study is being conducted and the issues within this context that are pertinent to this study, such as the need for greater interdisciplinary collaboration and sense of community. We then provide a description of how a Facebook group can be used to promote sense of community within the academic setting of interest here. We discuss the methodology used to develop our sense of community scale and present the results of our analysis of its validity and reliability. We conclude with a discussion of our results, limitations of the study and our plans for future research.

2. Defining Sense of Community

There is no strict consensus on the definition and measurement of the concept of sense of community (SOC). However, the theory of sense of community developed by McMillan and Chavis [4] has been used as the cornerstone of most recent studies on this concept [5]. Sense of community, defined earlier in Section 1, is an abbreviated label used by McMillan and Chavis [4] to represent “psychological sense of community,” which was introduced by the psychologist Seymour Sarason in 1974.

A “sense of community index” (SCI) was proposed by Chavis et al. [6]. According to Chipuer and Pretty [7], this index has been the most used and broadly validated measure of SOC. This index comprises four dimensions: (1) membership, which is explained by a feeling of emotional safety and a sense of belonging or identification with the larger group or community defined by a specific boundary; (2) influence, which is described as the mutual ability of the individual and the community to effect change in each other; (3) integration and fulfillment of needs, which refers to a good person-environment fit in which the needs of individuals are met by contributions of others within the community; and (4) shared emotional connection, which pertains to emotional support typically arising from past shared experiences. These four elements were later rearranged and renamed as: spirit, trust, trade, and art in McMillan’s revised perspective of sense of community described as “a spirit of belonging together, a feeling that there is an authority structure that can be trusted, and awareness that trade, and mutual benefit come from being together, and a spirit that comes from shared experiences that are preserved as art” [8] (p. 315).

3. Sense of Community, Collaboration and Advancement in Academia

This study is part of a broader NSF funded program, titled ADVANCE, being implemented at a technological university, which we refer to as Northeastern Technical University (NTU). The goal of the ADVANCE program is to increase the participation and advancement of women in academic Science, Technology, Engineering and Mathematics (STEM) careers.

Statistics given in WEPAN (Women in Engineering Programs and Advocate Networks) National Conferences (2005, 2006) speak volumes about the under-representation of women in STEM fields. Although women account for nearly half of the country’s engineers are female (WEPAN National Conference, 2005). Women’s representation in senior academic positions is even more dismal. For example, only 3% of full professors in engineering, computer science and physical science are women [9].

At the time data were collected for this study, only 13.5% of the 297 NTU tenure-track faculty members were women. In a study conducted at NTU about five years earlier, almost all the women who were interviewed indicated that they were dissatisfied with the inadequate mentoring that they received and that they had difficulty in finding compatible collaborators. A majority of the women also felt that they were “out of the loop” during their careers at the university. In short, “isolation” was identified as the overarching reason for many of problems expressed by women [10].

As noted in Steffen-Fluhr [10], isolation limits opportunities to get vetting of new ideas and research initiatives. It limits access to tacit knowledge; timely news about hot research areas and funding opportunities; unpublished research; invitations to join grant initiatives; support for intellectual exploration and risk-taking; guidance that demystifies promotion processes; and, brokered connections to the high status people. Scattered by ones and twos among disparate departments, female faculty are generally not included in the male-dominated peer groups that run departments and collaborate in research; they stand alone like silos on a Kansas wheat field. This isolation is devastating and circular. [10, 11].

At NTU, our approach to lessening isolation of women and building research groups that include women involves the implementation of a number of strategies including: 1) enabling and funding a network of interdisciplinary research collaborations among female faculty members and their male colleagues, and 2) assisting in establishing new connections and
strengthening existing ones between individuals of different disciplines with the use of traditional networking techniques and those afforded by social networking sites such as Facebook. In particular, several face-to-face networking events are being held to help faculty self-organize into a number of interdisciplinary research interest groups. However, without an online mechanism to support continuing communication after the face to face meeting, the groups tend not to be active. This is a particular niche of support that we hope to fill via the use of Facebook groups to build and sustain a research community. We believe that sense of community is a powerful contextual factor that underlies and predicts future levels of retention, promotion, and research productivity for female faculty.

4. Prior Research on Social Networking Sites and Sense of Community

boyd and Ellison define social networking sites (SNS) as web-based services that allow users, at the basic level, to perform three functions: “(1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system” [2] (p. 2). Some examples of these sites are Facebook, LinkedIn, Hi5, and MySpace. These sites usually include features such as: chat rooms, instant messaging, video, voice chat, file sharing, blogging, and discussion groups. The main characteristic that distinguishes social networking sites from older computer mediated communication (CMC) technologies like newsgroups is the capability of allowing users to “articulate and make visible their social networks” [2] (p. 2). SNS are therefore mainly organized around people, not interests [2].

Some SNS researchers posit that SNS primarily support pre-existing social relations by maintaining or strengthening existing offline relationships [12], [13]. Prior studies have illustrated such support as well as other benefits of SNS as they relate to SOC. For instance, Gaved and Mulholland [14] conducted a qualitative study of five hybrid communities using “using both online and offline channels to communicate among residents, gather and store information and support social interaction.” Although it was not stated explicitly that these communities used SNS, it was noted that they used “social software” described as “software that supports the sociality of people in a beneficial way both online and offline” [15]. One of the primary observations was that the low cost network infrastructure made available to the community seemed less important than the social interactions it supported. A separate study conducted by Lampe, et al. [16] was based on the premise that profiles in SNS could convey a sense of social presence. Lampe et al. [16] found that the number of populated profile fields (except for open-ended fields) or the degree of social presence was positively related to the number of friends listed in a user’s profile. This finding considered along with the positive correlation between social presence and sense of community, supported by Rovai’s [17] study, suggest that there could be an indirect relationship between the number of friends listed in one’s profile in a SNS and a sense of community. In Humphreys’s [18] year-long qualitative study of Dodgeball (a mobile SNS designed to transmit location-based information about users), it was concluded that Dodgeball contributed to users feeling socially connected and to a collective experience and movement of social groups through public space. These feelings can be viewed as being comparable to a spirit of belonging together, which is an aspect of sense of community.

5. Building and Sustaining Sense of Community in Social Networking Sites

At NTU, as noted earlier, efforts are currently ongoing to establish a Facebook group to support the offline academic community and facilitate collaboration. With the Facebook group feature, an NTU hybrid networked community can be formed in which both online and offline channels can be used to communicate, gather and store information and support social interaction [14]. There are standard features of Facebook such as member profiles and social network lists that can improve social presence or faculty awareness of other members in the NTU community. Further, the articulation of social networks (i.e. who is connected to whom) can help members to establish new connections from their existing connections (e.g. a friend of a friend).

Classic CMC tools, such as discussion forums and chat rooms within Facebook, can also be used to increase interaction and emotional connection. However, in addition to these traditional tools, there are also some third-party applications available in Facebook that can be leveraged to promote sense of community: e.g. Zoho Office (a suite of document sharing applications) and a number of calendar sharing applications.

Preece [19] warns that software alone is not enough to promote collaboration and foster the trust and cooperation needed to maintain a successful online community. Therefore, the establishment of a Facebook group and the encouragement of faculty
members to use some of the features and applications noted above cannot be a panacea for reducing isolation and enhancing sense of community. It is important, however, to determine if this Facebook intervention is in some way making a contribution to remediating isolation. More specifically, future assessments are expected determine whether correlations exist between members’ sense of community and the extent and type of activities that they perform in the online Facebook community. These assessments necessitate the development of a sense of community scale.

6. Development and Assessment of a Sense of Community Scale

In the development of the SOC scale for this study, we referenced the SCI index noted earlier. However, like other researchers (e.g. [17, 20]) who are interested in building and sustaining SOC in online communities such as virtual classrooms, we found it necessary to customize this index. There are three primary reasons for our decision to customize the index. Firstly, as explained by Chavis and Pretty [5], there are inconsistencies in the psychometric properties of the subscales corresponding to the four dimensions of the construct. For this reason, many researchers have created distinct measures of SOC by removing some of the items from the SCI or by combining the SCI with other items or instruments [5, 7]. Secondly, it was important to use an instrument that was sensitive to the characteristics of the academic setting in which this study was conducted. According to Hill, “the reason for the lack of consistent findings regarding dimensions and correlates is that some significant percentage of aspects of psychological sense of community differ from setting to setting” [21] (p. 433). This echoes Rheingold’s [22] earlier remarks regarding the distinctiveness in the characteristics of various communities. Thirdly, we needed a scale that was not as lengthy as those used in prior studies such as [23] and [20], and did not further deter faculty members from participating in the study.

Our initial SOC scale comprised ten items and emphasized primarily the dimensions of spirit and trust described by Rovai [17, 20, 24], whose focus was on sense of community in a virtual classroom. We limited our initial sense of community scale to the two factors, spirit and trust, because in Rovai’s studies, spirit and trust were proven to be the most essential contributors to increasing overall sense of community. Interaction and the sharing of common expectations proved to be less important in that respect.

Spirit “denotes recognition of membership in a community and the feelings of friendship, cohesion, and bonding that develop” among members of the community [20] (p. 107). A measure of spirit is therefore expected to be negatively correlated with degree of isolation. As explained earlier, isolation was identified as the underlying problem impeding the advancement of women faculty in science and engineering departments.

Although trust has been defined in a number of different ways (e.g., [25, 26]), Mayer et al.’s conceptualization is close to our preferred definition: “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” [27] (p. 712). Trusting relationships in any team or relationship reduce transaction costs, increase cooperation, and promote respect [28]. In forming new collaborative relationships for research, when issues of intellectual property and fair division of authorship credits and research resources loom in the future, trust is likely to be a very important factor.

6.1. Methodology

The initial scale of SOC items designed for use in this study focused on the entire university campus as the community. This initial scale evolved through a process involving two pre-tests in which eleven faculty members (five in the first pre-test and six in the second) were asked to comment on the clarity, suitability and face validity of its items. The scale was revised after each pre-test. The main remarks made by pre-test participants were: (1) some of the items were too general; (2) an individual’s perception of SOC at the campus level could be very different than his/her perception of SOC at the department level and consequently, it would be important to make a distinction between these two perceptions and measure them separately; (3) the scale should make reference to a community, such as tenure track faculty, with a more clearly defined boundary, thus, part-time lecturers who are rarely present on campus would not be considered; and (4) if possible, items should be rephrased so that responses would be given in the form of a percentage (0%, 10%, 20%, ..., 100%) in order to improve variability in responses as individuals were tempted to select “neutral” in the original five point Likert-type scale. The following example illustrates how the items were modified:

Initial item: I feel that faculty on this campus care about each other (5-point Likert-type scale – Strongly agree/ Strongly Disagree)
Final item – department level: I feel that ___ % of faculty in my department care about each other
Final item – campus level: I feel that ___ % of faculty in this campus community care about each other

Appendix 1 shows the final scale used to assess SOC at the department level. At the campus level, “my department” was replaced with “this campus community” for each item. This scale was administered as part of a broader online survey in which participants were asked to list their research colleagues and on campus friends (details of these additional components of the survey are discussed later). Invitations to participate in the online survey were emailed to all 286 tenure track faculty members at the university who did not participate in the pretests. Despite follow up reminders and an email message to all faculty from the Provost, only 66 or 23% of the non-pretest participants responded partially or completely to the survey. Although a 23% response rate was below our initial expectations, we deemed it to be acceptable as prior IS research, example [29], with lower response rates has been published in reputable journals. Pitkow and Kehoe [30] explain that solicitation emails are often ignored or erased by individuals, and thus it is generally difficult to obtain high response rates with this method. The response rate by gender was also disproportionate. The percentage of female faculty (of special interest for this study) responding was 74%, (26 of 35) compared to only 16% (40 of 251) of the male tenure track faculty. There were 59 (20 female and 39 male) and 56 (19 female and 37 male) usable responses to the SOC scale at the department and the campus level, respectively.

6.2. Results

6.2.1. Summary Statistics. The range of values for each of the sense of community scales is 0 to 100 since possible scores for each of the ten items were between 0 and 10 inclusive (percentage responses, which were multiples of 10, were divided by 10). Respondents’ total SOC scores at the department (D-SOC) and campus (C-SOC) levels are summarized in Table 1.

Table 1: Summary of total SOC scores

<table>
<thead>
<tr>
<th>Sense of Community</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department Level</td>
<td>59</td>
<td>49.1</td>
<td>20.5</td>
</tr>
<tr>
<td>Campus Level</td>
<td>56</td>
<td>32.5</td>
<td>15.8</td>
</tr>
</tbody>
</table>

The mean score at the department level is slightly below the mid-point of 50 and suggests there is definitely room for improvement. At the campus level, however, the mean score is significantly lower. These results confirm that efforts by ADVANCE to increase collaboration and bonding at the department level, and more so, at interdepartmental level are quite appropriate.

6.2.2. Assessing Validity. The two types of validity assessed were construct validity and criterion-related validity. Construct validity was tested using factor analysis with the oblique quartimax rotation method. Criterion-related validity was assessed using two criteria: number of tenure track faculty members listed as (a) colleagues and (b) friends.

Construct Validity: Before proceeding with the factor analysis procedure, Bartlett’s test of sphericity and the measure of sampling adequacy (MSA) were used to determine, respectively, the overall significance of the correlation matrices generated from the items in each scale and the factorability of these items. The results of Bartlet’s test, shown in Table 2, suggest that significant correlation exists among the items in each scale. The values in the partial correlation matrices, shown in Tables 2-1 and 2-2 of Appendix 2, are less than 0.5; also indicating strong interrelationship among the items in the scales. The overall MSA value for each scale is greater than the acceptable value of 0.5 specified in Hair et al. [31], and therefore, supports the use of factor analysis to group the items in each scale into one or more sets of underlying factors. The MSA values for the individual items in the two scales also exceed the recommended threshold value of 0.5, and hence, justify the inclusion of all ten items in the factor analysis. Collectively, the Bartlett’ test, the MSA, the correlations and the partial correlation values all indicate that the ten items in each scale meet the fundamental requirements, specified in Hair et al. [31], for proceeding with factor analysis.

Table 2: Bartlett’s test and Overall MSA

<table>
<thead>
<tr>
<th></th>
<th>D-SOC</th>
<th>C-SOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA</td>
<td>0.877</td>
<td>0.862</td>
</tr>
<tr>
<td>Bartlett’s Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx. $\chi^2$</td>
<td>385.07</td>
<td>287.51</td>
</tr>
<tr>
<td>Df</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Sig</td>
<td>&lt; 0.0001</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

Two factors with Eigenvalues greater than 1.0 resulted from the initial execution of the factor analysis procedure with the oblique quartimax rotation method on the ten item “sense of department community” (D-SOC) scale. All variables except D-SOC9 (“other faculty members depend on me”) had “good” (i.e. 0.55 or greater factor loadings on Factor 1 according to guidelines provided in Comrey and Lee [32] (p. 243). D-SOC9 loaded well on Factor 2. The communality
value for D-SOC5 (I feel isolated in my department) was 0.36, which is less than 0.5, and thus a decision was made to omit this item in the subsequent analysis based on the guidelines provided in Hair et al. [31] (p.151). A second factor analysis with the same rotation method was performed with the reduced set of items. The results of this analysis, shown in Table 3, suggest a 9-item/2-factor solution. This solution was considered to be acceptable because each item had “good” loading (defined as loading above 0.55) on only one factor and communality values for all items were above 0.5.

Table 3. Dept SOC oblique quartimax rotated factor pattern

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor1</th>
<th>Factor2</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-SOC1</td>
<td>0.79</td>
<td>0.18</td>
<td>0.72</td>
</tr>
<tr>
<td>D-SOC2</td>
<td>0.62</td>
<td>0.46</td>
<td>0.75</td>
</tr>
<tr>
<td>D-SOC3</td>
<td>0.73</td>
<td>0.02</td>
<td>0.54</td>
</tr>
<tr>
<td>D-SOC4</td>
<td>0.79</td>
<td>0.05</td>
<td>0.64</td>
</tr>
<tr>
<td>D-SOC6</td>
<td>0.92</td>
<td>-0.12</td>
<td>0.80</td>
</tr>
<tr>
<td>D-SOC7</td>
<td>0.93</td>
<td>-0.06</td>
<td>0.84</td>
</tr>
<tr>
<td>D-SOC8</td>
<td>0.82</td>
<td>-0.06</td>
<td>0.65</td>
</tr>
<tr>
<td>D-SOC9</td>
<td>-0.05</td>
<td>0.97</td>
<td>0.92</td>
</tr>
<tr>
<td>D-SOC10</td>
<td>0.88</td>
<td>-0.07</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>5.54</td>
<td></td>
<td>4.60</td>
</tr>
<tr>
<td></td>
<td>61.50</td>
<td></td>
<td>57.48</td>
</tr>
</tbody>
</table>

In general, the results of the factor analysis procedures contradict the theorized two dimensions construct of the sense of community scale. In particular, the consistent loading of item 9 on factor 2 at both the department and campus level strongly suggests that it may be part of a distinct dimension. A closer examination of D-SOC9 reveals that this item questions respondents on their belief of the perception of their dependability. For both the department and campus SOC scales, Factor 2 explains 11.99% and 14.04% of the variance respectively (refer to Tables 3 and 4). It would therefore not be appropriate to delete this factor. Rather, in future revisions of the SOC scale, it would be more logical to add item (variables) related to one’s perception of the level of trust that others have in them.

For the “campus sense of community” (C-SOC) scale, two factors emerged from the initial factor analysis with the oblique quartimax rotation technique. Using the same criterion (communality < 0.5) for eliminating variables from future analyses, items C-SOC5 (I feel isolated in this campus community) and C-SOC8 (other faculty members in this campus community do not help me) were deleted from the C-SOC scale. Table 4 presents the results of the second factor analysis done with the reduced 8-item scale. Similar to the D-SOC scale, the only item that loaded well on Factor 2 was C-SOC9 (other faculty members in this campus community depend on me). However, the composition of Factor 1 was different as item SOC8, which loaded well on Factor 1 in the department SOC scale had to be deleted from the campus SOC scale. This difference in Factor 1 suggests that there is a bit of inconsistency in the construct of the scale when it is used for different communities. Also, C-SOC8 may not be relevant to the scale when a larger community like an entire campus is considered.

Table 4: Campus SOC oblique quartimax rotated factor pattern

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor1</th>
<th>Factor2</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-SOC1</td>
<td>0.86</td>
<td>-0.04</td>
<td>0.72</td>
</tr>
<tr>
<td>C-SOC2</td>
<td>0.57</td>
<td>0.49</td>
<td>0.70</td>
</tr>
<tr>
<td>C-SOC3</td>
<td>0.87</td>
<td>-0.21</td>
<td>0.70</td>
</tr>
<tr>
<td>C-SOC4</td>
<td>0.82</td>
<td>-0.19</td>
<td>0.62</td>
</tr>
<tr>
<td>C-SOC6</td>
<td>0.75</td>
<td>0.13</td>
<td>0.63</td>
</tr>
<tr>
<td>C-SOC7</td>
<td>0.71</td>
<td>0.35</td>
<td>0.76</td>
</tr>
<tr>
<td>C-SOC9</td>
<td>-0.04</td>
<td>0.93</td>
<td>0.85</td>
</tr>
<tr>
<td>C-SOC10</td>
<td>0.75</td>
<td>0.25</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>4.60</td>
<td></td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>57.48</td>
<td></td>
<td>14.04</td>
</tr>
</tbody>
</table>

In order to assess the criterion-related validity of the SOC scales, two criteria measured concurrently were chosen: the number of tenure track faculty listed as friends and the number of tenure track faculty listed as research colleagues by subjects. These numbers were obtained at the department level and campus-wide as described below.

Survey participants were asked to list their NTU and non-NTU research colleagues as well as their NTU
friends irrespective of their tenure status. Research colleagues and friends were defined as follows:
Research Colleagues are those with whom you might engage in activities that are research-related, from informal discussions to coauthoring a paper or book. You might collaborate with these people by:
- Discussing research ideas or activities
- Critically reading one another’s drafts
- Working on a formal research proposal or project
- Coauthoring a paper or book
- Serving as a mentor or being mentored
- Advising them as Ph. D. students
- or some other form of collaboration…
Friends are colleagues:..:
- with whom you discuss important matters, or
- with whom you regularly keep in touch, or
- with whom you do things, or
- who are “there for you” if you need help.

From the lists of research colleagues and friends provided by respondents, tenure track faculty members were identified and counted. Only tenure track faculty members were considered in each criterion because the SOC scale required that the subjects consider only this category of faculty members in their responses. The identified NTU tenure track faculty members were further grouped into two categories for each respondent: those within the same department and those in other departments. The faculty members in these categories were counted for each respondent.

The results of a correlation analysis between SOC (using the revised scale) at the department level and the two previously-mentioned criteria are shown in Table 5. These results suggest that for the community defined as tenure track faculty members within an individual’s department, that individual’s sense of community is a rough but valid estimator of the number of research colleagues or the number of friends listed by that individual.

6.2.3. Assessing Reliability. Carmines and Zeller [34] briefly discuss four basic methods of estimating the reliability of empirical scales, namely: (1) the retest method; (2) the alternative form method; (3) the split-halfes method; and (4) internal consistency method. These authors note that the alternative form method and the internal consistency methods are superior. For the alternative form method, however, it is required that the survey questionnaire be administered twice. Since the survey questionnaire in this study has thus far been administered only once, it is not possible to use this method to assess reliability.

In assessing the reliability of the revised instruments for sense of community using the internal consistency method, Cronbach’s coefficients (alpha) of 0.91 and 0.88 were computed for the department and the campus level respectively. The relatively high values of the Cronbach’s coefficients suggest that the instruments demonstrate internal consistency and are therefore reliable. Carmines and Zeller ([34], p. 51) believe that “reliabilities should not be below 0.80 for widely used scales. At that level, correlations are attenuated very little by random measuring error.”

7. Discussion

Our Sense of Community scale focuses on the dimensions of Spirit and Trust, described by Rovai [20, 24]. These dimensions seemed to us to be the most relevant to supporting the emergence of research collaboration networks in academia. In future research, however, it would be prudent to add items from the “missing” dimensions that had been included in prior studies of sense of community in other contexts. Although factor analysis suggested a two factor solution for the SOC scale at the department and at the campus level, the majority of the items for both trust and spirit loaded on one factor. The one item loading on a second factor measures the respondents’ perceptions of other people’s thoughts rather than their direct beliefs and opinions. It is therefore reasonable to conclude that spirit and trust as directly perceived by respondents is part of one underlying dimension. There are examples of prior studies that also seem to suggest that SOC is a unidimensional construct. In Buckner’s [35] scale designed to measure cohesion, sense of community was initially treated as one of three dimensions. The other dimensions were attraction to neighborhood and degree of neighborhood. The results of a factor analysis on this scale suggested that it should be interpreted as measuring a unidimensional construct, which Buckner labeled as sense of
community/cohesion. Davidson and Cotter [36] also developed a 17 item SOC scale. A factor analysis on this scale also led to the conclusion that it was one dimensional.

8. Limitations

There are a few limitations in the execution of this study that are worth noting. The ADVANCE project is aimed primarily at the advancement of women in science and technology academic careers. Therefore, an assertive effort was made in encouraging women to participate in this study. This resulted in a sample that was not representative of the population of tenure track faculty, with a significant disparity between the percentage of women in the population who participated and the percentage of men who did. However, the sample comprised almost twice as many male as female faculty members.

As noted earlier, the SOC scale was administered as part of a longer study questionnaire, in which subjects were asked to list research colleagues and friends in their professional and social networks, and to specify the ways that they collaborated with their research colleagues. Therefore, completing this questionnaire was time consuming, and although 66 subjects started responding, some of them (primarily male) stopped before answering the SOC questions placed at the end of the questionnaire. Further, at the time of the study, there were some incompatibilities between the browser Internet Explorer version 7.0 and SurveyMonkey® (the software used to develop the online survey). As a result, the subjects who used this browser experienced technical difficulty and this could have also contributed to some of them abandoning their efforts before completing the SOC questions.

Given the response rate problems, one must be cautious about extrapolating the implications of this study beyond the context in which it was conducted. In order to obtain a greater response rate and a sample that is more reflective of the composition of the entire population in future studies, the SOC scale will be administered by itself and a special appeal will be made to encourage male faculty members to participate.

In the broader sense of “cause and effect,” even if the introduction of Facebook groups is shown to be followed a year or so later by changes in levels of Sense of Community, we cannot prove causality. To explore any causal relationship, we will need to observe the interaction on Facebook directly, and also to include some items on a post questionnaire that directly ask the extent to which the use of the Facebook groups may have helped participants to strengthen their existing campus collaborations or to find new academic friends and/ or collaborators.

9. Conclusion and Future Research

Our motivation for developing this sense of community scale, as noted earlier, is to have an instrument that can be used to evaluate progress that is possibly attributed to the efforts of the ADVANCE project. Although the scale we developed demonstrated good reliability generally and moderate concurrent validity only when used at the department level, there seem to have been some inconsistency when construct validity was assessed. In some studies, sense of community has been accepted as a unidimensional construct. However, we believe the weaknesses in some aspects of the validity of our scale suggest that it might be necessary to modify it so that there is consistency in its construction when used in the two communities that we are considering in our broader research – department and campus wide.

In our future related research, we can draw on the work of prior researchers such as Lampe et al. [16] and investigate possible relationships between changes in sense of community of faculty members and their online representation and activities in Facebook. For example, research questions such as the following can be explored with larger or repeated samples.

- How significant are the changes, if any, in sense of community since the start of the ADVANCE project?
- How significant are the changes, if any, in sense of community since the deployment of the Facebook group to support the online/offline community?
- What is the relationship between profile entries (one indicator of online social presence) and the increase in sense of community?
- What is the relationship between the extent of use of collaborative tools that are made available to faculty members and any change in sense of community?

10. Acknowledgements

This research is funded by the NSF 05-584, NSF 0534520 and NSF-CISE 0454081 grants from the National Science Foundation. The opinions expressed are those of the authors and not necessarily of the NSF. We wish to thank Linda Plotnick for her work in the preliminary testing of the initial scale with students.
11. References


Appendix 1:

**Sense of Community Scale – Department Level**

Below you will see a series of statements concerning your feelings about the other tenure track faculty in your department. (Note… items were inter-mixed and not labeled).

**Spirit**
1. I feel that _____ % of faculty in my department care about each other.
2. I feel connected to ____ % of faculty members in my department.
3. I do not feel a spirit of community in my department
4. I feel that my department is like a family
5. I feel isolated in my department

**Trust**
6. I trust ___ % of faculty members in my department
7. I feel that I can rely on ____% of other faculty members in my department.
8. I feel that ___% of other faculty members in my department do not help me.
9. I feel that ___% of other faculty members in my department depend on me.
10. I feel confident that ____% of other faculty members in my dept will support me if I need them to do so.

**Note:**
- For items 1-2, and 6-10, the respondents were given the option of selecting any multiple of ten within the range 0 to 100 inclusive e.g. 10, 20, 30, etc.
- For items 3-5, an 11-point semantic differential scale, ranging from 0 to 10, was used with extreme values of "strongly disagree" to "strongly agree"

Appendix 2:

**Table 2-1: Dept SOC – Measures of Sampling Adequacy and Partial Correlations**

<table>
<thead>
<tr>
<th></th>
<th>D-SOC1</th>
<th>D-SOC2</th>
<th>D-SOC3</th>
<th>D-SOC4</th>
<th>D-SOC5</th>
<th>D-SOC6</th>
<th>D-SOC7</th>
<th>D-SOC8</th>
<th>D-SOC9</th>
<th>D-SOC10</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-SOC1</td>
<td>0.888</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC2</td>
<td>0.289</td>
<td>0.824</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC3</td>
<td>0.247</td>
<td>-0.056</td>
<td>0.944</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC4</td>
<td>-0.017</td>
<td>0.387</td>
<td>0.197</td>
<td>0.878</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC5</td>
<td>0.004</td>
<td>0.054</td>
<td>0.072</td>
<td>0.041</td>
<td>0.927</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC6</td>
<td>0.208</td>
<td>-0.143</td>
<td>0.057</td>
<td>0.191</td>
<td>-0.193</td>
<td>0.873</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC7</td>
<td>0.295</td>
<td>-0.009</td>
<td>-0.066</td>
<td>0.096</td>
<td>0.213</td>
<td>0.449</td>
<td>0.894</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC8</td>
<td>0.204</td>
<td>-0.140</td>
<td>0.107</td>
<td>0.292</td>
<td>0.130</td>
<td>-0.092</td>
<td>0.054</td>
<td>0.914</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D-SOC9</td>
<td>0.089</td>
<td>0.424</td>
<td>0.028</td>
<td>-0.151</td>
<td>0.053</td>
<td>-0.010</td>
<td>-0.037</td>
<td>0.019</td>
<td>0.685</td>
<td></td>
</tr>
<tr>
<td>D-SOC10</td>
<td>-0.288</td>
<td>0.386</td>
<td>0.115</td>
<td>-0.231</td>
<td>0.085</td>
<td>0.386</td>
<td>0.316</td>
<td>0.293</td>
<td>-0.108</td>
<td>0.836</td>
</tr>
</tbody>
</table>

**Table 2-2: Campus SOC – Measures of Sampling Adequacy and Partial Correlations**

<table>
<thead>
<tr>
<th></th>
<th>C-SOC1</th>
<th>C-SOC2</th>
<th>C-SOC3</th>
<th>C-SOC4</th>
<th>C-SOC5</th>
<th>C-SOC6</th>
<th>C-SOC7</th>
<th>C-SOC8</th>
<th>C-SOC9</th>
<th>C-SOC10</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-SOC1</td>
<td>0.850</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC2</td>
<td>0.331</td>
<td>0.866</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC3</td>
<td>0.317</td>
<td>-0.005</td>
<td>0.872</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC4</td>
<td>0.117</td>
<td>0.093</td>
<td>0.344</td>
<td>0.889</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC5</td>
<td>0.132</td>
<td>-0.039</td>
<td>0.297</td>
<td>-0.102</td>
<td>0.874</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC6</td>
<td>-0.060</td>
<td>0.205</td>
<td>0.007</td>
<td>0.098</td>
<td>0.070</td>
<td>0.895</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC7</td>
<td>0.374</td>
<td>0.019</td>
<td>-0.057</td>
<td>0.057</td>
<td>-0.153</td>
<td>0.220</td>
<td>0.868</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC8</td>
<td>-0.035</td>
<td>0.067</td>
<td>0.107</td>
<td>-0.204</td>
<td>0.079</td>
<td>-0.068</td>
<td>0.121</td>
<td>0.878</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-SOC9</td>
<td>-0.272</td>
<td>0.440</td>
<td>0.084</td>
<td>-0.044</td>
<td>0.194</td>
<td>-0.201</td>
<td>0.288</td>
<td>-0.044</td>
<td>0.616</td>
<td></td>
</tr>
<tr>
<td>C-SOC10</td>
<td>-0.024</td>
<td>0.019</td>
<td>0.075</td>
<td>0.114</td>
<td>0.238</td>
<td>0.355</td>
<td>0.351</td>
<td>0.285</td>
<td>0.062</td>
<td>0.882</td>
</tr>
</tbody>
</table>

**Note:** In Tables 2-1 and 2-2, MSAs are on the diagonal, partial correlations in the off-diagonal