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DISAGGREGATED EFFECTS OF COMPUTER MEDIATED COMMUNICATION USAGE PATTERNS ON SOCIAL NETWORKS

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Abstract

Various studies have reported that computer-mediated communication (CMC) increases, decreases and has no effect on social capital. These conflicting outcomes of CMC on social ties resulted in a rich debate. However, the core question remains unanswered - how does usage of CMC disrupt relationships and make individuals isolated but at the same time function as a channel for creating new and enduring social ties within and across the populations? We measure CMC usage for learning activities, leisure and socializing communications, and entertainment purpose. We find that those who use CMC more for entertainment have less developed social networks irrespective of the contexts we studied. Those who use CMC for leisure and socializing communication have well developed broader social networks and close friendships networks but less developed work networks. Finally, those who use CMC more for learning activities are more central in work networks but less central in broader social networks and close friendship networks.

Introduction

The nature of social interactions has been altered by the broad diffusion and acceptance of communications technologies. Indeed, computer mediated communication (CMC) has become a rich field of research within the broad agenda of information systems researchers. Concurrently, organizational theorists have been concerned with social interactions as the foundation of the development of social networks – structures which confer particular kinds of resources and assistance to individuals. We all are members of various types of social networks – friends, family and advice networks – to name a few. Within each context occupying structurally advantageous positions is extremely valuable to individuals because it provides benefits such as control of unique information, valuable emotional support, and/or early promotion opportunities at work (refer to Brass et al., 2004 for a review). Structurally advantageous positions are generally defined in terms of specific characteristics of the social networks that they belong to and these positions are achieved through multiple and diverse social interactions with others. Therefore, understanding these social interactions particularly as they are now frequently mediated by technologies can provide valuable insight to both research and practice.

To date research on the effects of CMC[1] use to support social interactions within a social network has produced mixed findings. Various studies have reported that CMC use increases, decreases and has no effect on an individual's number of social ties (refer to Wellman et al., 2001 for a review). Interestingly, studies carried out by the same team of investigators using the same data and, similar designs and measures also led to conflicting results (Kraut et al., 2002a; Kraut et al., 1998). These conflicting outcomes of CMC use have resulted in a rich debate about the nature of CMC effects on social interactions and the consequences this has for social networks and there benefits to individual members. Many questions remained unanswered: for example - How does a medium created to facilitate interactions end up increasing isolation or how does the use of CMC tools, claimed to disrupt relationships and make individuals isolated, also function as channels for creating new and enduring social ties within and across communities? This debate has resurfaced recently with a finding that the average number of close ties an individual maintains has decreased from 3 to 2 in past twenty years (McPherson et al., 2006) as higher use of CMC reduces the time one spend with friends and family (Nie et al., 2005), thus leading to shrinkage in social networks of close ties (McPherson et al., 2006). Paradoxically, Boase et al (2006) provides evidence that CMC is actually helping people maintain their social networks and create networks across communities and geography (also refer to Plickert et al., 2007; Wellman et al., 2006).

Various aspects of CMC have been researched in the IS field and there is a recent impetus towards integrating findings in social network studies with various IS theories. This provides a unique opportunity to integrate our rich understanding of CMC usage impact on social interactions with the growing stream of social network research. This crossing of boundaries between the fields of technology use and social networks will enable the organizational theory field to develop greater understanding of widely diffused CMC technologies and individual use patterns while also deepening the IS fields' understanding and use of the theory and methods of social networks analysis. In our review of these two literatures, we believe that the conflicting results outlined can be accounted for by three factors. The first is measurement issues associated with how organizational theorists conceptualize CMC usage. Most studies measure CMC usage either as a dichotomous variable - users versus non-users (e.g., Nie et al., 2005) or as total duration of use (e.g., Kraut et al., 2002a; Kraut et al., 1998). We argue that

[1] The term computer mediated communication (CMC) is used here in broad sense to include all the activities one performs using computer which requires some form of connectivity either Internet or Intranet. CMC usage here includes use of e-mail, Web surfing etc. The activities included are covered in a separate section.

both conceptualizations neglect important insight about the nature of the activities that individuals undertake with such technology. For example, someone who uses CMC (say the Internet) for the purpose of entertainment (gaming) will not have same effects on his/ her social ties as someone who uses it for social activities (such as Facebook). Some scholars have taken a step further and measured the use of different kinds of technologies such as email, World Wide Web and many-to-many communication tools (newsroom, bulletin boards etc) (e.g., Zhao, 2006). While this is a good first step and helps us understand individuals' usage of different technologies, this still does not provide sufficient information on the effect CMC use has on social networks because the same technology if classified as the World Wide Web could be used quite differently. At one extreme, it could be used purely for entertainment such as downloading music or watching a video clip. On the other extreme, it could be for extensive social exchanges through websites like Facebook, Linkedin or MySpace. Thus, classifying the CMC usage by technologies does not entirely address the measurement issue of understanding user's actual CMC related activities.

Second, there is another measurement issue with respect to aggregation of the types of social interactions in which an individual engages. Most studies ask for the number of other people (ties) that someone interacts with rather than specifying the reason the individual interacts with these other people. A person may interact with a contact for job related issues, with another contact for leisure activities, and with others for emotional needs. We argue that CMC usage will have differential effects on the creation and maintenance of ties for these different purposes. For example, it can be argued that use of CMC for social activities such as chatting and Facebooking, may not have much an impact on number of ties in advice networks where as use of CMC for work related interactions will probably bear no effect on number of social ties.

Third, most of these studies do not control for the known antecedents of social networks such as personality traits, gender, and ethnicity. Thus, there is potential that the relationships that have been found in some of the past studies may be spurious or may be due to specification bias.

In this paper, we attempt to address these disparate results by investigating CMC usage patterns and the social interaction purposes instead of traditional aggregate use and aggregate interaction measures. Our goals are to: 1) disaggregate the effects of CMC usage patterns on social network attributes and 2) disentangle how the use of CMC in different social interaction contexts by the same individual can result in different social network positions and hence advantages for that same person in their different networks. Achieving these goals will provide

significant insight to future researchers because this will indicate that there is no universally positive or negative effect of use of CMC in all contexts and for all types of usage.

Using a group of students recently enrolled in a professional degree program, we measure their CMC usage for: 1) learning activities and learning communications; 2) leisure and socializing communications; and 3) entertainment purposes (gaming, music/video downloads etc). Also, we identify three different types of social networks that individual's belong to: 1) their close friendship network; 2) their broader social network and 3) their work (in this research their school/course work) network. We then estimate the effect of usage patterns on various attributes of each network type using measures of network size (such as indegree, outdegree), betweenness centrality and aggregate constraints. We control for individual personality traits (self-monitoring behavior, extraversion), gender, and ethnicity.

In the next section we build our hypotheses based on existing literature and theoretical arguments which we build from integrating research in the field of computer mediated communication with social networks research. This is followed by a section describing our research methodology, data analysis and results. In the final section we discuss implications of our findings and some directions for future research.

Social Network Theory, Research Model and Hypotheses

Social Networks

Social networks are patterns of interactions or connections that exist amongst a group of individuals. Individuals' locations in a structure of relationships create opportunities or advantages and improve their performance because "they are somehow better connected with other people" (Burt, 2005, p 4). The network of relationships can be understood in terms of the number of ties (commonly measured as indegree or outdegree) and the configuration of ties (centrality and aggregate constraints) which are discussed in more detail below. In an asymmetric network[2], indegree refers to number of ties that are pointed towards an ego (focal individual) and outdegree refers to number of ties that emerge from an ego. For example, in a close friendship networks, indegree would mean number of individuals who nominated ego as a close friend where as outdegree would mean number of

individuals whom ego has nominated as his/her close friends and therefore these are the two common measures of network size in this context. The configuration of ties can be measured in many ways: the two most popular and commonly used measure of configuration is betweenness centrality and aggregate constraints (Brass, 1984; Mehra et al., 2001; Nooy et al., 2005). The ability to exploit structural holes (Burt, 1992b) is sometimes measured as the reciprocal of aggregate constraints on an individual (Nooy et al., 2005).

Social network ties or connections are created, maintained, and developed through a series of interactions and communications between the ego and alters. In today's interconnected world, these interactions or communications can take place in various ways including, but not limited to, face-to-face (FTF), telephone, emails, online chat, web-posting, web-casts, or offline messages. As individuals interact in an organizational context, they often use a variety of communication strategies and tools to create, sustain, and develop social networks. This is because an individual's relative position (in terms of time, place, hierarchy, and social standing), their access to communication channels, and the type of message they want to deliver varies.

Social networks supported by CMC enable local and non-collocated individuals to interact synchronously or asynchronously (Kiesler and Sproull, 1992a). CMC supports the social network because it overcomes the barriers of homophily, proximity and temporality. Various structural attributes and the effects of CMC use are discussed below.

Network size

Network size is one of the most important characteristics of social networks. The benefits that accrue from social networks are a function of the size of the network and the volume of resources possessed by networked individuals (White, 2002a). The general understanding in the literature on social networks is that the more people (alters) an ego has in his/her network, the greater the chance that one of the alters has a resource the ego needs (Uzzi, 1996). Thus, network size is an indicator of potential material, informational, and emotional benefits (Lin, 1999a). Similarly, network size has been shown to be related to the performance of individuals in the network (Totterdell et al., 2004). However, in face-to-face (FTF) interaction, the constraints of having to be in the same time and same place in order to interact limit the size of social networks. It is much easier to maintain larger social

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[2] *Asymmetric networks are also referred to as directed networks. In these type of networks A's relationship with B may not*

networks when they are supported by CMC (Wellman et al., 1996). This is because CMC overcomes some of the limitations of FTF interactions, such as the need for proximity and temporality. This effect holds for both those individuals who nominate the central individual (ego) as a close tie (indegree size measures) or for the individual (ego) who nominates others as close ties (outdegree size measures).

Aggregate constraints

Patterns of connections create possibilities for brokerage (Burt, 2005). A situation of brokerage exists when there are structural holes in the ego's network ties. A structural hole is an incidence of lack of network ties between two groups of people in a network (for example). An individual (ego) whose has ties between both groups then spans the hole. The advantage to an ego from the presence of structural holes in his/ her ego-centric network arises because of the possibilities that they could receive non-redundant information and novel ideas from unconnected parts of their networks and from the ability to use the non-connection between others to their own advantage. The incidence of structural holes has been associated with promotion (Burt, 1992b), satisfaction (Seibert et al., 2001), performance (Lazega, 1999) and creative ideas (Burt, 2004) for the individual (ego). Structural holes can be measured in terms of the reciprocal of aggregate constraint i.e. low aggregate constraint indicates high incidence of structural holes. What this means is that the higher the aggregate constraint, the less freedom a person has to withdraw from existing ties without incurring losses on account of others being able to exploit the structural hole thus created. Therefore, aggregate constraint is inversely related to the ability and value which come from exploiting structural holes. High aggregate constraints on an individual indicate that there are very few structural holes available to him/her and hence less possibility of brokerage (Burt, 2005; Nooy et al., 2005). Social interactions that occur in physical settings tend to create dense ties, that is 'alters' of an ego tend to know each other as they interact in physical settings. On the other hand, if the ego typically communicates with his/her alters through CMC, then in comparison to face-to-face, there is a higher probably that at least some of those alters will not know each other, resulting in lower aggregate constraints on the ego, thus more chance for brokerage and the advantage that arise from it.

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necessarily indicate B's relationship with A.

Centrality

Betweenness refers to the extent to which a node falls between pairs of other nodes on the shortest path connecting them. An ego who is in a position of high betweenness can be a major channel of information. In other words, when a person is strategically located on the communication paths linking pairs of others, they are central in terms of betweenness. This individual can influence the ego-centric network by withholding or distorting information in transmission (Freeman, 1979). Such nodes facilitate communication and coordinate activities over the network (Ibarra, 1993a). Thus, high centrality has many benefits for the ego. Higher centrality provides the ego with more information more quickly, compared to alters who are at the periphery and lack betweenness (or who at least have less betweenness than the ego) (Ibarra, 1993a). The higher the betweenness centrality of the ego compared with alters in the ego-centric network, the higher the benefits to the ego. When most of the interaction takes place in through CMC, the individual who uses CMC for creating and maintaining ties will be become more central and his/her betweenness centrality with be higher.

Effect of CMC usage patterns

As noted earlier there are disparate views about the effects of CMC use on social interactions. These views spread across social, political, psychological and organizational spheres and manifest themselves in claims that CMC has potential to change social interactions, politics, communities, or society (Boase et al., 2006; Graf and Darr, 2004; Kavanaugh et al., 2005; Uslaner, 2004; Wellman et al., 2006). Those who see communication technology as facilitator of social interactions argue that CMC use will result in larger social networks (more ties), provide access to non-redundant resources and will create networked society (e.g., Boase et al., 2006). On the other hand, those who see communication technology as a time sink (Wallace, 1999) provide a dark side of CMC usage and argue that more time spent online, results in self-absorption and isolation (Kraut et al., 1998; Nie and Erbring, 2002) and leads to decrease in number of social ties (Nie et al., 2005). Thus, "utopians have claimed that the Internet provides new and better ways of communication, whereas dystopians have argued that the Internet takes people away from their communities and families" (Wellman et al., 2001, p 437). In this paper, we argue that the effect of CMC usage on number of social ties and other aspects of social interactions depends on the context of interactions and purpose for which CMC is used. For example, one might use CMC for long hours and use it exclusively for gaming and other entertainment activities such as downloading music, watching movies etc. In this case we would expect that higher

use of CMC might lead to reduction in social interaction. On the other hand an individual might use CMC for communicating with his/ her friends, family members and even strangers. In this case CMC will help create new ties and maintain existing ones.

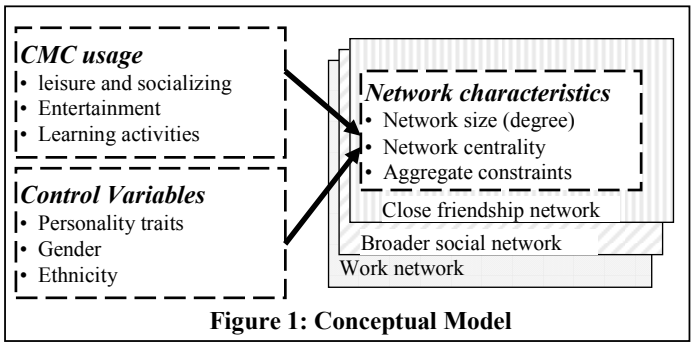

Figure 1: Conceptual Model

The conceptual model guiding our research model is presented in Figure 1. In the interest of space, we portray our model broadly rather than drawing in each relationship. We provide detailed hypotheses below. We identify three type of CMC usage: leisure and socializing use, entertainment use and work use (in our context - school activities). We also identify three types of networks: close friendship network, broader social network and work network (classmates). We present our hypotheses in the context of each of these networks.

Close Friendship Networks

Numerous studies have documented the importance of friendship ties in social and organizational settings (Gibbons, 2004; Gibbons and Olk, 2003; Kilduff, 1992; Klein et al., 2004; Krackhardt and Kilduff, 1990; Lincoln and Miller, 1979; Marsden, 1987; McPherson et al., 2006). Close friendship ties are characterized by high frequency of interactions and multiplexity and are helpful in various outcomes such as emotional support, financial support, and resource exchanges. However, maintaining close friendship ties in face to face situations requires high temporal and spatial commitments and thus limits the number of close ties one can maintain. We theorize that when individuals use CMC for maintaining close friendship ties some of these time investment restrictions are not present. Moreover, social interactions that are supported by CMC usage do not take place in physical setting and there is lower possibility that the alters of an ego will know each other through serendipitous or other collocated interactions. Further, CMC enabled social interactions are not observable by others in the ego's network and therefore there is a possibility of high betweenness centrality and lower aggregate constraints when CMC usage for social interactions is high. Therefore,

H1: Higher use of CMC for leisure and socializing purpose will be associated with a) larger number of ties, b) higher betweenness centrality, and c) higher incidence of structural holes in close friendship networks.

When individuals spend more time on CMC usage for work (course) related activities or entertainment activities then we argue that the time they expend to do that will come out of either face-to-face or online socializing activities resulting in lower network attributes. Therefore,

H2: Higher use of CMC for work activities will be associated with lower a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in close friendship networks.

H3: Higher use of CMC for entertainment activities will be associated with lower a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in close friendship networks.

Broader Social Networks

Broad social networks are formed primarily for the purpose of organizing social events, partying, and sharing lighter moments; however, they may also help in reducing stress and depression (Henderson, 1981). Unlike close friendship networks, strong ties are not the essential feature of these networks. Since broad social networks are formed to stimulate an array of activities such as getting out and mingling with many others, CMC usage for leisure and socializing communications will be positively associated with network attributes for this type of network. Thus,

H4: Higher use of CMC for leisure and socializing communications will be associated with higher a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in broad social networks.

As argued before, when individuals spend more time on CMC usage for work (course) related activities or entertainment activities then that time will come out of either face-to-face or online socializing activities resulting in lower network attributes. Therefore,

H5: Higher use of CMC for learning activities and communications will be associated with lower a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in broad social networks.

H6: Higher use of CMC for entertainment activities will be associated with lower a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in broad social networks.

Work Networks

Work related networks are the patterns of interactions pertaining to learning activities and learning communications. In our research setting – a university program - students interact with and help each other on issues such as information exchange and problem solving and advice related to their courses. Those who use CMC for learning activities and communications related information search and interaction will have more ties, a central position in work networks and will have a higher incidence of structural holes to broker. Thus,

H7: Higher use of CMC for learning activities and learning communications will be associated with higher a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in work networks.

When individuals spend more time on CMC usage for leisure and socializing activities or entertainment activities then that time may come out of course related activities resulting in lower network attributes. Therefore,

H8: Higher use of CMC for leisure and socializing communication will be associated with lower a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in work networks.

H9: Higher use of CMC for entertainment activities will be associated with lower a) in-degree centrality, b) out-degree centrality, c) betweenness centrality, and d) incidence of structural holes in work networks.

Control variables

Homophily (i.e. similarity in visible attributes such as gender, ethnicity and culture) has been identified as antecedent to formation of friendship networks (Gibbons and Olk, 2003; Ibarra, 1992; McPherson et al., 2001). The 'homophily' argument suggests that 'birds-of-a-feather-flock-together' (Ibarra, 1992; McPherson and Smith-Lovin, 1987; McPherson et al., 2001; Ruef et al., 2003) and it create social networks that are cohesive (Reagans and Zuckerman, 2001; Yu, 2002). Homogeneous ego-centric networks are easier to form, less costly to maintain and more harmonious (McPherson et al., 2001). Therefore, gender and ethnicity were used as control variables[3].

The extant literature on social networks identifies self-monitoring behaviors (Mehra et al., 2001) and extraversion (Klein et al., 2004) as important individual attributes that determine individuals' relative positions in

social networks. For example high self-monitoring was found to be associated with high betweenness centrality (Mehra et al., 2001). Self monitoring involves "active construction of public selves to achieve social ends" (Gangestad and Snyder, 2000, p 546) and those low on it find it difficult to be the centre of attraction and hence have low betweenness centrality. Similarly, extroversion was found to be associated with in-degree centrality in advice and friendship networks (Klein et al., 2004). Thus, we also used self-monitoring behavior and extraversion as control variables in this study.

Research Method

Data on social networks, CMC usage patterns, and demographics were collected from the cohort of 300 students entering the same undergraduate honors business program[4]. Data were collected approximately 4 months after the students had entered the program to allow participants time to start to build their social networks. The members of the population were very nearly the same age (20-22), and the selectivity of the honors program meant that all individuals in this population were of high intellectual ability. Because they had all chosen the same program, many differences in preferences were reduced among this group as well. For these reasons, the effects observed for the variables of interest to the study, namely personality traits, minority status, and internet usage patterns are very unlikely to be confounded by individual differences such as work experience, ability or occupational choice. The response rate was 70.7% i.e. 212 out of 300 students provided usable data for the analysis through an online social network survey. Network data based on much less than 70% of the population is considered to be unreliable. Thus, we had adequate response rate to make reliable network related inferences.

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[3] There was not much variation in age of the participants and hence age was not used as control variable to avoid problems arising out of restricted range.

[4] The program in question is a "2+2" design, thus the entering students were in their third year of university study. Each student is assigned to a section of 75 on entry in to the program, and they take all of their classes with their section. The students tend to interact most strongly with students in their own section.

Measures

Network data were collected following the roster method (Scott, 1992; Wasserman and Faust, 1997). The students were provided with the names of all of their counterparts and asked to indicate their close friends, the individuals with whom they interact for social leisure activities, and the individuals with whom they interact for work (course related) activities. To maximize reliability of our network measures and at the same time minimize participant fatigue, we asked students to respond to the network item ("close friend," "friend," or "don't know this person well")[5] for all 75 members of their same section, and then to choose up to 30 people from the complete listings of the other three sections and answer the friendship question about them. Providing a complete list of participants to respondents (i.e. roster method of data collection) is considered to be a more reliable method of network data collection than simple name generator techniques (Nooy et al., 2005; Scott, 1992; Wasserman and Faust, 1997). Demographics (gender, coded 0=female, 1=male; and visible minority status, coded 1=minority, 0=White), and personality traits measures were also obtained from survey responses. To capture this differentiated usage of CMC, we measured CMC usage pattern as number of hours per week invested in following activities: a) leisure and socializing (e-mails/offline messages/ chatting for purposes of socializing, playing online games with friends or acquaintances, etc.); b) entertainment (listening/ downloading music, gaming or with unknown people, watching movies/documentaries that are not for academic purposes, etc.); and c) work (course) related activities (information search, e-mail interaction, etc.). The survey questions asked for CMC usage is presented in the Appendix-1. The network attributes, indegree, outdegree, betweennees centrality, and aggregate constraints, for each of three networks (close friendship, socializing activities and course related activities) were calculated using UCINET 6.139 and Pajek software. Correlation matrix of the variables of interest is presented in the Appendix-2.

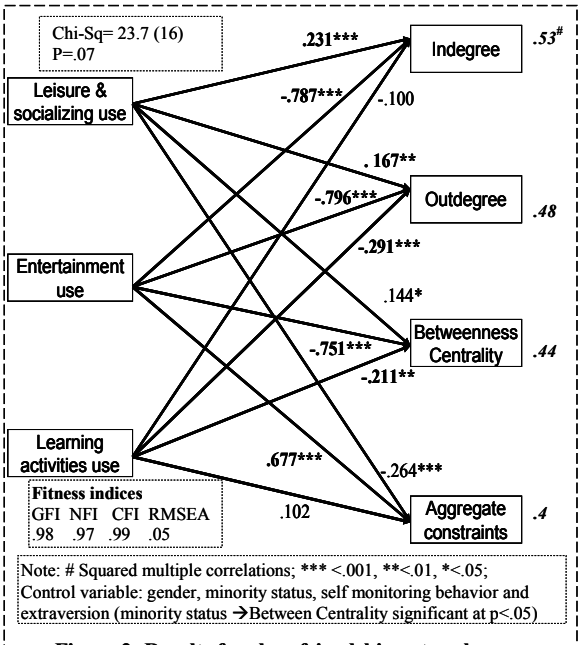

Figure 2: Results for close friendship network

Data Analysis and Results

As the research model contained multiple dependent variables, we decided to use structural equation modeling instead of multiple regression (Gefen et al., 2000; Kline, 2005)[6], even though most of the constructs in our model were single indicator[7]. Three different structural equation models were estimated, one each for close friendship networks, broader social networks and work networks. The results are presented in Figure 2, Figure 3 and Figure 4 respectively.

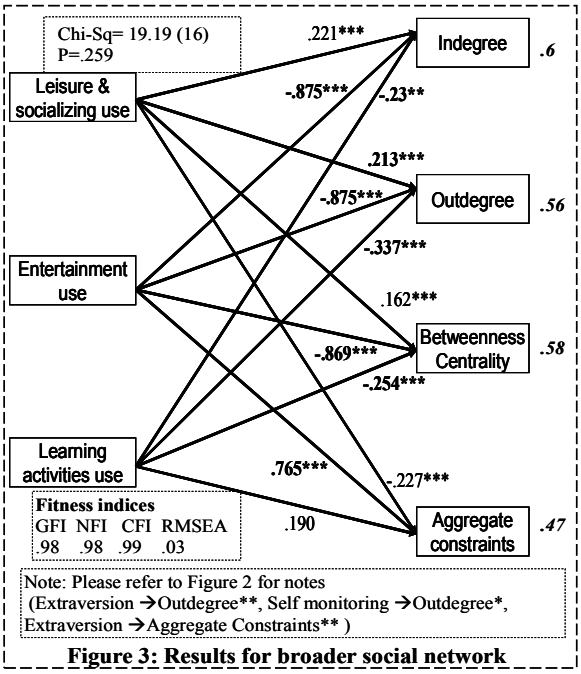

Figure 3: Results for broader social network

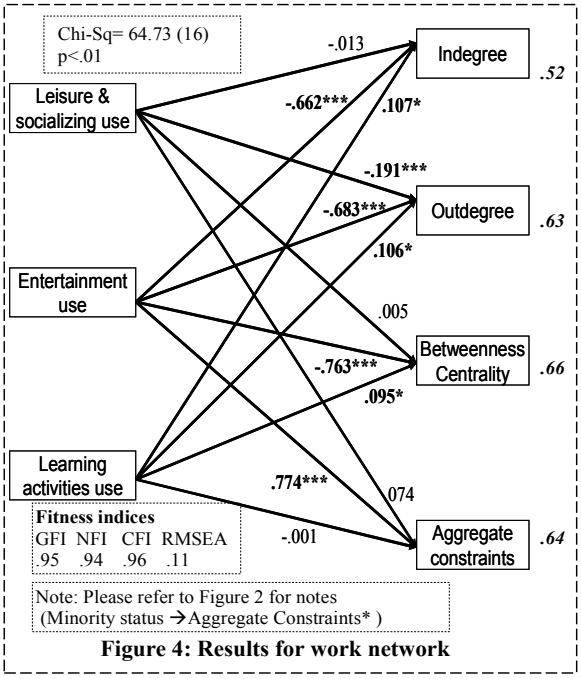

Figure 4: Results for work network

Close Friendship Network

The model proposed for close friendship networks yields fitness indices better than recommended levels i.e. >.95 for GFI, CFI and NFI, and < .06 for RMSEA (Hu and Bentler, 1999; Kline, 1998; Schumacker and Lomax, 2004) . Thus, this model fits the data reasonably well. Moreover squared multiple correlations (which are sometimes used as equivalent of R-square) are reasonably high, indicating that CMC usage patterns explain the variance in networks characteristics. All the hypotheses except H2a and H2d are

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[5] Network items for leisure activities and course related activities had six responses (1-Never, 2-Once in a month, 3-Once in a week, 4-Couple of times in a week, 5-Once in a day, 6-Several times in a day)

[6] We separately analyzed the data with multiple regression and found that similar results are obtained.

[7] Control variable self-monitoring behavior and extraversion were measured using multiple items, however, Cronbach's alpha for both of these constructs was greater than .85 justifying creation of index. Moreover, none of these two constructs was of primary interest in this study hence in interest of uniformity (as other variables were single item) these two construct were also reduced to single item through calculation of index.

supported (Figure 2). It should be noted that the negative relationship between the antecedent (socializing usage) and aggregate constraints indicates a positive relationship between the antecedent and the incidence of structural holes.

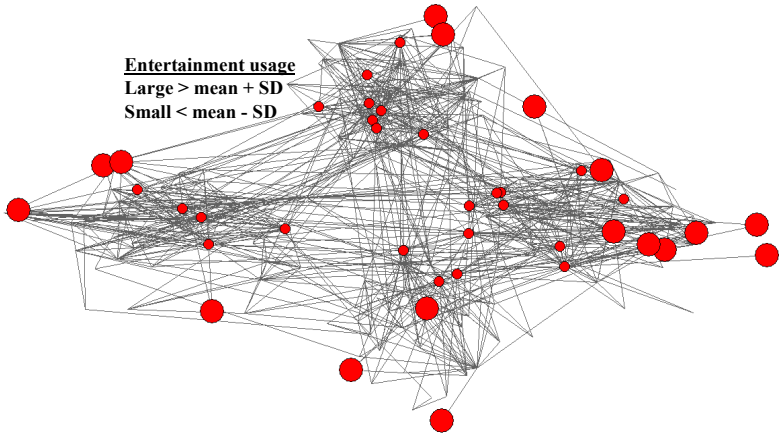

Figure 5: Effect of entertainment use on close friendship network

Broader Social Network

The model proposed for broad social networks also yielded fitness indices better than recommended levels. Thus, this model also fit the data reasonably well. Moreover, squared multiple correlations are reasonably high, which indicates that CMC usage patterns explain the variance in networks characteristics. All the hypotheses are supported (Figure 3).

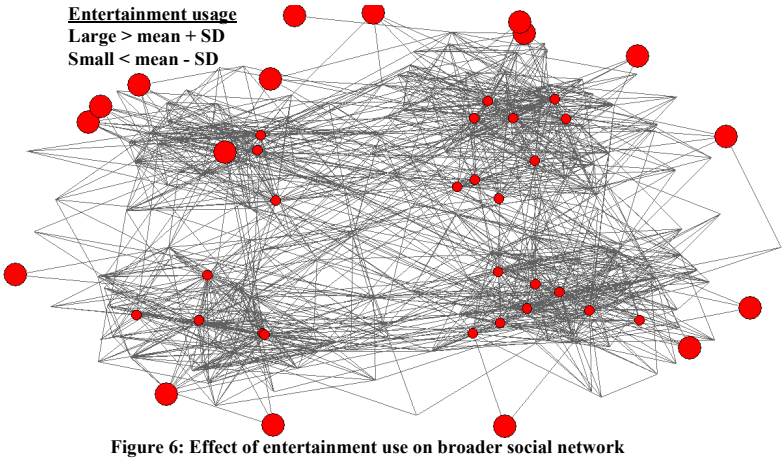

Figure 6: Effect of entertainment use on broader social network

Work Network

The model proposed for work networks has GFI and CFI above recommended levels and NFI (.94) very close to recommended cutoff. The RMSEA (.11) fit is poorer than recommended level (<.08). Thus, this model has only moderate fit with data. However, squared multiple correlations are reasonably high which indicates that

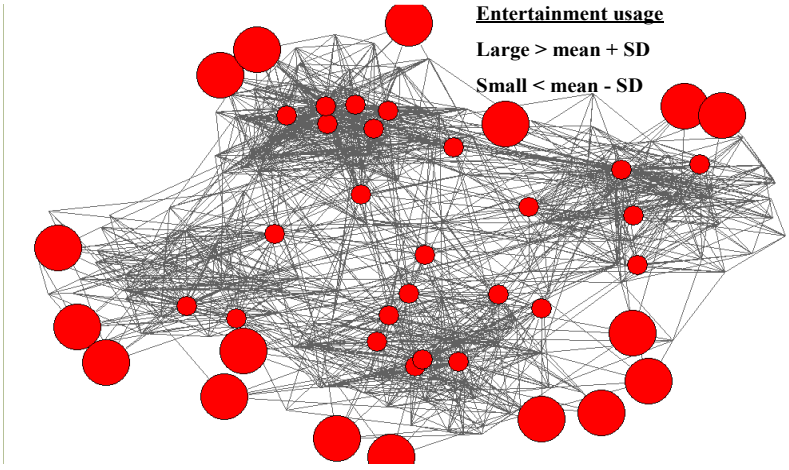

Figure 7: Effect of entertainment use on work network

CMC usage patterns explain the variance in networks characteristics. All the hypotheses, except H7d, H8a, H8c and H8d are supported (Figure 4).

Discussion

The growing usage of CMC by individuals is neither inherently beneficial nor detrimental to an individual's social interactions. Instead, the consequence of individual's CMC usage depends on the context of the network (work related, close friendship and broader social network). Our results reveal the complexity associated with increasing use of CMC enabled social interactions. In order to understand the effect of CMC usage, it is important to capture the pattern of CMC usage. Increasing CMC usage for entertainment activities is not the same as that for socializing activities. The disaggregated analysis of social networks and CMC usage provides more nuanced understanding about effects of CMC usage on social networks. CMC neither increases nor decreases social ties universally but the effect depends on the purpose for which CMC is used as well on the objective for which social network is created.

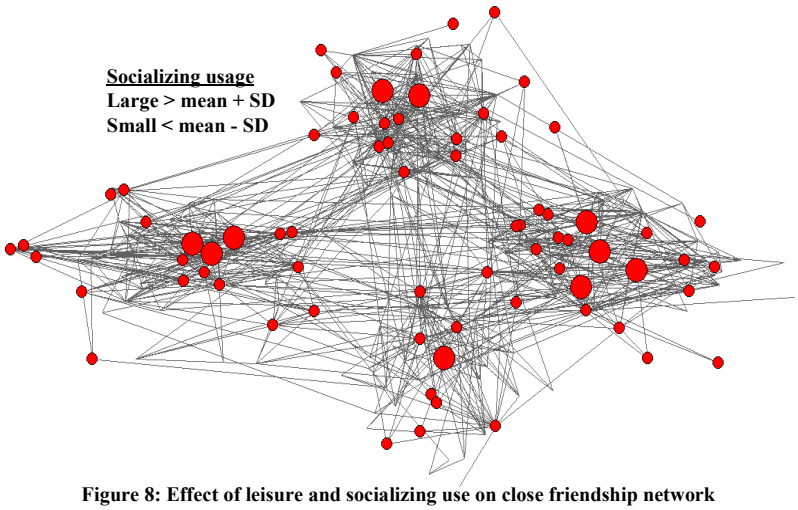

Figure 8: Effect of leisure and socializing use on close friendship network

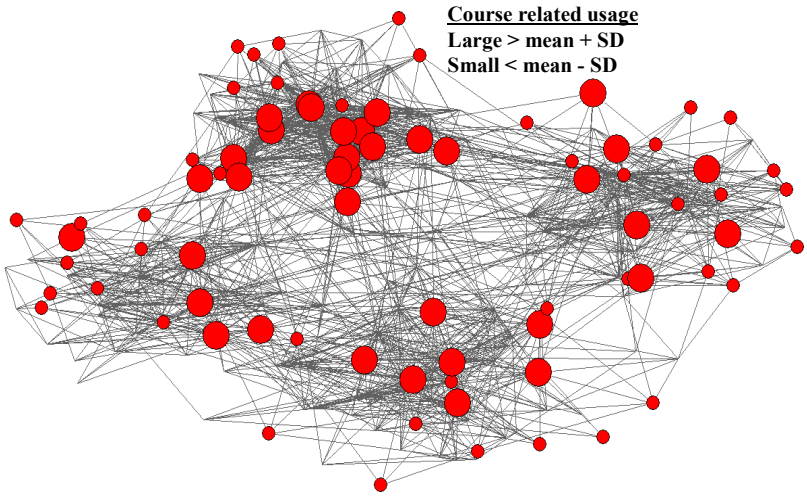

Figure 9: Effect learning activities use on work network

One important finding of this research is that individuals with high entertainment usage are isolated or confined to the periphery irrespective of the type of networks studied. Figure 5, Figure 6 and Figure 7 present network visualization for close friendship, broad social and work networks respectively. The larger circles represent

the individuals whose entertainment usage is higher than one standard deviation above the mean whereas small circles represent individuals whose entertainment usage is lower than one standard deviation below the mean. Across the board, high entertainment users have few ties; they are dependent on other for information; and since they are linked to each of their networks through only a few individuals, there is very high aggregate constraints on them as they can not afford to sever these ties without incurring huge losses in terms of lack of connectivity to rest of the networks. Those who are higher users (mean + SD) of CMC for entertainment purpose on an average consider 1.03 individuals as their close friends where as those who are lower CMC entertainment users (mean - SD) consider 15.11 individuals are their close friends. These numbers are comparable with those for broader social networks and course related networks. Similarly, there are 3-4 times higher aggregate constraints on the individuals with high entertainment usage indicating they have only 25 to 33 percent opportunity of exploiting structural holes compare to those who are lower users of CMC for entertainment.

In contrast those who use CMC for leisure and socializing purpose are central in the close friendship networks (Figure 8). They have higher indegree and outdegree, and lower aggregate constraints which indicate they have higher opportunity of exploiting structural holes. However, difference between low user and high users is not as high as in case of entertainment[8].

Figure 9 depicts the difference between high and low learning activities usage. Those who use CMC for learning activities and learning communications are central in work networks. On an average 12.7 individuals contact those whose CMC usage for learning activities are higher compare to 7.5 individuals who contact those whose CMC usage for learning activities is low[9].

The above findings have important implications for research on the impact of CMC use on social interactions. It is essential to differentiate between different types of use such as leisure and social communications, learning activities and learning communications use and entertainment use of CMC technologies in order to effectively detect and interpret the effects of CMC use on various social networks. While social activities and work related activities have positive effects on some aspects of social (or work related) networks, entertainment activities

[8] Diagrams for leisure/socializing CMC use on work and broader social networks followed similar patterns but were less polarized.

[9] Diagram for learning activities CMC use on close friends networks and broader social networks followed similar patterns but were less polarized.

have negative effects on all social networks. Thus, studies that have tried to capture the effect of net CMC usage might have missed these differentiated aspects and hence this would explain why there are so many conflicting findings. Our findings suggest that the relationship between CMC usage and social network attributes is positive if online time is spent on socializing, however, it may be negative if that time is spent on entertainment. Thus, it is important to take into account the duration and type of usage as well as context of social networks.

Limitations and Future Research

The current study was conducted in the university environment where students knew each other and anonymity is not salient. Such a situation will be similar to organizational setting but may not be generalizable to virtual communities where anonymity might play an important role. Secondly, the age of participants, their education background and career orientations were very similar. Although this setup provides good 'experimental' controls, it also restricts generalizability to other groups. Thirdly, the group selected represents a generation that has grown up with the Internet (CMC). For them, the Internet is just another aspect of life; however, it might be quite different for the older generation or individuals in different locations where the Internet is not as common. The setting chosen for this study represents conservative setting where we did not expect lot of variation in the individuals' CMC usage patterns; however, we did found support for most of our hypothesis. We expect these results to be more pronounced where there are large variations in the individuals' CMC usage. Finally, this study was a cross-sectional study. Such a study may claim associational relationships; it is difficult to establish the causal relationships. Future researcher should use this disaggregated operationalization of CMC usage to conduct longitudinal studies to establish the causal relationship.

In conclusion, this study discovers a relationship between what individuals' use the CMC for and the attributes of social networks that those individuals develop. This relationship is contigent on the types of social network sought to be created. In general, individuals who spend lots of time using CMC in the ways that do not involve interacting with other people wind up with poorly developed networks in which they are relatively isolated socially. This study argues that differences in the kinds of CMC usage are responsible for prvious conflicting results regarding effects of CMC on social ties.

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Appendix -1: Questions on CMC usage

On average, how frequently do you use the internet (including email)?

☐ A few times a week ☐ About once a day ☐ Twice a day ☐ Several times a day ☐ Mostly online ☐ Always online

In a typical week, how much do you use the Internet (in hours and minutes)for the following activities (please include your ezone activities if they are relevant)

	Hours	Minutes
Socializing usage: Socializing (e-mails/offline messages/ chatting for purposes of socializing, playing online games with friends or acquaintances, etc.)		
Entertainment usage: Entertainment (listening/ downloading music, gaming solo or with unknown people, watching movies/documentaries that are not for academic purposes, etc.)		
Learning usage: Course related activities (information search, e-mail interaction, etc.)		
Career related usage: Career related information search (job search, e-mail communication for career related queries, information about potential employer, etc.)		
Other usage: General surfing and other activities (online shopping, product search, etc.)		

Appendix 2: Correlation matrix

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1) SU	715	207														
2) EU	472	161	0.22**													
3) LU	696	323	0.18**	-0.39**												
4) ID_CF	5.73	3.22	0.03	-0.69**	0.27**											
5) OD_CF	7.84	6.98	-0.08	-0.64**	0.08	0.43**										
6) BC_CF	0.0075	0.0095	-0.08	-0.63**	0.14*	0.64**	0.79**									
7) AC_CF	0.2157	0.1561	-0.09	0.58**	-0.19**	-0.54**	-0.56**	-0.48**								
8) ID_BSN	8.87	4.12	-0.01	-0.73**	0.16*	0.77**	0.43**	0.53**	-0.50**							
9) OD_BSN	12.63	12.71	-0.05	-0.69**	0.10	0.30**	0.48**	0.30**	-0.31**	0.35**						
10) BC_BSN	0.0060	0.0078	-0.08	-0.73**	0.14*	0.55**	0.47**	0.53**	-0.34**	0.59**	0.78**					
11) AC_BSN	0.1493	0.0994	-0.01	0.64**	-0.20**	-0.39**	-0.40**	-0.36**	0.61**	-0.54**	-0.55**	-0.45**				
12) ID_WN	10.09	4.52	-0.14*	-0.71**	0.34**	0.76**	0.35**	0.52**	-0.48**	0.74**	0.22**	0.42**	-0.45**			
13) OD_WN	14.15	12.92	-0.32**	-0.77**	0.33**	0.33**	0.43**	0.36**	-0.28**	0.37**	0.64**	0.56**	-0.40**	0.31**		
14) BC_WN	0.0064	0.0071	-0.15*	-0.80**	0.38**	0.64**	0.47**	0.59**	-0.37**	0.61**	0.55**	0.77**	-0.41**	0.59**	0.72**	
15) AC_WN	0.1265	0.0545	0.24**	0.79**	-0.29**	-0.45**	-0.48**	-0.45**	0.55**	-0.52**	-0.53**	-0.51**	0.66**	-0.59**	-0.67**	-0.62**

SU, EU and LU represents socializing use, entertainment use and learning use respectively (in minutes per representative week); ID, OD, BC and AC are Indegree, Outdegree, Betweenness Centrality, and Aggregate Constraints; CF, BSN, and WN represents Close Friendship Networks, Broader Social Networks, and Work Networks.

* <.05; ** < .01