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1997

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Abstract

A small world study is an easy way to introduce students to the challenges and rewards of network studies. Hypotheses about networks can be formulated and easily tested during the course of a term. Here, hypotheses about the communication patterns among undergraduates were tested by creating a small world study with an administrator as a target. Undergraduates were found to prefer to pass small world folders among their own class and did not pass folders to lower classes. Graduate students, faculty and staff were more closely connected to the administration as compared to undergraduate students, and freshmen were particularly isolated in communication networks. Women relied more on homophilous ties to pass folders compared to men, and both sexes relied on homophilous ties when passing folders across occupational boundaries.

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Comments

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Study of Networks

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A small world study is an easy way to introduce students to the challenges and rewards of network studies. Hypotheses about networks can be formulated and easily tested during the course of a term. Here, hypotheses about the communication patterns among undergraduates were tested by creating a small world study with an administrator as a target. Undergraduates were found to prefer to pass small world folders among their own class and did not pass folders to lower classes. Graduate students, faculty and staff were more closely connected to the administration as compared to undergraduate students, and freshmen were particularly isolated in communication networks. Women relied more on homophilous ties to pass folders compared to men, and both sexes relied on homophilous ties when passing folders across occupational boundaries.

The "small world" problem has a rich and interesting history in the study of social networks. Milgram (1967), noting that people sometimes run into friends (or friends of friends) in locations far from home and exclaim "My, it's a small world!", formulated the problem as: "Starting with any two people in the world, what is the probability that they will know each other?" (Milgram, 1967: 62). This small world problem had originally been articulated in an unpublished paper by Pool and Kochen finally published in 1978. Using a mathematical model, Pool and Kochen (1978) speculated there was a one in 200,000 chance that two Americans would know each other, assuming that each American knows about 500 others. Thus more than 50% of the time any two Americans can be linked if two intermediaries are allowed.

Milgram's genius was to develop a simple methodology for actually studying how people are linked to others. Milgram gave a folder to a "starting person" who is instructed to send the folder to a "target person". If the starter does not know the target, then the starter is instructed to send the folder to someone else the starter knows that might be able to send the folder to the target. Thus the researcher can determine how closely linked any two people are in a population. In the original Milgram study, starters in Kansas tried to get folders to the wife of a divinity student in Cambridge, Massachusetts, and starters in Nebraska tried to get folders to a stockbroker in Sharon, Massachusetts. In the Nebraska study, Milgram found five intermediaries was the median number of links between the starter and target.

Milgram has developed a simple low cost way of studying networks and social structure that would seem to be well suited to a class project in the study of networks in organizations. In this paper we discuss the usefulness of conducting a small world (SW) study as a class project and report on our findings of the small world of the university.

The Small World Study as a Class Project

A SW study can be a useful tool for studying the network connections between individuals in organizations as a classroom

exercise. First, a SW study offers an opportunity for students to think about the nature of networks. Second, the students can consider the SW technique in the context of other network research methodologies. Third, a SW study can provide an opportunity to delineate an organization's informal network patterning.

In addition, a SW study provides an opportunity to consider the problems of developing and executing a research project. The SW experiment provides the students with the opportunity to hone rudimentary research skills. As a group, the students can consider (and confront) their own implicit and explicit hypotheses about networks. They can work through methodological design issues, such as ways to test hypotheses, formulate sample sizes, conduct studies, perform appropriate data analyses and determine a study's overall contribution. A SW study enables the student to confront the barriers to network based research such as garnering the cooperation of organizational respondents and generalizability to other populations. Working through these issues as a group enables the student to learn different approaches to the same question or problem from each other. The collegial nature of the classroom enables the students to discuss and defend their approaches with one another.

Research Hypotheses. To keep our study relatively simple, we decided to focus our attention on undergraduate students and how they would contact an administrator. We assumed that undergraduates would interact with each other and be somewhat isolated from other groups in the university. This led us to formulate a number of hypotheses about their communication patterns.

Previous SW studies had indicated that respondents are likely to pass folders to someone they know (Stevenson and Gilly, 1991; Travers and Milgram, 1969). Since network connections are likely to develop as an individual spends more time in the organization, we would expect, for example, that freshmen would have less connections to others as compared to seniors. Thus:

Hypothesis 1: The longer the time at the university, the more likely a student is to initiate a successful chain of communication to a target.

Small world studies are interesting in organizations because there is a formal organizational structure that may alter the contacts between individuals. Milgram was not oblivious to the social structure that alters otherwise random networks of acquaintances in society. He and others have found that selecting the next link is based on friendship, residence of the target, and occupation of the target (Travers and Milgram, 1969) and successful, i.e., completed chains, involve participants with higher occupational prestige and more weak, infrequent relations than unsuccessful chains (Lin, Dayton, and Greenwald, 1978). Small world studies in the organizational setting have shown that barriers between professional groups exist and these barriers make it difficult for SW folders (and other communication) to cross these barriers (Lundberg, 1975; Stevenson and Gilly, 1993). Therefore we expected that it would be difficult for folders to cross boundaries between professors, staff members, administrators and students. Thus:

Hypothesis 2: Small world folders are more likely to be passed within a class than between classes and occupational groups in a university.

Previous studies had indicated a funneling effect in both organization and societal studies. Studies in both organizations and the larger society have found that folders converge on a small number of sociometric "stars" before reaching the target person. In the societal case, Travers and Milgram (1969) found, that of 64 letters sent, 25 percent of the letters reached the target through one neighbor, and three penultimate links accounted for 48 percent of the completions. Stevenson and Gilly (1993) found that folders converged rapidly on a small number of managers in an organization, and Lundberg (1975) found that chains funneled through a small number of people in both his society and organizational studies. We would expect in this case that students would pass SW folders to staff and faculty as repositories of knowledge about the organization.

<u>Hypothesis 3</u>: Small world folders will converge on faculty and staff before reaching the target.

It has often been noted that ties between people tend to be homophilous. For example, Travers noted in the original Kansas study that females were more likely to send to females and males to males. Furthermore, other SW studies have shown that those who are culturally (Bochner, Buker, and McLeod, 1976) and racially similar (Korte and Milgram, 1970) are more likely to be linked. Sex differences were the most prevalent measure of diversity in this university population. Therefore:

    <u>Hypothesis 4</u>: Small world folders are more likely to be passed to members of the same sex.

<u>Methodology</u>

The hypotheses were developed in the class based on previous studies and hunches about networks. The folder was created in class after examining other examples of SW folders. Then the folder creation and data analysis work was divided among the class members.

As a first step in conducting a SW study, a target person and starting people were identified by the class. We thought it would be interesting to see how the undergraduates were connected to the administration of the university. This is an interesting question since most undergraduates have very little contact with the administration beyond the registrar, financial aid, or housing office. We picked the undergraduate dean of the school of management as the target. The undergraduate dean was picked because he was located in the building where most of the classes are held and would be easy to physically access.

However, the students could not simply hand the folder to the dean. We stipulated in the folder that the students needed to have had contact with the person they were forwarding the folder

to. As shown in the Appendix, we wanted the students to forward the folder "to someone you have had several conversations with outside the classroom". Similar to most SW studies, we were interested in the preexisting ties that connect people to each other in a university. We did not want to restrict the ties to strong friendships for fear that the folders would never reach the administrator. Also, we wanted the students to be able to forward the folder across occupational boundaries. We did not want the students to simply hand the folder to a professor, secretary, or the student sitting next to them in class, so we stipulated that they had to have several conversations outside the classroom with the next link in the chain.

In order to study the difference in acquaintance chains among the four classes, folders were distributed equally to freshman, sophomores, juniors, and seniors. Folders were initially distributed in selected classes. The freshmen were randomly selected in a required freshman ethics class. Sophomores and juniors were randomly selected in two required introductory classes in organizational behavior. Seniors were sampled in an elective course.

The number of folders to be distributed led to extensive discussion. Previous SW studies in the larger society had completion rates of approximately 21-22% (Lundberg, 1975, Travers & Milgram, 1969; Korte & Milgram, 1970), but Lundberg had found a completion rate of 57% in his organizational study as compared to a 21% rate in his society study. We estimated that our completion rate would be closer to 50% given that the study was going to be distributed in classes most of which were conducted in the same building as the target. In addition, we did not want to deluge the administration or any potential funnels with folders. Accordingly, we estimated that sending out 60 folders equally distributed to those in the four categories of students would yield about 30 completed chains. We thought this would be an adequate number for the analysis of the simple crosstabulation of results that we planned.

This was a very useful discussion, because rarely do students consider the problems of non-response and how it is linked to the ability to analyze data. This discussion forced the students to consider how the data would be analyzed and the implications of the research design for the testing of their hypotheses. Once

the number of folders were determined, we distributed them in classes. Folders were distributed at the end of class to prevent them from being casually passed among the class.

Each starter was given a folder, shown in the Appendix, and asked to pass it to the target. The folder described the study, named the target, and asked the respondent to pass the folder on. Each person who received the folder was asked to write their name in the folder and give some brief identifying information about themselves. This was done for two reasons. First, we wanted to know information about links in the chain. Second, consistent with other SW studies, we did not want to folder to get caught in a loop between people. It was assumed that the respondent would not send the folder backwards in the chain after looking at the list of those who had received the folder.

Anticipating that many students might funnel the folder to department secretaries as easily accessible administrative contacts, a memo was sent to all secretaries alerting them about the study and asking them to call the professor in charge of the study with any concerns. (No one called him.) The undergraduate dean was given a box for the collection of folders. The professor dropped by the dean's office periodically to check the box. The last folders were turned in about two weeks after the study began.

Results

As shown in Table 1, 16 of 60 folders (27%) reached the target with a mean of 1.25 links between the starter and the target. This was a lower than expected completion rate and chain length, but not out of line for SW studies in general. Small world studies in organizations have shown, given the relatively clear boundaries in organizations, the number of intermediaries between a starter and target is smaller, and more chains are likely to successfully reach their target in SW studies in organizations as compared to the larger society. For example, Travers and Milgram found the mean number of intermediaries in his original study was slightly more than five, Lundberg (1975) in a study comparing SW chains in the larger society versus two organizations found the mean number of intermediaries for the

society study was slightly more than five, but the mean for the organizations was slightly more than three. Stevenson and Gilly (1991) found that only one or two intermediaries were necessary to deliver a problem to someone who could solve it in a hospital setting.

[TABLE 1]

According to Hypothesis 1 we expected that folders starting with more senior students would reach the target. This was not entirely the case. Eighty-one percent of the completed folders were started by sophomores and juniors, but only 2 (13%) of the folders were started by seniors, leaving one completed folder started by a freshman. However it was the case that the upper-class students were more involved in the completed chains. Only one of the 37 starters or intermediate links was a freshman. This study was conducted during the second semester of the school year and may show the isolation of the freshmen.

Table 2 provides some confirmation that SW folders would stay within student groups until being passed to an administrator as suggested in Hypothesis 2. This table also shows the hierarchy of student communication links. No student ever passed a folder to a student in a lower class.

Table 2 also shows how folders converged on faculty, graduate students and staff. Given that 7 out of the 8 folders that reached these groups were passed directly to the target administrator, it is apparent that these groups felt more closely connected to the administration. However, according to Hypothesis 3, folders should have converged on these groups before reaching the target. This was not necessarily the case, as only 44% of the penultimate links were in these groups.

[TABLE 2]

This result shows the contradictory impacts of the barriers to communication stated in Hypothesis 2 and the efficiency of the organizational hierarchy for communication as stated in Hypothesis 3. That is, assuming that the student did not

9

directly know the administrator, a student who wanted to get the folder to the administrator quickly would have been wise to pass to the faculty, graduate students or staff people who 88% of the time would pass the folder directly to the administrator. As shown in Table 1, in only two cases did the starter student pass the folder directly to the target administrator. However, since they were limited to those with whom they had several conversations, undergraduate students were unlikely to use this direct strategy and stayed mostly within their class until they could find an effective penultimate link.

[TABLE 3]

Homophilous ties were also expected to guide the folders as stated in Hypothesis 4. Looking only at folders passed to and from undergraduates, Table 3 shows that this homophilous tendency is especially pronounced among undergraduate women: 6 out of the 8 paths that originated from undergraduate female students went to other females. It was expected that crossing a boundary between classes or job categories would be more difficult, and this difficulty may lead to more homophily in boundary crossing. Table 4 shows that overall (including all job categories) women were more likely to pass folders within their gender, and the bottom panel shows that both sexes were more likely to pass folders across boundaries while keeping the folder within their gender. This is not an artifact of the distribution of sexes across boundaries. The undergraduate classes are evenly distributed in gender, the staff are overwhelming female, and while the majority of the faculty are male, there is a large minority of females.

[TABLE 4]

Discussion

The results, although extremely tentative due to the low response rate, were interesting. Students exhibited a hierarchy of communication with upper-class students never passing folders to lower-class students. Graduate students, staff, and faculty seemed to be much more closely tied to the administration as they overwhelmingly passed the folder directly to the administrator. However, undergraduate students were somewhat

10

isolated from other groups as they passed folders within their own classes and infrequently passed folders to other groups such as the faculty who could deliver the folders directly to the administrator. Freshmen seemed particularly isolated, as only one of the 21 starter or intermediate links were freshmen. Women relied more on homophilous ties to pass folders compared to men.

The results are interesting, however certain compromises were made in the research methodology which weakened the results. In other SW studies, the intermediate respondents are asked to return a postcard describing themselves so that chains that do not reach the target can be analyzed. In this case, we decided not to try to attach postcards to the folder since the university lacked an internal mail system for undergraduates, and not including postcards would keep the complication and cost of the folder down. The tradeoff, however, was that we received much less information on the links between individuals in the chains of communication. One alternative that we considered was to interview the first and additional links of non-completed folders to trace the incomplete folders. Time constraints prevented us from implementing this strategy.

A more elaborate study with postcards for intermediate links would produce a richer data set that could be amenable to more sophisticated data analysis. The thrust of the class was to learn network concepts and methodologies rather than statistical techniques. If the instructor was willing to devote the time to teaching statistics, a richer data set could be used to compare the sequences produced by successful and unsuccessful chains (Abbott, 1990); Markov models could be used to model the transitions from one link to the next to determine the distance between groups (Hunter & Shotland, 1974); and logistic regression could be used to test which characteristics of the respondents affect the probability of forwarding to the administrator (Stevenson & Gilly, 1991) or crossing boundaries (Stevenson and Gilly, 1993).

Additional studies could produce many variations on this SW exercise. For example, different targets could be chosen across academic schools to determine how students would communicate across academic boundaries. The gulf between undergraduate and graduate students could be explored. The students could be given a problem to solve having to do with their life at the

university and be asked to forward the folder to the person who could solve it in order to determine problem-solving networks. Many other variations on this basic technique are possible.

The study was successful in terms of a class project. Students were given the opportunity to develop network hypotheses and test them over the course of a semester. The study was relatively quick and very low cost and provided an introduction to the difficulties and promise of conducting network research.

Acknowledgment

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Table 1.

Table 1
Starters and Intermediate Links for Returned Folders[1]

Folder #	Gender[2]	Status[3]
1	F F F	SO SO SE
2	F F	SO SE
3	F M F	JU GR GR
4	M F	JU JU
5	F F F	SO SO SO
6	M M	JU JU
7	F F	JU JU
8	M	SO
9	F	FR
10	M F M	SE SE SE
11	F F	JU FA
12	M F F	JU JU ST
13	F M	SO FA
14	F M	SO FA
15	F M M M	SE SE SE FA
16	M M	SO FA

(a) The first listed individual for every folder received the folder directly from the researchers. The last individual handed it to the target. (b) F=female, M=male. (c) FR=freshman, SO= sophomore, JU=junior, SE=senior, GR=graduate student, ST=staff, FA=faculty

Table 2.

from \to	FR	SO	JU	SE	GR	ST	FA	Target
FR	-	-	-	-	-	-	-	1
SO	-	3	-	2	-	-	3	2
JU	-	-	4	-	1	1	1	3
SE	-	-	-	4	-	-	1	3
GR	-	-	-	-	1	-	-	1
ST	-	-	-	-	-	-	-	1
FA	-	-	-	-	-	-	-	5

(a) FR=freshman, SO=sophomore, JU=junior, SE=senior, GR=grad,
ST=staff, FA=faculty

Table 3.

Table 3
Movement of Folders By Gender
Among Undergraduates Only[a]

From \ To	Female	Male
Female	6	2
Male	3	2

(a) Not counting target

Table 4.

<div align="center">

Table 4
Movement of Folders Across Gender
Groups for All Job Categories[a]

</div>

All Undergrads	Female	Male
Female	8	5
Male	4	4

Across Status Boundaries	Female	Male
Female	4	3
Male	0	2

<div align="center">

(a) Link to target not counted

</div>

18

Small World Folder

March, 1996

Dear Fellow University Member,

How are you connected to the rest of the university? How could you reach someone that you don't know personally? We are interested in these questions and need your help in a study we are doing on social networks at the university. The object of the study is to trace how this letter is forwarded to reach a target individual. We hope that you can help us out. It is really simple to participate and won't take a lot of your time.

You have received this letter from a friend or acquaintance. All we ask is that you follow the instructions on the next page and forward this letter to someone who is more likely than you to reach the target individual.

John Doe, Associate Dean for Undergraduate Studies in the School of Management, has agreed to serve as the target person in this study. The goal of this study is to transmit this folder to John Doe using only a chain of friends and acquaintances.

If you have any questions, please contact me at ext. 1234. Thanks for helping us learn more about how the university is "connected"!

Sincerely,

William Stevenson

Associate Professor

<u>HOW YOU CAN TAKE PART IN THIS STUDY</u>

1. Add your name to the attached roster so that the next person who receives this letter will know who it came from.

2. If you have had several conversations with John Doe, deliver this folder directly to him.

3. If you do not know John Doe, do not try to contact him directly. Instead, deliver this folder to someone you have had several conversations with outside the classroom, who is more likely than you to know John Doe. (This person may be a faculty member, staff member, administrator or student.)

4. If you find yourself receiving a large number of these folders, please contact Dr. _____ at ext. 1234.

ROSTER

Print Your Name on next available line below:	Length of Time at University	--- check all that apply ---		
		University Affiliation	School	Sex
1._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
2._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
3._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
4._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
5._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
6._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
7._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
8._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female
9._____	_____ years	__ Student __ Staff __ Faculty	__ SOM __ Other	__ Male __ Female