Journal of the Association for Information Systems

RESEARCH ARTICLE

WHO'S AFRAID OF THE VIRTUAL WORLD?
Anxiety and Computer-Mediated Communication*

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Abstract

This study integrates the literature on computer anxiety and communication apprehension to determine their joint impact upon individual attitudes toward using and use of computer mediated communication (CMC). We introduce the application-specific CMC anxiety, defined as an individual's level of fear or apprehension associated with actual or anticipated use of information technology to communicate with others. Furthermore, we advance a new nomological structure that positions CMC anxiety as a proximal mediating construct between the more general constructs of computer anxiety, communication apprehension, and CMC familiarity, and the dependent constructs of CMC attitudes and use. We develop and empirically test this nomological structure, finding that computer anxiety, oral communication apprehension, and CMC familiarity contribute to CMC anxiety, while written communication apprehension does not. CMC anxiety fully mediates the relationship between the general constructs and attitude toward using CMC. CMC anxiety explains 34% of the variance in attitudes, while attitudes, coupled with familiarity, explain 14% of the variance in CMC use.

* Sirkka Jarvenpaa was the accepting senior editor for this paper; Gabriele Piccoli and Elena Karahanna were blind reviewers for this paper.

Keywords: computer anxiety, communication apprehension, email, CMC anxiety, virtual team, computer-mediated communication, technology-mediated learning

Introduction

Computer-mediated communication (CMC) applications support a great deal of the collaborative activities in organizations and society. The use of CMC applications is widespread in business and educational institutions (Garton and Wellman, 1995; Markus, 1994), with over 90% of businesses using the Internet, and electronic mail (email) identified as the primary application (Taylor Nelson Sofres, 2002). A recent survey of 123 large businesses indicates that organizations continue to increase their investment in CMC applications for communication, management, and other collaborative activities (Brownell et al., 2002). However, some evidence suggests that it is difficult to ensure broad-based use of these technologies to achieve organizational goals (Naughton et al., 1999).

Organizational dependency on one type of CMC, email, is particularly salient, as it is frequently the foundational communication component of networked organizations (Ahuja and Carley, 1999; Holland and Lockett, 1997), virtual teams (Jarvenpaa and Leidner, 1999; Townsend et al., 1998), and electronic communities (Sproull and Kiesler, 1991). Likewise, educational organizations rely heavily on email and text-based messaging components of CMC technologies to facilitate technology-mediated and distance education (Belanger and Jordan, 2000; Leidner and Jarvenpaa, 1995; Piccoli et al., 2001). Yet, while email appears to flourish at the organizational level as a successful implementation of CMC technology, anecdotal and empirical evidence reveals uneven and problematic usage at the individual level (e.g., Grudin, 1994; Hara and Kling, 2000).

When dealing with CMC applications such as email, individuals must simultaneously contend with both computers and communication. This interaction of computer technology and communication medium may have unintended consequences for CMC use. Individual differences pertaining to the use of a computer, and/or communicating can have a negative impact on an organization's ability to encourage use of CMC applications. Thus, an organization's provision of a suitable collaborative workplace or educational environment may be unintentionally thwarted at the individual level of CMC application adoption and use. Research in information systems (IS) has identified a number of individual differences that affect attitudes toward using and use of computers and systems (e.g., Agarwal and Prasad, 1999; Igbaria et al., 1995; Karahanna et al., 2002; Zmud, 1979). Some of the more recent research rests on the theoretical foundation of Bandura's social cognitive theory (1986) and isolates the construct of computer self efficacy as an instrumental influence on an individual's experiences with technology (Agarwal et al., 2000; Compeau and Higgins, 1995; Igbaria and Iivari, 1995). Strongly related to computer self efficacy, and potentially a precursor to its development, is computer anxiety (Marakas et al., 1998). Computer anxiety has been shown to have a negative influence upon an individual's use of information technology, both directly (Igbaria and Iivari, 1995; Igbaria and Parasuraman, 1989; Marakas et al., 1998) and indirectly (Agarwal et al., 2000; Venkatesh, 2000).

Research in computer anxiety suggests that some individuals experience tension when exposed to computers (Chua et al., 1999; Rosen and Maguire, 1990). Likewise, individuals with communication apprehension experience stress with certain forms of

communication (Patterson and Ritts, 1996; Richmond and McCroskey, 1992). The blending of computer and communication technologies, as in CMC applications, may present a particularly challenging environment for such individuals. Prior research has examined problematic technology use in the context of computer anxiety. However, the non-significant and sometimes conflicting findings in computer anxiety research (e.g., Chua et al., 1999; Compeau et al., 1999; Kernan and Howard, 1990; Maurer, 1994) may be due, in part, to the attempt to capture application-specific anxiety with a generalized computer anxiety construct. Therefore, similar to the argument that computer self-efficacy has a general and an application-specific component (Marakas et al., 1998; Agarwal et al., 2000), we propose that specific types of computer applications may engender differing types of anxiety. In this study, we focus on CMC applications generally, and email specifically.

Email provides a unique CMC application for study, as our understanding of the nature of email communication continues to evolve. Although it is often considered a low-tech innovation, email has been found to have a significant impact on organizational interactions (e.g., Ahuja and Carley, 1999; Holland and Lockett, 1997) and the learning process (Coppola et al., 2002). Email is essentially a text-based CMC application, and its socially constructed communication purposes may range from formal directives to informal chats (Sarbaugh-Thompson and Feldman, 1998). While its form and structure (headers indicating to, from, date, and subject) lend it to be seen as the natural evolution of the written memo (Yates and Orlikowski, 1992), it also bears a resemblance to oral interaction based on the level of informality, the potential for synchronous communication, and the ability to convey equivocal information (Grudin, 1994; Markus, 1994, Sproull and Kiesler, 1986). Thus, communication in the computer-mediated environment can be seen as exhibiting characteristics of a formal written interaction, an informal oral interaction, or something in between. These different views and uses of email, combined with the fact that email is embedded in computer technology, suggest that to understand email use or avoidance, we need to understand how communication apprehension **and** computer anxiety work together in influencing an individual's attitudes toward using and use of CMC technology. In order to more fully understand the issues associated with CMC use, this research has the following objectives:

1. To introduce and define a construct, CMC anxiety, that captures anxiety specific to computer mediated communication,
2. To identify the determinants of CMC anxiety, and
3. To empirically test a model of CMC anxiety.

The remainder of this paper is organized as follows. First, we present the conceptual background and model development. This is followed by a discussion of the research methodology, instrument validation, and a description of the study conducted to test the hypotheses. The paper concludes with a discussion of the results and implications for research and practice.

Conceptual Background and Model Development

CMC systems are *computer-based* systems that enable individuals to *communicate* with others (Rice et al., 1990). These systems include many of the tools used to communicate today, such as telephone systems, voice mail, and videoconferencing, as well as text-based systems, such as bulletin boards, instant messaging, and email.

These latter text-based systems consist of computer text-processing and communication tools used to exchange information among participants (Sproull and Kiesler, 1986). They require individuals to use a computer to communicate (telephone, voice mail, and videoconferences do not necessarily require direct interaction with a computer). Although information technology is widespread in organizations, a number of recent studies support the notion that anxiety often stands in the way of technology adoption (Rajneesh et al., 2002; Rovai and Childress, 2002-2003; Venkatesh, 2000). Further, computer-mediated communication is still sufficiently new to the general population that low levels of satisfaction are reported (Piccoli et al., 2001). Thus, although information technology and CMC applications appear to be widely adopted at the organizational level, anxiety continues to have a significant impact upon individual adoption and usage of information technology applications. Therefore, to understand the individual characteristics that impact perceptions and use of CMC systems, we must understand the anxieties associated with computer use and communicating.

Anxiety

The term anxiety "is most often used to describe an unpleasant emotional state or condition which is characterized by subjective feelings of tension, apprehension, and worry" (Spielberger, 1972, p. 482). Highly anxious people exaggerate the threat of evaluation associated with a situation, which produces the feelings of anxiety (Sarason, 1972). The anxiety then motivates an individual to avoid conditions that produce anxious feelings (Cheek and Buss, 1982; Epstein, 1972). Under this view, cognitions mediate between the environment and the emotion (i.e., anxiety) (Lazarus and Averill, 1972). The resulting relationship is: environmental stimulus leads to cognition, which leads to anxiety, which leads to behavior (e.g., avoidance).

In IS, anxiety has been viewed as a personality variable that influences system use (Agarwal, 2000; Zmud, 1979). Some social anxiety researchers have argued that the relationship between anxiety and behavior is mediated by beliefs (Schlenker and Leary, 1982). A number of IS studies are consistent with this view and incorporate anxiety as an antecedent to the beliefs of usefulness and ease of use (e.g., Igbaria, 1993; Venkatesh, 2000). However, Bandura (1986) suggests that a reciprocal relationship exists between expectations (e.g., beliefs) and anxieties, such that the anxiety may precede the expectation **or** the expectation may precede the anxiety. According to Epstein (1972), it is the violation of expectancies (e.g., beliefs) that produces anxiety. This view is consistent with the perspective held by classical anxiety theorists that anxiety mediates the relationship between beliefs and behavior (Spielberger, 1972). Thus, anxiety can be viewed as a result of the beliefs an individual has, rather than as an antecedent to them. For example, an individual who has a belief that she will be embarrassed by delivering a speech has speech anxiety (commonly called stage fright); as a result of the anxiety, she refuses to give speeches. The belief leads to the fear (i.e., anxiety), which leads to the behavior (i.e., avoidance). This is the perspective taken in this research.

Marakas et al. (1998) proposed the presence of both general and specific computer self efficacy (CSE), arguing that the more specific measure would be a better representation of self efficacy in a particular context. Agarwal et al.'s (2000) results support this notion and further demonstrate that specific CSE partially mediates between general CSE and perceptions of ease of use. Similar logic can be applied to computer anxiety. Research

has demonstrated that computer anxiety may derive either from a very general anxiety trait or from other anxieties, such as test or math anxiety (e.g., Heinssen et al., 1987; Loyd and Gressard, 1984; Todman and Monaghan, 1994). Just as general CSE represents a "lifetime of related experiences" (Marakas et al., 1998, p. 129), general computer anxiety effectively represents the accumulated experiences associated with computers. Given the wide array of technological applications that are included under the umbrella of 'computer', it seems reasonable to expect different anxieties would be associated with different uses of the computer.

An application-specific measure of computer anxiety serves two purposes. First, it focuses on the particular computer application of interest, rather than technology or computers in general. Second, it represents a more proximal representation of the context and an individual's cognitions in that context, thus providing greater explanation and prediction. In the next section, we introduce a particular form of specific computer anxiety associated with communicating in the computer-mediated context.

Computer-Mediated Communication (CMC) Anxiety[1]

We define computer-mediated communication anxiety as an individual's level of fear or apprehension associated with actual or anticipated use of information technology to communicate with others. We propose that CMC anxiety will mediate the relationship between the independent variables of computer anxiety and communication apprehension and the dependent variable of attitude, which leads to subsequent use. This view is similar to the general versus specific self efficacy proposed by Marakas et al. (1998), and supported by Agarwal et al. (2000). Similarly, we propose that the specific form of anxiety, CMC anxiety, will be determined by the more general forms of anxiety. Further, given consistent research linking familiarity to anxiety and use, we incorporate familiarity with CMC applications as an additional independent variable. We present the conceptual model in Figure 1. For the purposes of this study, we focus on email as the CMC of interest.

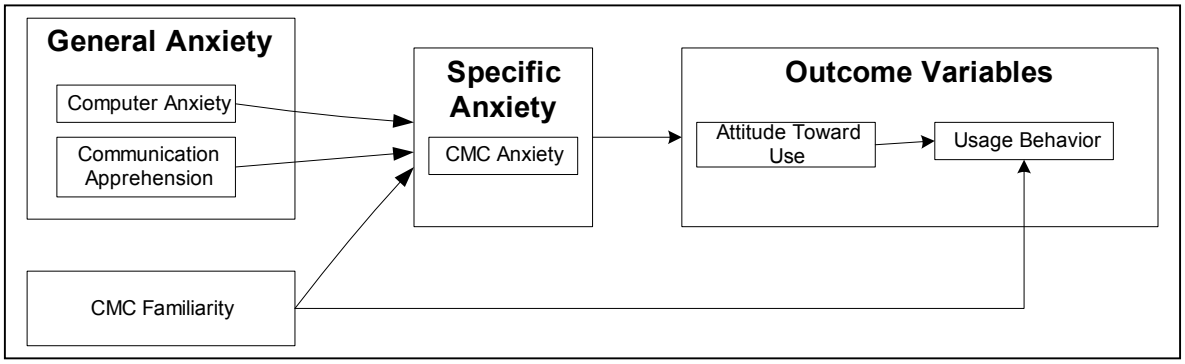

Figure 1. Conceptual Model

[1] The use of anxiety and apprehension is consistent with the literature in the fields of IS and Communication, respectively. Apprehension is often used in the definition of anxiety and likewise, anxiety is often used in the definition of apprehension (Epstein 1972). Our choice of CMC *anxiety* is to be consistent with IS research.

Computer Anxiety

Computer anxiety is "the tendency of individuals to be uneasy, apprehensive, or fearful about current or future use of computers" (Igbaria and Parasuraman, 1989, p. 375). A number of studies have provided evidence supporting a direct relationship between computer anxiety and computer use (Brosnan, 1999; Chua et al., 1999; Howard and Mendelow, 1991; Igbaria et al., 1996; Scott and Rockwell, 1997; Todman and Monaghan, 1994; Weil et al., 1990). Others have demonstrated a direct relationship between computer anxiety and attitudes (Howard and Smith, 1986; Igbaria, 1993; Igbaria and Chakrabarti, 1990; Igbaria and Parasuraman, 1989). The computer anxiety research clearly shows that a highly computer anxious individual will be at a significant disadvantage compared to his/her peers in computer-mediated communication environments. One example of such an environment is a virtual team, which requires multiple uses of computer technology over an extended period of time in order to make decisions, resolve conflict, and solve problems (Jarvenpaa and Leidner, 1999). The highly computer anxious individual is at risk for resisting the use of computer technology and thus limiting his/her personal success as well as the success of the team. As a result, these individuals can hinder organizations from reaping the full benefits of communication technologies (Townsend et al., 1998).

In order to use many CMC technologies, and email in particular, a person must use a computer. Thus, an individual's feelings regarding computer use may very well influence his/her feelings regarding email use. Research examining computer self efficacy and computer anxiety has demonstrated that more general efficacies and anxieties are determinants of more specific ones. For example, Agarwal et al. (2000) demonstrated that general computer self efficacy was a determinant of at least one type of application-specific self efficacy. Similarly, Thatcher and Perrewé (2002) demonstrated that trait anxiety, a general form of anxiety, was positively associated with computer anxiety, a more specific form of anxiety. As a result, we would expect that individuals with higher levels of computer anxiety would likewise experience higher levels of CMC anxiety.

H1: Computer anxiety will have a positive effect on CMC anxiety.

Communication Apprehension

With regard to communicating, anxiety is studied under the heading of communication apprehension, and is defined as "an individual's level of fear or anxiety associated with either real or anticipated communication with another person or persons" (McCroskey, 1984, p.13). Individuals with communication apprehension tend to avoid communication situations, often steering clear of courses and jobs in which they perceive the communication requirements to be high (McCroskey and Andersen, 1976). Communication apprehension has been associated with social anxiety (Schlenker and Leary, 1982), which suggests that individuals refrain from social activities when their desire to create a certain impression is coupled with a lack of confidence about their ability to do so. Though correlated, communication apprehension and social anxiety have been shown to be distinct constructs (Patterson and Ritts, 1996). Thus, communication apprehension can also be thought of as a special type of anxiety.

A number of studies have demonstrated a direct relationship between communication apprehension and communication avoidance (see Allen and Bourheis, 1996; Lustig and

Andersen, 1990; Richmond and McCroskey, 1992). Individuals with high communication apprehension have been shown to talk less, perceived as lacking communication skills, judged as less competent, and evaluated lower overall (see Richmond and McCroskey, 1992 for a review). There is also evidence that individuals with high communication apprehension experience less satisfaction and more negative attitudes toward communication experiences than do low apprehensives (Richmond and McCroskey, 1992).

As originally defined, communication apprehension was considered "a broadly based anxiety related to *oral* communication" (Richmond and McCroskey, 1992, p. 41, emphasis added). Over time, however, aspects of written communication apprehension were identified that were theoretically distinct from oral communication apprehension, warranting a separate treatment (Daly and Miller, 1975). We next describe these two communication apprehension constructs.

Oral Communication Apprehension

Oral communication apprehension is the fear or anxiety associated with situations in which oral communication is required (McCroskey, 1984). It includes apprehension in interpersonal (dyadic), group, formal meeting, and public speaking contexts. Research has demonstrated that individuals high in oral communication apprehension avoid situations in which speaking is required (e.g., Daly and McCroskey, 1975; Lederman, 1982). Further, when high oral communication apprehensives face situations that require them to communicate orally, they are perceived by themselves and others as less competent communicators than low oral communication apprehensives (Allen and Bourhis, 1996; Daly and Leth, 1976; Richmond and McCroskey, 1992). As a result, individuals with high oral communication apprehension have low satisfaction with communicating orally and are less likely to engage in the oral communication activity (Richmond and McCroskey, 1992).

Karahanna et al. (2002) examined oral communication apprehensives' beliefs about using a group support system (GSS). They found that oral communication apprehension was positively related to perceptions of the relative advantage of a GSS, a key determinant of attitude and behavior (Karahanna et al., 1999). One potential interpretation of these findings is that oral communication apprehensives perceived the GSS to be an *alternative* to oral communication, thus it provided a more comfortable medium through which to communicate. This suggests that individuals with high levels of oral communication apprehension would embrace the text-based CMC as a means to avoid speaking, and likely have less fear associated with using it. Thus, we anticipate that individuals with higher levels of oral communication apprehension would experience lower levels of CMC anxiety.

> *H2: Oral communication apprehension will have a negative effect on CMC anxiety.*

Written Communication Apprehension

Written communication apprehension is the fear or anxiety associated with situations in which writing is required (Daly and Miller, 1975). It encompasses factors that can be labeled as anxiety about writing in general, having one's writing read by others, and self-evaluation of writing. Research suggests that individuals who are writing apprehensive

will avoid those situations that evoke the anxiety. For example, it has been demonstrated that people with high levels of writing apprehension select occupations with little required writing (Bennett and Rhodes, 1988; Daly and Shamo, 1976). When writing-apprehensive individuals are required to write, their performance will typically be evaluated lower than their less apprehensive peers.

A text-based CMC, like email, can be seen as an evolution of the office memo (Yates and Orlikowski, 1992). Since individuals who are writing apprehensive will try to avoid situations and occupations that require them to write, they are likely to avoid using text-based media. However, prior research examining text-based communication technologies and written communication apprehension has had conflicting results. Hartman et al. (1991) found a negative relationship between writing apprehension and electronic student-teacher interactions, while Scott and Rockwell (1997) found no relationship between writing apprehension and intention to use text-based communication technologies. Most recently, Karahanna et al. (2002) found that writing apprehension was positively related to perceptions of the relative advantage of a GSS. However, the anonymous nature of the GSS used in the Karahanna et al. (2002) study may have masked the evaluative component of the writing. Further, prior non-technology based research has consistently found that individuals with written communication apprehension avoid writing situations, perform less well when forced to write, and are less satisfied with the written communication experience (Daly and Miller, 1975; Dwyer, 1998). Thus, we expect that individuals with higher levels of written communication apprehension would experience higher levels of CMC anxiety.

H3: Written communication apprehension will have a positive effect on CMC anxiety.

Familiarity

Familiarity is a combination of the knowledge, understanding, and amount of time an individual has had experience with something. Much research indicates that familiarity with computers is inversely related to computer anxiety (e.g., Heinssen et al., 1987; Igbaria and Chakrabarti, 1990; Igbaria and Parasuraman, 1989; Rosen and Maguire, 1990; Todman and Monaghan, 1994), although the results are somewhat mixed (e.g., Bloom and Hautaluoma, 1990; Rosen et al., 1993; Weil et al., 1987). A recent study found that computer anxiety mediated the relationship between familiarity and ease of use, a precursor to use (Hackbarth et al., 2003). Communication research indicates that familiarity with the particular type of communicative interaction is associated with reduced apprehension (Carlson and Wright, 1993; Richmond and McCroskey, 1992). Extrapolating to the specific context of CMC anxiety, we would expect that the more familiar an individual is with CMC applications, the lower would be his/her level of CMC anxiety.

H4a: CMC familiarity will have a negative effect on CMC anxiety.

Research on attitudes in general (Bagozzi and Kimmel, 1995; Fazio and Zanna, 1978) and technology use more specifically (Szajna and Scammel, 1993; Venkatesh, 2000;

Venkatesh et al., 2002) highlights the role of experience in shaping future behavior.[2] In essence, prior research suggests that the more experience an individual has with a specific behavior, the more likely he/she is to perform that behavior in the future, regardless of the individual's beliefs. This relationship between experience, or familiarity, and repeat behavior is particularly relevant for examining technologies with which there is an expectation of familiarity. Thus, we expect that individuals familiar with CMC applications will have increased usage of CMC applications.

H4b: CMC familiarity will have a positive effect on CMC use.

Attitudes and Use

Attitudes toward using and actual use of technology have long been the subject of research in the area of technology acceptance, with research demonstrating a relationship among beliefs, attitudes, and behaviors (Davis et al., 1989; Karahanna et al., 1999; Taylor and Todd, 1995). Attitude is a person's affective evaluation of a specific object (Davis et al., 1989). Prior research suggests that individuals high in computer anxiety will have negative attitudes toward using a computer (e.g., Igbaria 1990). Likewise, individuals high in communication apprehension have negative attitudes toward engaging in communication (e.g., Richmond and McCroskey, 1992). Due to its application-specific focus, CMC anxiety is a more proximal predictor of attitude toward a CMC application than either computer anxiety or communication apprehension. Thus, it should exhibit a significant effect on attitudes regarding the CMC application (Ajzen, 1988), such that individuals with high CMC anxiety would have less favorable attitudes toward using the CMC.

H5: CMC anxiety will have a negative effect on CMC attitudes.

Use has been defined and measured in several different ways (e.g., appropriate use, breadth of use). This research defines use as the end user behavior (i.e., interaction event) with an information system of interest in order to derive some form of individual impact (Seddon, 1997). Prior research suggests that attitude toward a computer technology is associated with use (e.g., Carlson and Wright, 1993; Scott and Rockwell, 1997). Therefore, we would expect that higher levels of CMC attitude will be related to higher levels of CMC use.

H6: CMC attitudes will be positively related to CMC use.

Research Methodology

Study Context and Sample

The subjects for this study were students at a large Midwestern public university, enrolled in an introductory accounting course for non-business majors. These particular

[2] Using Rogers (1995) adoption decision process as the framework, we take the view that awareness is the foundation for familiarity. Given that awareness precedes the adoption decision, we focus on familiarity as an antecedent to use. Additionally, Agarwal et al. (2000) show that experience is antecedent to self efficacy and belief formation, both of which have been identified as determinants of attitude and behavior.

subjects had easy access to email, the text-based CMC used in this study, which was important to mitigate confounding due to access issues. These subjects also were voluntary users of email, which was desired so that the dependent variables (attitude usage) would not be artificially inflated due to mandated use (such as that required for coursework). Finally, the students were from a variety of majors, thus representing varying degrees of technical sophistication. Since student subjects represent the workforce of the future, this study provides insights for organizations as they plan for implementation of and investments in CMC applications. Respondents completing all elements of the survey and providing usage data received extra credit in the course. Of 270 participants, 193 completed both surveys and provided usage data, resulting in an overall response rate of approximately 72%. Participant characteristics are in Table 1.

We employed a survey methodology consisting of four parts administered over the course of 12 weeks. The first part, administered during the second week of the semester, consisted of the items measuring computer anxiety, CMC familiarity, CMC attitude, written communication apprehension, and oral communication apprehension. The second survey, conducted two weeks later, contained the items measuring CMC anxiety. We distributed the first two surveys during class time, and the students completed and returned them within that same class period. We administered the third and fourth parts during weeks 12 and 14 of the semester, and these consisted of measures for the dependent variable of CMC usage, presented separately in order to minimize the impact of common method bias and persistence (Podsakoff and Organ, 1986). To capture usage, we gave the subjects a form to carry with them that had spaces for each day of the week in which they could record the number of email messages that they *sent*. The emphasis on sent mail was intended to capture the CMC usage behavior that was *initiated* by the respondent, and thus communication in which they wanted to engage. Further, we wanted to lessen the confounding effects from responding in kind to messages; we were interested in the times the subjects *chose* to use email for communication. We asked the subjects to complete the form during the week and return it at the end of the week.

Table 1. Sample Characteristics

	Frequency	Percent
Freshman	6	3.1
Sophomore	88	45.6
Junior	72	37.3
Senior	22	11.4
Graduate	4	2.1
Male	68	35.2
Female	125	64.8

	Minimum	Maximum	Mean	Std. Deviation
GPA	1.96	4	3.1322	0.451
Age	18	44	20.1762	2.4875
Yrs Work Exp.	0	24	4.6508	2.7329

Instrument Development

We measured all variables using multi-item scales (see Table 2) and adapted the scale for oral communication apprehension from McCroskey's (1984) Personal Report of Communication Apprehension (PRCA). The PRCA has demonstrated reasonable reliability and validity over time (e.g., Dwyer, 1998; Scott et al., 1978). Email allows people to communicate with another individual or a group of individuals, and thus exhibits characteristics most like group and dyadic communication. Then we used the eight items representing group and dyadic communication from the full PRCA scale. We chose to focus on a subset of the full 24-item PRCA scale because we wanted to minimize the likelihood of respondent fatigue across multiple surveys. Further, our pilot study supported the choice of the subset scale as the group and dyadic items were significant, while the omitted items were not. Specifically, subjects were unable to distinguish between group and meeting communication apprehension, and public speaking apprehension had no significant impact; therefore, we did not include items regarding meetings and public speaking in the final scales.[3]

We adapted the items used to measure written communication apprehension from Daly and Miller's (1975) Writing Apprehension Test (WAT), which has demonstrated reasonable reliability and validity over time (Bennett and Rhodes, 1988). Since the essence of text-based CMC is that one writes something for other people to read, we used four items from the WAT that represent 'others reading one's writing'. Again, our pilot study supported this choice of items. We adapted the computer anxiety scale consisting of six items from Heinssen et al. (1987) and Loyd and Gressard (1984). We measured CMC usage using a self-report of the number of email messages *sent* by the subjects during two separate weeks of reported usage. These two measures, and one item measuring perceived CMC usage, were used to capture CMC usage behavior.

We developed the items measuring CMC familiarity, CMC anxiety, and CMC attitude using a multi-stage, iterative process (Straub, 1989). First, we reviewed existing scales. Next, we constructed an initial set of items and had a panel of experts evaluate it for face validity. We submitted this set of items to the scrutiny of colleagues, who were asked to evaluate the wording of the items, group them according to likeness, and create a construct for each of the groups. We then pilot-tested the scales using samples of 141 and 88 in two separate studies. The resulting scales contained four items capturing CMC familiarity, six items capturing CMC anxiety, and three items measuring the dependent variable of CMC attitude.

Results

The data were analyzed using PLS-Graph Version 3.00 (Build 1017). PLS is a latent structural equation modeling technique that is particularly well-suited for theory

[3] In terms of the oral communication apprehension scale, our pilot study demonstrated that the group and meetings constructs loaded together. That is, subjects were not capable of distinguishing between group interaction and meeting interaction. Additionally, we found that the measures for stage fright had no significant impact on anything in the model. We felt it was not necessary to include them. With respect to the writing apprehension instrument, we selected the items that are most closely associated with others reading your writing. These were selected because the text-based communication medium requires others to read one's writing.

Table 2. Constructs and Items		
Construct (Variable Name)		**Measure (Operationalization)** All items (except USAGE2, USAGE3) were measured on a 7-point scale where 1= strongly disagree and 7=strongly agree
Computer anxiety	CA1	○ Computers make me feel uncomfortable
	CA2	○ I get a sinking feeling when I think of trying to use a computer
	CA3	○ Computers scare me
	CA4	○ I feel comfortable using a computer (R)
	CA5	○ Working with a computer makes me nervous
Oral communication apprehension	OC1	○ I dislike participating in group discussion
	OC2	○ Generally, I am comfortable while participating in a group discussion (R)
	OC3	○ I am tense while participating in group discussions
	OC4	○ I like to get involved in group discussions (R)
	OC5	○ While participating in a conversation with a new acquaintance, I feel nervous
	OC6	○ I am afraid of speaking up in conversations
	OC7	○ Ordinarily, I am relaxed in conversations (R)
	OC8	○ While conversing with a new acquaintance, I feel relaxed (R)
Written communication apprehension	WC1	○ I have no fear of my writing being read by others (R)
	WC2	○ I like to share what I have written with others (R)
	WC3	○ I do not like my writing to be read by others
	WC4	○ I like to have others read what I have written (R)
CMC familiarity	CMCFAM1	○ I am very knowledgeable about email
	CMCFAM2	○ I understand how to use email
	CMCFAM3	○ I have a lot of experience using email
	CMCFAM4	○ Overall, I believe I am very familiar with email
CMC anxiety	CMCANX1	○ Using email makes me nervous
	CMCANX2	○ Using email makes me uneasy
	CMCANX3	○ I feel comfortable using email (R)
	CMCANX4	○ I would be comfortable sending email messages that I know a lot of people will read (R)
	CMCANX5	○ While composing an email message to someone I don't know, I feel tense
	CMCANX6	○ I would be fearful of sending email to someone I don't know
CMC attitude	CMCATT1	○ I like sending messages with email
	CMCATT2	○ I look forward to using email
	CMCATT3	○ I dislike using email (R)
CMC usage	USAGE1	○ About how many times per day do you use email?
	USAGE2	○ Count of the number of email messages sent by the subject, captured **twice** over **two** separate weeks
	USAGE3	

development and applicable when the research goal is causal-predictive testing and explanation of variance (Barclay et al., 1995; Chin 1998). Furthermore, given our sample size of 193, PLS can provide a robust analysis due to its component-based estimation (Chin, 1998). We employed a 2-step approach to model testing in which we first assessed the measurement model then the structural model. We present the measurement model test results first, then those for the structural model.

Measurement Model

We assessed the psychometric properties of the scales (the measurement model) by examining item reliability and discriminant validity. Internal composite reliability (ICR), a measure similar to Cronbach's alpha, was calculated for the measurement scales. All measurement scales exhibit reliability well above the .70 threshold (DeVellis, 1991; Nunnally, 1978). Descriptive statistics and ICR for the constructs are in Table 3.

Table 3. Construct Descriptive Statistics and Internal Composite Reliabilities (ICR)

	# Items	Mean	Std. Dev	Response Range	ICR
CA	6	5.81	1.42	1 – 7	0.937
OC	8	4.89	1.55	1 – 7	0.893
WC	4	4.40	1.61	1 – 7	0.931
CMCFAM	4	6.17	1.15	1 – 7	0.954
CMCANX	6	5.92	1.38	1 – 7	0.857
CMCATT	3	5.94	1.28	1 – 7	0.924
USAGE	3	13.87	12.79	0.67 – 95.33	0.857
Valid N		193			

Table 4. Inter-construct Correlations[a]

	CA	OC	WC	CMCFAM	CMCANX	CMCATT	USAGE
CA	**0.86**						
OC	0.17	**0.72**					
WC	0.24	0.35	**0.88**				
CMCFAM	-0.53	-0.14	-0.14	**0.92**			
CMCANX	0.33	0.25	0.14	-0.34	**0.71**		
CMCATT	-0.20	-0.18	-0.12	0.32	-0.58	**0.90**	
USAGE	-0.24	-0.07	-0.12	0.29	-0.20	0.32	**0.82**

[a] The square root of the average variance extracted (AVE) between the construct and measures is shown on the diagonal. For discriminant validity, the diagonal element should be larger than the off-diagonal correlations.

Table 5. Factor Loadings and Cross Factor Analysis

ITEM	Oral Comm. Appreh (OC)	Written Comm. Appreh. (WC)	CMC Anxiety (CMCANX)	CMC Usage (USAGE)	CMC Familiarity (CMCFAM)	CMC Attitude (CMCATT)	Computer Anxiety (CA)
OC1	0.681	0.281	0.145	-0.052	-0.118	-0.143	0.104
OC2	0.725	0.291	0.114	-0.030	-0.113	-0.166	0.134
OC3	0.753	0.301	0.221	-0.043	-0.073	-0.127	0.122
OC4	0.650	0.282	0.134	-0.128	-0.088	-0.206	0.119
OC5	0.700	0.215	0.177	-0.070	-0.185	-0.052	0.105
OC6	0.754	0.137	0.234	-0.058	-0.122	-0.068	0.169
OC7	0.698	0.301	0.204	-0.005	-0.061	-0.204	0.127
OC8	0.756	0.224	0.104	-0.051	-0.047	-0.077	0.045
WC1	0.287	0.862	0.127	-0.084	-0.123	-0.077	0.190
WC2	0.314	0.925	0.128	-0.116	-0.130	-0.124	0.244
WC3	0.333	0.924	0.145	-0.106	-0.141	-0.121	0.243
WC4	0.288	0.795	0.082	-0.111	-0.073	-0.108	0.141
CMCANX1	0.108	0.073	0.801	-0.098	-0.203	-0.516	0.193
CMCANX2	0.174	0.091	0.755	-0.074	-0.318	-0.494	0.238
CMCANX3	0.086	0.008	0.580	-0.045	-0.172	-0.288	0.124
CMCANX4	0.205	0.107	0.643	-0.208	-0.264	-0.399	0.293
CMCANX5	0.351	0.244	0.662	-0.213	-0.155	-0.320	0.215
CMCANX6	0.230	0.087	0.729	-0.153	-0.228	-0.306	0.204
USAGE1	-0.105	-0.019	-0.216	0.813	0.299	0.329	-0.242
USAGE2	-0.199	-0.128	-0.128	0.802	0.188	0.201	-0.174
USAGE3	-0.181	-0.187	-0.112	0.833	0.171	0.210	-0.139
CMCFAM1	-0.083	-0.145	-0.335	0.331	0.899	0.372	-0.550
CMCFAM2	-0.162	-0.178	-0.299	0.231	0.919	0.229	-0.449
CMCFAM3	-0.171	-0.080	-0.324	0.227	0.935	0.250	-0.472
CMCFAM4	-0.131	-0.155	-0.313	0.242	0.932	0.277	-0.485
CMCATT1	-0.212	-0.175	-0.521	0.279	0.292	0.897	-0.217
CMCATT2	-0.143	-0.068	-0.502	0.362	0.292	0.893	-0.139
CMCATT3	-0.123	-0.085	-0.548	0.214	0.271	0.897	-0.171
CA1	0.133	0.190	0.258	-0.147	-0.399	-0.147	0.828
CA2	0.144	0.226	0.286	-0.252	-0.516	-0.194	0.885
CA3	0.089	0.197	0.261	-0.196	-0.466	-0.144	0.906
CA4	0.143	0.159	0.296	-0.220	-0.461	-0.182	0.864
CA5	0.213	0.258	0.302	-0.211	-0.425	-0.173	0.840

We assessed discriminant validity by determining if the constructs share more variance with their own measures than they share with the other constructs in the model. Table 4 presents the results of the correlation matrix for the research model and the average variance extracted (AVE), which provides a measure of the average variance shared between a construct and its measures. For discriminant validity, the measure in the diagonal (square root of the average variance shared between a construct and its measures) must be greater than the variance shared between that construct and the other constructs. In each case, the diagonal value is larger than the corresponding row and column correlation, suggesting adequate discriminant validity (Fornell and Larcker, 1981). To further examine discriminant validity, we examined each item's factor loadings to ensure that each item loaded higher on its own construct than on any other construct. Table 5 presents the results of the factor loadings and cross loadings.

Structural Model

The tests of the structural model are shown in Figure 2 and Table 6. Figure 2 shows the path coefficients and explained variances (R^2) for the constructs in the model. Although PLS does not explicitly provide significance for path coefficients, we performed a bootstrapping resampling technique to generate t-statistics to determine the significance level of the model paths. Table 6 provides summary results of the hypothesis testing and tabular representation of path beta coefficients.

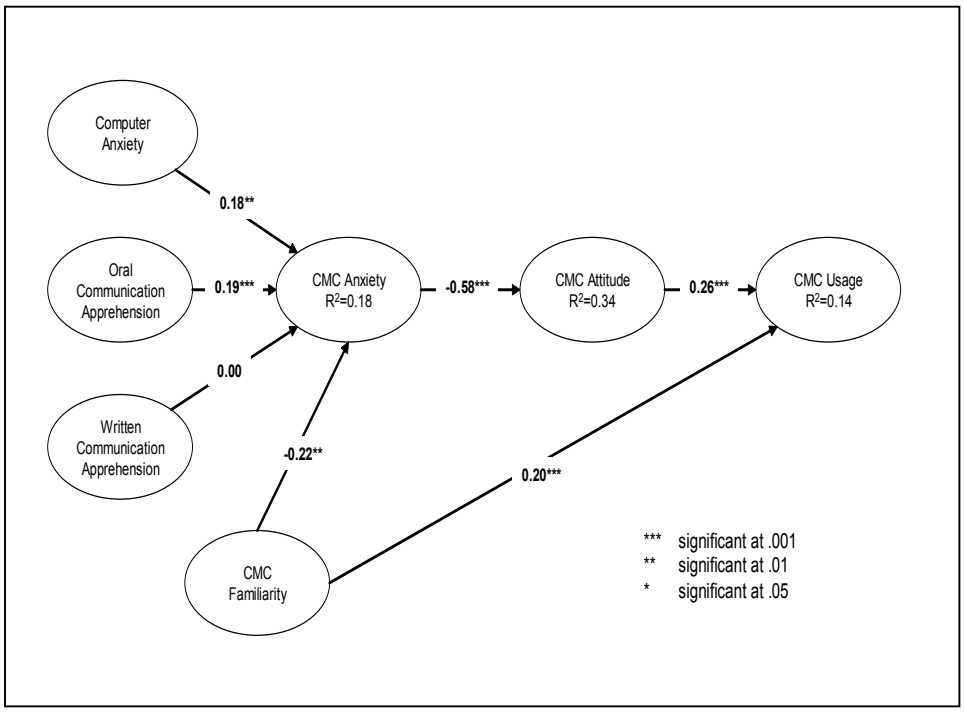

Figure 2. PLS Results

Hypotheses 1 and 3 propose that computer anxiety and written communication apprehension will have a significant, positive effect on CMC anxiety. Hypothesis 2 proposes that oral communication apprehension will have a significant, negative effect on CMC anxiety. For these three hypotheses, we examined the path coefficients from computer anxiety, oral communication apprehension, and written communication apprehension to CMC anxiety. The standardized coefficient of 0.18 ($p<0.01$) from computer anxiety to CMC anxiety provides support for Hypothesis 1. The standardized coefficient of 0.19 ($p<0.001$) from oral communication apprehension to CMC anxiety, while significant, is in the opposite direction hypothesized, failing to support Hypothesis 2. The standardized coefficient of 0.001 (p=n.s.) from written communication apprehension to CMC anxiety indicates that written communication apprehension is not a significant predictor of CMC anxiety, failing to provide support for Hypothesis 3. Hypothesis 4a proposes that familiarity with CMC technology will have a significant, negative effect on CMC anxiety. The standardized coefficient of -0.22 ($p<0.01$) for the path from CMC familiarity to CMC anxiety provides support for Hypothesis 4a. Hypothesis 4b proposes that familiarity with CMC technology will have a significant, positive effect on CMC use. The standardized coefficient of 0.21 ($p<.001$) for the path from CMC familiarity to CMC use provides support for Hypothesis 4b. Hypotheses 5 and

Table 6: PLS Results

Hypothesis	Path			Path Coefficient	Supported?
H1	CA	→	CMC Anxiety	0.18**	Y
H2	OC	→	CMC Anxiety	0.19***	N
H3	WC	→	CMC Anxiety	0.00	N
H4a	CMC Familiarity	→	CMC Anxiety	-0.22**	Y
H5	CMC Anxiety	→	CMC Attitude	-0.58***	Y
H6	CMC Attitude	→	USAGE	0.26***	Y
H4b	CMC Familiarity	→	USAGE	0.21***	Y
R^2	CMC Anxiety	0.18			
	CMC Attitude	0.34			
	USAGE	0.14			
*p<0.05, **p<0.01, ***p<0.001					

6 propose that higher levels of CMC anxiety will have a significant, negative effect on CMC attitudes toward CMC technologies, and CMC attitudes will have a significant positive effect on CMC use. For these hypotheses we examined the paths from CMC anxiety to CMC attitude and from CMC attitude to CMC Usage. The standardized coefficient for the path from CMC anxiety to CMC attitude of -0.58 ($p<0.001$) indicates that Hypothesis 5 is supported. Likewise, the standardized coefficient of 0.26 ($p<0.001$) for the path from CMC attitude to CMC usage provides support for Hypothesis 6.

The results of the PLS analysis further indicate that together, computer anxiety, oral communication apprehension, and familiarity with CMC technology explain 18% of the variance in CMC anxiety. CMC anxiety explains 34% of the variance in attitude toward using CMC applications. Attitude and familiarity explain 14% of the variance in usage of CMC applications.

In order to test for mediation, we follow Baron and Kenny's (1986) recommendations. The Appendix shows the steps involved in testing mediation. We first demonstrate that the independent variables have a relationship with the mediator. All of the independent variables, except for writing apprehension, have a significant relationship with CMC anxiety. Second, we demonstrate that the mediator has a significant relationship with the dependent variables. CMC anxiety is significantly related to CMC Attitude. Finally, we show that the effect of the independent variables on the dependent variable is zero when the mediator is in the model. This holds for oral communication apprehension and computer anxiety, demonstrating that their relationship is fully mediated. Computer familiarity is partially mediated by CMC anxiety, as demonstrated by the significant relationship between familiarity and use, in the presence of a significant relationship with CMC anxiety.

Discussion

The goal of this research was to introduce, define, and empirically test a construct that captures the combination of anxiety associated with both communication and computers. Hence, we introduced the construct of CMC anxiety, developed a measurement scale, and provided evidence supporting its reliability and validity. Our results show that the factors contributing to CMC anxiety include computer anxiety, oral communication apprehension, and CMC familiarity. The results further show that CMC anxiety mediates the relationship between oral communication apprehension and computer anxiety and the dependent variables. Contrary to expectations, written communication apprehension was not a significant determinant of CMC anxiety. CMC anxiety explains 34% of the variance in attitude toward using CMC technology, and CMC anxiety and familiarity explain 14% of the variance in usage of CMC technology.

Prior to discussing the implications of this study, we must discuss limitations that constrain its results. First, relying on self-report data to capture CMC use may have had an unintended impact on the dependent variable. We were constrained by the research site, as it was unable to provide records of participants' email use due to privacy and security concerns. Problems regarding self report data have been clearly articulated (see Straub et al., 1995). The results regarding usage data should be interpreted with this in mind. A second limitation of this study is the use of student subjects. The limitation is not with the students per se, as they are users of CMC applications. Rather, the limitation is associated with the nature of their CMC application use and the types of interaction in which they engage. It is possible that the results of this study are biased toward more casual, social communication, and thus overlook some important elements of organizational or more specifically task-focused communication. To address this limitation, additional research should be conducted in organizational settings. This is discussed in more detail in directions for research. Finally, while this study discusses CMC generally, the context for the study is email, a text-based CMC application. While we anticipate that the findings will generalize to other text-based CMC applications, it does remain a question for future research. To test this, the items used in this study for CMC anxiety would need to be re-worded such that 'email' is replaced by the specific CMC in question.

Implications for Research

This study provides evidence in support of an application-specific type of computer anxiety, at least where communication technologies are concerned. Similar to the arguments set forth by Marakas et al. (1998), and supported by others, (see Agarwal et al., 2000; Chen et al., 2000) that computer self efficacy has both general and application-specific components, our empirical findings suggest that computer anxiety has both general and application-specific components.

Research in psychology has raised this issue regarding the relative importance of distal (i.e., general) and proximal (i.e., application-specific) influences in explaining task performance and behavior (e.g., Chen et al., 2000; Kanfer, 1990, 1992; Martocchio and Judge 1997). The research suggests that there is a continuum from distal individual differences that are thought to be trait-like, to more proximal individual differences that are thought to be state-like (Kanfer, 1990). Our results are consistent with Kanfer (1990; 1992), who has demonstrated that the proximal constructs serve as mediators for the

distal constructs. The reasoning for this is that the proximal indicators are more closely related to behaviors that are important "*during engagement with the task*" (Kanfer 1990, p. 82, emphasis in original). This is echoed in the attitude literature regarding belief measures: task-specific measures of beliefs correlate most strongly with the specific behavior (Ajzen 1988; Ajzen and Fishbein 1980). The essence of the argument is that the proximal, or application-specific constructs predict more accurately because they are more temporally proximal to the behavior. Therefore, it is easier for the individual to cognitively relate his/her behavior to the more proximal constructs as they are more immediately relevant to the situation.

In addition to the greater predictive ability afforded by the development and use of application-specific constructs, they also highlight the unique characteristics of the IT in question. This is an important issue for IS research in general. By focusing on the application-specific nature of IT-related behavioral determinants, we respond to the recent call to make the IT artifact prominent in IT research (Benbasat and Zmud 2003). This requires researchers to attend to the characteristics that make the IT artifact different from other non-technology based products, and to incorporate those characteristics into our theorizing. Further, the focus on application-specific, or proximal, constructs provides a mechanism for insuring that research attends to those factors that are "intimately related to the IT artifact" (Benbasat and Zmud 2003, p. 186).

Our findings indicate that oral communication apprehensives have negative attitudes toward using email and avoid using it. This differs from Karahanna et al.'s (2002) findings that suggest oral communication apprehensives embrace GSS as a way to avoid oral communication. Also in contrast to the Karahanna et al. (2002) study, our results show no significant relationship between written communication apprehension and CMC use. A number of methodological and theoretical issues can explain these differences. First, the GSS used in the Karahanna et al. study enabled anonymous participation, thus minimizing the potential for personal negative outcomes associated with use of the GSS. The anonymity allowed the participants to share comments without fear of embarrassment. As Jessup et al. (1990) argue, the deindividuation effect of "anonymity leads to a reduction in behavioral constraints and enables individuals to engage in behavior they would not engage in when identified" (p. 314). This is in stark contrast to email messages in which a person's name and/or user id are immediately apparent. Second, the focus of the GSS use in the Karahanna et al. study is on one specific goal – generating the characteristics of an 'ideal supervisor'. This focus on a specific, work-related task is in contrast to the wide variety of ways email could have been used by the subjects of our study. Third, the subject pools appear to be quite different in terms of their overall anxiety and apprehension. The mean scores in the Karahanna et al. study were below the midpoint, and in our study they are above the midpoint, indicating that our subjects exhibited greater levels of computer anxiety and communication apprehension. Finally, the items used to measure the constructs in this study differ from those used in the Karahanna et al. (2002) study. The oral communication apprehension items used in the Karahanna et al study were focused on group discussion, while the items used in this study more generally measured oral communication apprehension from group discussions *and* conversations. Likewise, the items used for written communication apprehension in the Karahanna et al study were more generalized measures of the construct, while in this study we used items focusing specifically on the apprehension of having one's writing read by another. These differences, while appropriate considering the different contexts for each study, may have further contributed to differences in the results obtained.

From a theoretical perspective, the differences in the findings may be due, in part, to the overall nomological perspective taken in the two studies. Specifically, this study examines computer anxiety and communication apprehension as determinants of CMC anxiety, which in turn influences attitudes toward using CMC. Karahanna et al. (2002) examine the relationship of computer anxiety and communication apprehension with relative advantage, a belief that determines attitude. Thus, their focus on beliefs is different from our focus on attitudes and could lead to different results. However, as discussed above, our study also uses a more proximal, or application specific measure of anxiety that mediates between the general measures and the outcome variables. In the absence of the mediating CMC anxiety construct, our results would be quite different (see the tests for mediation in the Appendix).

The comparison of this study to Karahanna et al. (2002) revealed that dimensions such as the nature of the communication (e.g., task vs. social) and the communication environment (e.g., anonymous vs. non-anonymous) are important factors to consider when examining CMC use. The goal of the communication (e.g. informing, influencing, coordinating, relating) (Te'eni, 2001) may also be important. Traditionally, GSS technologies have been examined in the context of a very specific task involving communication, such as brainstorming or decision-making. While email can be used for those tasks, it can also be used to initiate and sustain social relationships, send single messages to a large number of people, and communicate with others outside the confines of a particular group. Given the increased use of other text-based CMC applications (such as synchronous messaging) in organizations (Tischelle, 2001), future research should pay particular attention to the nature of the communication (social/task-related), the characteristics of the applications, the components of the tasks, and individual characteristics, such as CMC anxiety, in order to more fully understand how CMC applications can enhance (rather than hinder) communication.

Although there were strong relationships between CMC anxiety and CMC attitude and between CMC attitude and use, the variance explained in CMC use was not as large as expected. This may be due, in part, to the phenomenon of critical mass, as discussed by both Lou et al. (2000) and Markus (1990). While the individuals in this sample varied considerably in their attitudes and anxieties, they may have used email because so many other people they know used it. Evidence for this exists in the relationship between CMC anxiety and attitude toward using CMC. The subjects with high CMC anxiety used email for any variety of reasons; however, they continued to report negative attitudes toward using it. Understanding the role of critical mass in overcoming anxiety is an important direction for future research: at what point are enough relevant others using the CMC technology, such that an individual will put aside his/her anxiety in order to communicate?

Implications for Practice

This study also has implications for practice. Specifically, it identifies an important application-specific, rather than general-level, characteristic that should be considered when selecting individuals to participate in distance education, virtual teams, and other situations requiring technology-mediated communication. Further, this study highlights the importance of understanding the nature and context of CMC application use when assessing the probability of individual success with a given medium.

Individuals who have CMC anxiety may be at risk in those electronic environments that rely heavily on CMC for interactions, such as distance education and virtual teams. The findings indicate that some individuals will have more negative attitudes when put in a situation where they must communicate using text-based CMC. This combination of anxiety and negative attitude can interfere with an individual's willingness to participate in team and group communications (Lederman 1982, Phillips and Metzger 1973), a key element of virtual team, decision-making, and mediated learning environments (Leidner and Jarvenpaa 1995). However, it must be noted that simply capturing an individual's level of anxiety with communication and anxiety with technology is not sufficient to determine attitude and subsequent use of a CMC. The results of this study indicate that organizations need to understand, at an application level, the anxieties for potential users of a technology. Although individuals may have certain levels of communication and computer anxiety, it is the anxiety relevant *specifically* to using the CMC that will determine the individual's attitude and subsequent use of the CMC.

Assessing an individual's level of CMC anxiety prior to his/her interaction with CMC technologies is but one means of ensuring positive outcomes from technology-mediated environments. When the results of this study are compared to those of Karahanna et al. (2002), another set of critical management touchstones emerges. Specifically, those factors associated with the nature of the communication, such as the degree of anonymity and the social versus task-specific focus of the interaction are also important for managers to consider. By identifying the characteristics relevant in the technology-mediated communication environment and acknowledging the individual characteristic of CMC anxiety, individuals will be able to make more informed decisions regarding their participation in virtual teams and the many online learning environments available. Additionally, the focus on individual characteristics and communication environment may suggest alternative methods for content delivery, discussion, and technology to ensure that all participants can interact and reap the most benefit from these environments.

Directions for Future Research

Several opportunities for future research remain. First, examining the model in an organizational context will aid in assessing external validity and in understanding more fully the implications of organizational use of CMC applications. Further, research in organizations can more closely connect use of CMC applications to individual performance. Prior research regarding computer anxiety and communication apprehension suggests that lower levels of performance may be expected when anxious individuals are put in situations that require them to perform the behavior associated with the anxiety (e.g., Patterson and Ritts, 1996; Richmond and McCroskey, 1992; Webster et al., 1990). By exploring the model in organizational contexts, future research can incorporate performance outcomes that are closely connected to CMC anxiety and use, such as performance appraisals, thus providing a richer understanding of the consequences of CMC anxiety.

Second, exploring the model in technology-supported or distance education environments will provide a further test of its external validity. Leidner and Jarvenpaa (1993) proposed that research determines the student characteristics that make learning by computer-mediated techniques more or less effective. CMC anxiety is likely to be one of those characteristics. Incorporating CMC anxiety into models of technology supported learning (e.g., Leidner and Jarvenpaa, 1995) may provide a deeper

understanding of learner factors and may also shed light on the moderators of the relationships among teaching methods, class interaction, and learning. Further, examining the model as it relates to instructors should provide insight into which professors will adapt best to being virtual professors and dealing with the associated changes in their affective role of relating to students (Coppola et al., 2002).

Third, the exact role of CMC anxiety remains a question for future research. In this study, we chose an approach consistent with classical anxiety theorists: anxiety as a determinant of behavior. Prior research in IS has examined beliefs as mediators of the relationship between anxiety and behavior, consistent with social anxiety theorists. For example, Venkatesh (2000) demonstrated that computer anxiety is a significant antecedent to perceived ease of use. Other research has demonstrated that computer anxiety is an antecedent to usefulness and attitudes toward using technology (Igbaria, 1993; Winter et al., 1998). As discussed above, Karahanna et al. (2002) found a different relationship between anxieties and relative advantage than that found here between anxieties and attitudes. Given these differences in the pattern of results, future research should examine alternative relationships among anxiety (distal and proximal), ease of use, usefulness, other beliefs (e.g., relative advantage), and attitudes when the object of adoption is a form of CMC technology.

Finally, future research should be targeted at understanding individual perceptions regarding the nature of CMC technologies in other contexts. In this study, email was associated with oral communication apprehension. As previously noted, this result may be due to the broader communication functions (more casual and social communications) performed by the subjects in this study. These same individuals in other settings (e.g., work, professional) may have different perceptions of the use of email and thus may experience other forms of communication anxiety when faced with its use. An examination of the role of CMC anxiety in relation to the various theories of media (e.g., Carlson and Zmud, 1999; Daft and Lengel, 1986; Sproull and Kiesler, 1986) may help explain the complexity associated with media choice and use. Qualitative studies that delve into the characteristics that lead people to associate various CMC applications with written and/or oral communication would be extremely useful in advancing our understanding of current and future use of CMC applications. A great deal of work remains to understand CMC use, particularly as both individual technology perceptions and technologies continue to evolve over time.

Conclusion

This study has proposed, developed, and provided preliminary validation for a construct of CMC anxiety. The average variance extracted and cross factor analyses demonstrate that CMC anxiety is a unique (application-specific) construct, distinct from computer anxiety and oral and written communication apprehension. Furthermore, we have presented a new nomological structure that positions CMC anxiety as a mediating construct between the more general constructs of computer anxiety, communication apprehension, and CMC familiarity, and the dependent constructs of CMC attitudes and use. This study provides insights into some potential individual reactions to computing technologies that incorporate communication components. It also lays the foundation, through the nomological structure, for research that aims to develop our understanding of the relationship among communication technologies, the people who use them, and the resulting outcomes of their use.

Acknowledgements

The authors would like to thank the senior editor and the anonymous reviewers for their constructive comments and attention to detail. We would also like to thank Alan Dennis and Elena Karahanna for their insightful comments on earlier versions of this paper. The faculty in the department of Information Systems & Quantitative Sciences at Texas Tech University also provided helpful comments and ideas. Finally, we would like to thank Rick Schrimper for facilitating our data collection efforts.

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Appendix

Tests For Email Anxiety Mediation

1. Show that the initial variable is correlated with the mediator.

Path			Path Coefficient
CA	→	CMC Anxiety	**0.18****
OC	→	CMC Anxiety	**0.19*****
WC	→	CMC Anxiety	**0.00**
CMCFAM	→	CMC Anxiety	**-0.22****

*p<0.05, **p<0.01, ***p<0.001, Bold indicates paths that should be significant

2. Show that the mediator affects the outcome variable.

Path			Path Coefficient
CMC Anxiety	→	CMC Attitude	**-0.58*****

*p<0.05, **p<0.01, ***p<0.001, Bold indicates paths that should be significant

3. Show that the effect of the initial variable on the outcome variable is zero, controlling for the mediator.

Path			Path Coefficient
CA	→	CMC Anxiety	**0.18****
CA	→	CMC Attitude	-0.08
OC	→	CMC Anxiety	**0.18*****
OC	→	CMC Attitude	-0.04
WC	→	CMC Anxiety	**0.00**
WC	→	CMC Attitude	-0.03
CMCFAM	→	CMC Anxiety	**-0.23****
CMCFAM	→	CMC Attitude	0.12

*p<0.05, **p<0.01, ***p<0.001, Bold indicates paths that should be significant

Journal of the Association for Information Systems
ISSN: 1536-9323