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The Effect of Directional Advice Ties on Perceptions of Communication Technologies

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Abstract

The adoption of new technology is an important topic for communication and information technology researchers. Individuals' social interactions play an important role in how these technologies are perceived. Prior research has looked at social influence in the perception and use of new technologies, but it has not taken into account the differences in directional ties. This study looks at how incoming and outgoing advice ties influence the perception of communication technologies. Using network and survey data from a software consulting firm (N=74) this study finds that the number outgoing (advice seeking) ties has a significant impact on perceptions and that the perceptions of those from whom an individual seeks advice will be significantly correlated with the individual's perceptions. This does not hold true for incoming (advice giving) networks. This suggests that understanding the direction of ties can be important in studying technology adoption and use.

Keywords: Electronic communications, social networks, social influence, technology adoption

Introduction

The adoption of technology has been an important topic for information and communication technology researchers. The adoption of new technologies by organizations is far from automatic (Kwon and Zmud, 1987; Cooper and Zmud, 1990), regardless of the nature of the technology. Prior research on the adoption of innovations has shown that individuals' social contexts, as reflected by their social networks, directly impact perception and therefore adoption behavior (Coleman, Katz and Mendel, 1966; Burt 1987; Rogers 1995). This may be especially true for communication technologies, which directly support social interactions. This study looks at the relationship between social networks and the perception of computer communication networks (email) within an organization. The use of social network data provides a mechanism for understanding the social influences affecting an individual's perception. The study looks at how the direction of ties in a work related advice network impacts these perceptions. The results of this research can also give some insight into overall adoption behavior, not just behaviors specifically related to one technology.

Background and Hypotheses

Computer communication networks have come to play an important role in organizational communications over the past decade and have become a central IS research topic. One of the most prominent examples of this type of computer mediated communication is email. Traditionally, managers have relied heavily on face-to-face or written communication, but these communication channels involve temporal and geographic obstacles that often prevent or impede communication (Daft and Lengel, 1986). Email can overcome physical and situational constraints associated with face-to-face communications, scheduled meetings, and distributed work environments (Rice, 1990; Rice, 1994). Email can support an increased amount and diversity of communications with others, and awareness of others work (Rice, 1994). While the use of email has grown rapidly over the past several years, it is still not the primary form of communication in organizations. Many individuals still do not use e-mail, especially for intra-organizational communication, even though it has been shown to have many benefits.

Traditional diffusion studies have shown that interpersonal contacts are an important source of information about new technologies and innovations. (Rogers, 1995) Social influence, in the form of norms or expectations, may impact an individual’s perceptions
of technologies or intentions to adopt (Fulk, 1993). Furthermore, it has been argued that the way information technologies are perceived and evaluated is directly influenced by others with whom an individual interacts (Fulk, Schmitz, and Steinfield, 1990; Lea, O’Shea, and Fung, 1995). By communicating with others in the social network information about the technologies themselves are shared. Heald et al. (1998) demonstrate that coworkers that report similar task related contacts have greater perceptual congruence of the organizations social structure, which supports views of social influence existing within organizations (Salancik and Pfeffer, 1978).

Previous studies have looked at the relationship between social interaction and communication technologies, but they have not examined the direction of ties within the social network. It could be said that all ties are not created equal; the impacts of those you go to for advice and those who come to you may be very different. Simply the existence of a tie may, in and of itself, not be enough to influence the perception of a new technology without understanding the nature of the tie. This study specifically looks at the relationship between perceptions of communication technology and social network measures of centrality in both advice-seeking and advice-giving networks and similarities between an actors perceptions and those with ties to that actor. Perceptions of a technologies usefulness and ease of use have been shown to directly impact use (Davis, 1989), making perceptions an important consideration. Understanding these relationships, especially the differences in directional ties, could provide insight into the adoption of many types of new technologies.

**Centrality**

Measures of an actor's importance or standing in a network are among the most important and frequently reported social network measures (Wasserman and Faust, 1994). These measures of centrality or prestige attempt to measure or describe an actor's location within a social network relative to other actors. Actors that are the most important or influential are usually located in strategic locations or have access to a wider variety of information (Burt, 1982). The three most common measures of centrality are degree, closeness, and betweenness centrality. These measures and their underlying computations and assumptions are compared and reviewed by Freeman (1979). This study will use degree centrality, which is the most widely used of the three measures. This measure looks at the number and weight of ties, essentially giving a measure of how many other actors the person has ties (Wasserman and Faust, 1994).

**Centrality and Perceptions**

New communication technologies supplement or replace some forms of interpersonal communication suggesting the importance of social context. Prior research studies have shown that communication technologies are most often used between individuals who already have ties (Rice, Grant, Schmitz, and Torobin, 1990). In a case study of a large consulting firm Orlikowski (1993) found that an implementation of Lotus Notes failed to generate new social interactions. The communication facilities present in the product were primarily used amongst people who interacted without the benefit of the new medium. Other researchers contend that new communication technologies provide new sources of information and interpersonal contacts. (Sproull and Kiesler, 1991) This difference suggests that different actors may have different evaluations and perceptions of information and communication technologies based on the amount of ties they already have. The relative value of these technologies may vary across positions within the social network with more connected individuals valuing network communication technologies more highly.

Those individuals who do not have many interpersonal relationships or are not well connected may also perceive communication technologies as less essential than individual with more ties. Fewer ties would indicate that less communication is necessary in order to maintain the ties. Also, as the number of ties increases, it becomes more likely that the actors to whom an individual is connected will not be collocated, which would increase the need for electronic communication, which does not rely on individuals being collocated. This would be expected especially when the ties being considered are advice ties. Also it is important to look at both incoming and outgoing advice networks. While it would be expected that central actors in both networks would perceive communications technologies as important, there could be distinct differences. The following two hypotheses will be tested:

**Hypothesis 1:** An individual's centrality in the outgoing advice (advice-seeking) network will be significantly positively correlated with that individual's perceptions the importance of computer communication networks.

**Hypothesis 2:** An individual's centrality in the incoming ties (advice-giving) network will be significantly positively correlated with that individual's perceptions the importance of computer communication networks.
**Social Influence**

Individuals' perceptions of the world are not based solely on personal observations. Rather, individuals develop their understanding of the world based on how they perceive the orientations of others around them and how they are oriented to those others (McLeod and Chaffee, 1973). People often seek the advice of others as a way of forming their own perceptions (Friedkin, 1991). In the course of communications about work related topics individuals become aware of what others think. According to social influence models the perceptions gathered from interaction with others help to form the individual's perceptions (Friedkin, 1991).

There are however, two types of relationships in an advice network: advice seeking and advice giving. These two types of relationships would be expected to have different impacts on the social influence towards an individual's perception. The people that an individual goes to for advice are already seen as experts, which would be expected to affect the amount of influence they can exert. Advice seekers, on the other hand, would not have the same influence on the people from whom they seek advice. While communication and a relationship are important, the direction of the tie should also play an important role. When people seek advice they are more likely to be influenced by the people providing that advice. The perceptions of people to whom an individual goes for advice would be expected to be similar to the individual's own perceptions because of the social influence advice-givers have through their advice ties. The following hypotheses will be tested:

**Hypothesis 3:** The perceptions of the actors that an individual goes to for advice will be correlated with the individual's perception of the importance of computer communication networks.

**Hypothesis 4:** The perceptions of the actors that come to an individual for advice will not be correlated with the individual's perception of the importance of computer communication networks.

**Network Data**

The dataset used for this research contains the work related advice network from a software consulting company. The entire dataset captures archival and longitudinal survey data gathered over a one year period from November 1994 – December 1995. The data used in this analysis consists of self-reported advice networks (incoming and outgoing) and survey data regarding perceptions of communication technology.

Three separate time points were collected of which only one (spring 1995) is used in this analysis. In total there are 127 people that worked for this company who were included on the survey at the three time periods. The time period used for this analysis consisted of 108 employees. All 108 employees in the organization were listed on the survey form and all 108 employees received the survey. A total of 80 employees returned the survey for a response rate of 74%. There were five respondents who were new to the company and had not been included on the list. While they could say that they communicated with others, others could not indicate that they communicated with them. These individuals were not included for a total of 75 useable responses. Employees not returning the survey were also not included in the network matrices used in the analysis meaning that some reported ties had to be excluded.

**Advice Networks**

Data on the advice networks in the organization was collected using roster questionnaires. Respondents were given a list of all the employees in the organization. They were then asked to indicate how often 1) the person comes to them for work-related advice and 2) how often they go to the person for work-related advice. Respondents could respond 1- at least once per month, 2- at least once per week, 3-at least once per day, or blank for individuals they did not interact with for advice. This procedure produced two valued network matrices for each time point, the incoming advice network and the outgoing advice networks.

The outgoing advice network indicates who members of the network report that they go to for work related advice. In this network matrix the value at $ij$ indicates that $i$ goes to $j$ for advice according to $i$. This can be viewed as the advice-seeking network. The incoming advice network indicates what persons the individual indicates as coming to them for advice. In this network matrix the value at $ij$ indicates that $j$ comes to $i$ for advice according to $i$. This network can be viewed as the advice-giving network.
In the advice-seeking network outdegree centrality represents how active the individual is in seeking advice as reported by that individual and indegree centrality for this network measure how many people seek advice from this individual as reported by the other actors in the network. In the advice-giving network outdegree centrality measures how much the actor's advice is sought according to the actor while indegree centrality measures how many actors say this actor comes to them for advice. Since this analysis is concerned with individual perceptions it is necessary to measure from the individuals perspective. It is not necessarily important that the measures are accurate or reflect the true number of ties, but that they reflect the individual's perception of their centrality in the network. In this study only outdegree measures are used.

Perception Measures

Respondents were asked to give their perceptions concerning computer communication technology within the organization. These assessments used seven point Likert scale measures indicating the extent to which respondents agreed/disagreed with statements about computer communication networks. The survey asked a total of 15 questions of which only 4 of these items were intended to measure the individual's perception of the importance of the technology. Other items covered how executive management viewed the technology and availability of resources, which while important, are not necessary to test the hypotheses of this study.

Table 1. Survey items used in current analysis

<table>
<thead>
<tr>
<th>Item 1</th>
<th>Computer communication networks will play an important part in the way &lt;this organization&gt; conducts business</th>
<th>.774</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 2</td>
<td>Using computer communication networks will have a significant positive impact on the way I do my job</td>
<td>.826</td>
</tr>
<tr>
<td>Item 3</td>
<td>Using computer communication networks will have significant positive impact on the way &lt;this organization&gt; conducts business</td>
<td>.783</td>
</tr>
<tr>
<td>Item 4</td>
<td>Information from computer communication networks will be an important part of my work</td>
<td>.848</td>
</tr>
</tbody>
</table>

In order to derive a single score for individual perception of email, a factor analysis was done on the data. This was done to make sure the 4 items of interest grouped as a single factor, which would allow these to be dealt with using a composite score. Table 1 shows the items of interest and demonstrates that these items load into one factor with loadings well above the typical .4 cutoff. The other items on the survey also loaded well into factors, although these are not used in this analysis and are not shown in the table. These 4 items indicate the respondent's perception of the importance of computer network communications. Since the items factored together they can be combined into an overall score by averaging the individual responses for the four items. The overall perception score will be used in subsequent analyses.

Analysis and Results

Social network measures used in these analyses were calculated using UCINET V.

Hypothesis 1 and 2

The analysis provides evidence that an actor's centrality influences their perception of computer-meditated communication depending on the nature of the tie. These results are shown in Table 2. Hypothesis 1 looks at the centrality in the advice-seeking network. The centrality measure for this network shows a significant correlation (r = .265, p = .022) to the overall perception score for computer communication networks offering support for Hypothesis 1. Hypothesis 2 looks at centrality in the advice-giving network, which is not significantly correlated (r= .192, p=.101) with the overall perception of the importance of computer communication network. While in the hypothesized direction, this fails to support Hypothesis 2. These results suggest that the number of people from whom individuals seek advice impact their perceptions of computer-mediated communication, but not how many people seek advice from that individual.
Table 2. Correlation for Degree Centrality Measures

<table>
<thead>
<tr>
<th>Perception of the importance of computer communication networks</th>
<th>Advice Seeking</th>
<th>Advice Giving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.265</td>
<td>.192</td>
</tr>
<tr>
<td></td>
<td>(.022)</td>
<td>(.101)</td>
</tr>
<tr>
<td>N=74</td>
<td>N=74</td>
<td></td>
</tr>
</tbody>
</table>

**Hypotheses 3 and 4**

These two hypotheses focus on the relationship between the perceptions of those actors an individual has contact with and that individual's perception. This is measured using the average perception score for all the individuals a person is connected to in the network. The average score ($s$) was calculated by dichotomizing both the outgoing and incoming ties networks and using the following calculation

$$s = \left( N \times a \right) / c$$

Where $N$ is the matrix of network ties, $a$ is a column vector of perception scores of everyone in the network, and $c$ is a column vector of the rowsums of the of the network matrix. This provides an average score of the other actors to which an actor is tied. This was done for both the incoming and outgoing advice networks.

Hypothesis 3 states that there will be a significant positive correlation between the perceptions of computer communication networks of those persons an individual goes to for advice and the individual's own perception. Table 3 shows that this hypothesis is supported. There is a significant correlation ($r = .281, p = .015$) between individual perception scores and the average perception scores of the actors to whom the individual has outgoing ties (advice seeking). This suggests that the people an individual goes to for work-related advice influences that individual's opinion about a technology.

Hypothesis 4 states that there will be no correlation between the perceptions of those actors who come to a specific individual for advice and that person's perceptions of communication technologies. The failure to find a significant relationship supports this hypothesis. The results of this test indicate that there is not a significant relationship between advice giving ties and a person's perceptions of communication technology, suggesting that those that come to an individual for advice do not influence a person's perceptions.

Table 3. Correlation Between Individual Perceptions and Average Perceptions of Connected Individuals inIncoming and Outgoing Advice Networks

<table>
<thead>
<tr>
<th>Perception of the importance of computer communication networks</th>
<th>Average perception</th>
<th>Average Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advice Seeking</td>
<td>.281</td>
<td>.176</td>
</tr>
<tr>
<td></td>
<td>(.015)</td>
<td>(.135)</td>
</tr>
<tr>
<td>N=74</td>
<td>N=74</td>
<td></td>
</tr>
</tbody>
</table>

**Summary of Analysis**

Three of the four hypotheses tested in the study were supported. A summary of the results is shown in Table 4. The results of this analysis suggest that ties different effects on perception depending on the direction of the tie. Advice-seeking ties have a significant effect on perception while advice-giving ties do not. This suggests that advice-givers or opinion-leaders have more influence on perception.

Table 4. Summary of Results

<table>
<thead>
<tr>
<th>Correlation</th>
<th>p-value</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis 1</td>
<td>.265</td>
<td>.022</td>
</tr>
<tr>
<td>Hypothesis 2</td>
<td>.192</td>
<td>.101</td>
</tr>
<tr>
<td>Hypothesis 3</td>
<td>.281</td>
<td>.015</td>
</tr>
<tr>
<td>Hypothesis 4</td>
<td>.176</td>
<td>.135</td>
</tr>
</tbody>
</table>
Limitations

While this study provides useful analysis of the impact of advice ties on the perception of technology, there are also several limitations that should be mentioned. This analysis looks at only one time period, which does not address the stability of the network over time. If the network itself is unstable analyses of different time periods might yield different results. A second limitation is that this looks at only one type of tie. Other ties such as friendship ties could have a significant impact on perceptions as could the overall level of communication although neither is measured here. The use of perceptions rather than actual use is also a limitation that should be addressed in further studies. These limitations do not necessarily take away from these results, but they do indicate that further research is necessary.

Discussion

New technologies can have an impact on the structure of social interactions within an organization. While this is a typical view of the impact of new technologies, the nature of the social network can also affect how new technologies are perceived and ultimately whether or not they are used. One way that the social network can influence the adoption of new technologies is through the influence that social actors have on each other's perceptions of the technology. This is in line with the social influence perspective that exists in organizational studies. The social interactions that a person has influences how they obtain information and directly impacts their perceptions.

One important factor that has not been previously studied is how the direction of ties changes the social influence exerted on an individual's perception. This study demonstrates incoming and outgoing ties have different effects on an individual's perception of a technology. The people from whom an individual seeks advice have a significant impact on perceptions of the technology, while those that come to the individual for advice do not. This seems to make intuitive sense, but it has not been the focus of studies on communication technologies. When a person seeks advice they are receptive to influence, but when they give advice they would not necessarily be receptive to the views of the asking party.

Understanding what types of ties have the most influence can help to focus studies of technology usage in organizations. This of course requires that organizations know more about the social interaction that take place, but it can have significant benefits. Prior technology adoption research looking at social influence has not examined incoming and outgoing ties separately. This study suggests differences in the direction of ties must be taken into account. This could influence strategies that organizations use when trying to introduce new technologies. If advice-givers accept a new technology than those they interact with will have a more positive perception of the technology increasing the level of adoption and usage. In terms for future research, future studies of technology adoption should consider the direction of ties instead of just whether or not a tie exists.

While these results may only confirm practitioners' beliefs, the results have direct practical implications concerning how new technologies should be introduced. When introducing new technologies organizations should identify the advice givers and try to influence these individuals' perceptions. This advice is slightly different than just looking for central individuals. All types of centrality are not necessarily the same. Just being socially active does not necessarily mean an individual is an opinion leader. Differentiating between advice seekers and advice givers could impact the success of new technology implementations.

References


