Computer Self-Efficacy: Development of a Measure and Initial Test

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Abstract

This paper discusses the role of individuals' beliefs about their abilities to competently use computers (computer self-efficacy) *in the determination of computer use. A survey of Canadian managers and professionals was conducted to develop and validate a measure of computer self-efficacy and to assess both its impacts and antecedents. Computer self-efficacy was found to exert a significant influence on individuals' expectations of the outcomes of using computers, their emotional reactions to computers (affect and anxiety), as well as their actual computer use. An individual's self-efficacy and outcome expectations were found to be positively influenced by the encouragement of others in their work group, as well as others' use of computers. Thus, self-efficacy represents an important individual trait, which moderates organizational influences (such as encouragement and support) on an individual's decision to use computers. Understanding self-efficacy, then, is important to the successful implementation of systems in organizations. The existence of a reliable and valid measure of self-efficacy makes assessment possible and should have implications for organizational support, training, and implementation.*

Keywords: User behavior, psychology, measurement, causal models, partial least squares

ISRL Categories: GB03,GB02

Introduction

Understanding the factors that influence an individual's use of information technology has been a goal of MIS research since the mid-1970s, when organizations and researchers began to find that adoption of new technology was not living up to expectations. Lucas (1975, 1978) provides some of the earliest evidence of the individual or behavioral factors that influenced IT adoption. The first theoretical perspective to gain widespread acceptance in this research was the Theory of Reasoned Action (Fishbein and Ajzen, 1975). This theory maintains that individuals would use computers *if* they could see that there would be positive benefits (outcomes) associated with using them.

This theory is still widely used today in the IS literature and has demonstrated validity. However, there is also a growing recognition that additional explanatory variables are needed (e.g., Thompson, et al., 1991; Webster and Martocchio, 1992). One such variable, examined in this research, comes from the writings of Albert Bandura and his work on Social Cognitive Theory (Bandura, 1986).

Self-efficacy, the belief that one has the capability to perform a particular behavior, is an important construct in social psychology. Self-efficacy perceptions have been found to influence decisions about what behaviors to undertake (e.g., Bandura, et al., 1977; Betz and Hackett, 1981), the effort exerted and persistence in attempting those behaviors (e.g., Barling and Beattie, 1983; Brown and Inouye, 1978), the emotional responses (including stress and anxiety) of the individual performing the behaviors (e.g., Bandura, et al., 1977; Stumpf, et al.,1987), and the actual performance attainments of the individual with respect to the behavior (e.g., Barling and Beattie, 1983; Collins, 1985; Locke, et al., 1984; Schunk, 1981; Wood and Bandura, 1989). These effects have been shown for a wide variety of behaviors in both clinical and managerial settings. Within a management context, self-efficacy has been found to be related to attendance (Frayne and Latham, 1987; Latham and Frayne, 1989), career choice and development (Betz and Hackett, 1981; Jones, 1986), research productivity (Taylor, et al., 1984), and sales performance (Barling and Beattie, 1983).

Several more recent studies (Burkhardt and Brass, 1990; Gist, et al.,1989; Hill, et al., 1986; 1987; Webster and Martocchio, 1992; 1993) have examined the relationship between self-efficacy with respect to using computers and a variety of computer behaviors. These studies found evidence of a relationship between self-efficacy and registration in computer courses at universities (Hill, et al., 1987), adoption of high technology products (Hill, et al., 1986) and innovations (Burkhardt and Brass, 1990), as well as performance in software training (Gist, et al., 1989; Webster and Martocchio, 1992; 1993). All of the studies argue the need for further research to explore fully the role of self-efficacy in computing behavior.

This paper describes the first study in a program of research aimed at understanding the impact of self-efficacy on individual reactions to computing technology. The study involves the development of a measure for computer self-efficacy and a test of its reliability and validity. The measure was evaluated by examining its performance in a nomological network, through structural equations modeling. A research model for this purpose was developed with reference to literature from social psychology, as well as prior IS research.

The paper is organized as follows. The next section presents the theoretical foundation for this research. The third section discusses the development of the self-efficacy measure. The research model is described and the hypotheses are presented in the following section. Then, the research methodology is outlined, and the results of the analyses are presented. The paper concludes with a discussion of the implications of these findings and the strengths and limitations of the research.

Theoretical Background—Social Cognitive Theory

Social Cognitive Theory (Bandura, 1977; 1978; 1982; 1986) is a widely accepted, empirically validated model of individual behavior. It is based on the premise that environmental influences such as social pressures or unique situational characteristics, cognitive and other personal factors including personality as well as demographic characteristics, and behavior are reciprocally determined. Thus, individuals choose the environments in which they exist in

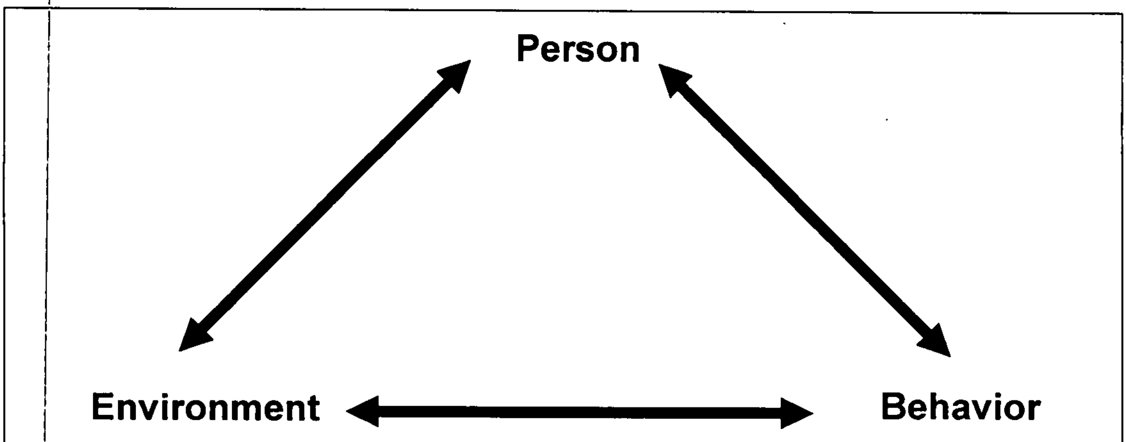

Figure 1. Triadic Reciprocality or Reciprocal Determinism

addition to being influenced by those environments. Furthermore, behavior in a given situation is affected by environmental or situational characteristics, which are in turn affected by behavior. Finally, behavior is influenced by cognitive and personal factors, and in turn, affects those same factors. This relationship, which Bandura refers to as "triadic reciprocality," is shown in Figure 1.

While Social Cognitive Theory has many dimensions, this research is particularly concerned with the role of cognitive factors in individual behavior. Bandura advances two sets of expectations as the major cognitive forces guiding behavior. The first set of expectations relates to outcomes. Individuals are more likely to undertake behaviors they believe will result in valued outcomes than those they do not see as having favorable consequences. The second set of expectations encompasses what Bandura calls *self-efficacy*, or beliefs about one's ability to perform a particular behavior. Self-efficacy influences choices about which behaviors to undertake, the effort and persistence exerted in the face of obstacles to the performance of those behaviors, and thus, ultimately, the mastery of the behaviors.

Outcome expectations have been considered by many IS researchers. The usefulness construct measured by Davis (1989) and Davis, et al. (1989) reflects beliefs (or expectations) about outcomes, as does the salient beliefs construct used by Davis, et al. (1989). Thompson, et al. (1991) tested a model of personal computer use based on Triandis (1980), which included perceived consequences as a central determinant of behavior. Questions measuring attitudes, such as those used by Robey (1979), also frequently reflect outcome expectations.

While outcome expectations have been considered by many IS researchers, the role of self-efficacy has received less attention. A few studies (e.g., Cheney and Nelson, 1988) have tried to develop measures of computer skill using self-reports. These measures would incorporate some aspects of computer self-efficacy, but are designed to measure actual capability rather than self-efficacy. Only a handful of studies explicitly consider the role of self-efficacy in computing behavior (Burkhardt and Brass, 1990; Gist, et al., 1989; Hill, et al., 1987; Webster and Martocchio, 1992; 1993). These studies provide initial evidence that self-efficacy has an important influence on individual reactions to computing technology.

Defining self-efficacy

Bandura (1986) defines self-efficacy as:

> People's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses (p. 391).

This definition highlights a key aspect of the self-efficacy construct. Specifically, it indicates the importance of distinguishing between component skills and the ability to "organize and execute courses of action." For example, in discussing driving self-efficacy, Bandura (1984) distinguishes between the component skills (steering, braking, signalling) and the behaviors one can accomplish (driving in freeway traffic, navigating twisting mountain roads). Similarly, Collins (1985) distinguishes between the component skills of mathematics (choice of operations and basic arithmetic skills) and mathematics behaviors (solving particular word problems). Thus, computer self-efficacy represents an individual's perceptions of his or her ability to use computers in the accomplishment of a task (ie., using a software package for data analysis, writing a mailmerge letter using a word processor), rather than reflecting simple component skills (ie., formatting diskettes, booting up a computer, using a specific software feature such as "bolding text" or "changing margins").

The concept of self-efficacy, while representing a unique perception, is similar to a number of other motivational constructs such as effort-performance expectancy (Porter and Lawler, 1968), locus of control, and self-esteem. Gist (1987) provides a detailed discussion of the similarities and differences between self-efficacy and these other motivational constructs.

Dimensions of Self-Efficacy

In defining self-efficacy, it is also important to consider the relevant dimensions of self-efficacy judgments. Self-efficacy judgments differ on three distinct, but interrelated, dimensions: magnitude, strength, and generalizability. The *magnitude* of self-efficacy refers to the level of task difficulty one believes is attainable. Individuals with a high magnitude of self-efficacy will see themselves as able to accomplish difficult tasks, while those with a low self-efficacy magnitude will see themselves as only able to execute simple forms of the behavior.

Self-efficacy *strength* refers to the level of conviction about the judgment. It also reflects the resistance of self-efficacy to apparently disconfirming information (Brief and Aldag, 1981). Individuals with a weak sense of self-efficacy will be frustrated more easily by obstacles to their performance and will respond by lowering their perceptions of their capability. By contrast, individuals with a strong sense of efficacy will not be deterred by difficult problems, will retain their sense of self-efficacy, and as a result of their continued persistence are more likely to overcome whatever obstacle was present.

Generalizability of self-efficacy indicates the extent to which perceptions of self-efficacy are limited to particular situations. Some individuals may believe they are capable of performing some behavior, but only under a particular set of circumstances, while others might believe they can execute the particular behavior under any circumstances and also perform behaviors that are slightly different.

Computer Self-Efficacy

Computer self-efficacy, then, refers to *a judgment of one's capability to use a computer.* It is not concerned with what one has done in the past, but rather with judgments of what could be done in the future. Moreover, it does not refer to simple component subskills, like formatting diskettes or entering formulas in a spreadsheet. Rather, it incorporates judgments of the ability to apply those skills to broader tasks (e.g., preparing written reports or analyzing financial data). Below, the dimensions are defined further in the context of computer self-efficacy.

Magnitude. The magnitude of computer self-efficacy can be interpreted to reflect the level of capability expected. Individuals with a high computer self-efficacy magnitude might be expected to perceive themselves as able to accomplish more difficult computing tasks than those with lower judgments of self-efficacy. Alternatively, computer self-efficacy magnitude might be gauged in terms of support levels required to undertake a task. Individuals with a high magnitude of computer self-efficacy might judge themselves as capable of operating with less support and assistance than those with lower judgments of self-efficacy magnitude.

Strength. The strength of a computer self-efficacy judgment refers to the level of conviction about the judgment, or the confidence an individual has regarding his or her ability to perform the various tasks discussed above. Thus, not only would individuals with high computer self-efficacy perceive themselves as able to accomplish more difficult tasks (high magnitude), but they would display greater confidence about their ability to successfully perform each of those behaviors.

Generalizability. Self-efficacy generalizability reflects the degree to which the judgment is limited to a particular domain of activity. Within a computing context, these domains might be considered to reflect different hardware and software configurations. Thus, individuals with high computer self-efficacy generalizability would expect to be able to competently use different software packages and different computer systems, while those with low computer self-efficacy generalizability would perceive their capabilities as limited to particular software packages or computer systems.

Development of a Computer Self-Efficacy Measure

The first step in our research program involved the development of a measure of computer self-efficacy. A few studies had previously measured self-efficacy in a computing context (Burkhardt and Brass, 1990; Gist, et al., 1989; Hill, et al., 1986; 1987; Webster and Martocchio, 1992; 1993), and a review of these measures contributed to the development of the current measure.

Previous approaches to computer self-efficacy measurement

A review of the literature concerning self-efficacy and computers uncovered five existing measures. One utilized a three-item scale to measure computer self-efficacy in a study of the early adoption of computing technologies (Burkhardt and Brass, 1990). This measure requested general perceptions about an individual's ability to effectively use computers in his or her job. Another measure studied the influence of computer self-efficacy on enrollment in a computer course (Hill, et al., 1987). The measure used a four-item scale, revised from a scale used in an earlier study (Hill, et al., 1986). This measure did not, however, appear to be measuring self-efficacy. Three of the items used measured general perceptions about the nature of computing, such as "only a few experts really understand how computers work." Responses to these statements may or may not reflect computer self-efficacy. Still another measure studied the influence of computer self-efficacy on training performance (Webster and Martocchio, 1992; 1993). A five-item scale was developed to measure software efficacy, based on work by Hollenbeck and Brief (1987). This measure, while it does seem to capture elements of self-efficacy, also incorporated other concepts, in addition to self-efficacy. For example, one item, used to measure self-efficacy before training, asked the respondents the extent to which they agreed with the statement "I expect to become very proficient at using WordPerfect merging." Responses to this item would also reflect expectations of the quality or content of the training program and might reflect elements of interest (in becoming proficient at WordPerfect merging).

The last two measures studied the relationship between computer self-efficacy, computer training methods, and training performance, and both were developed by Gist, et al. (1989). The first concerned the general construct, computer self-efficacy. The second focused on a measure specific to using a spreadsheet package. Neither of the measures could be considered task focused. Many of the items reflected component skills, such as the ability to boot up a computer from diskette or the ability to enter formulas in a spreadsheet cell, rather than the potential to use the software in the accomplishment of a task.

This examination of existing measures of computer self-efficacy indicated the need for additional development work. The Gist, et al. measure focused on component skills of behavior rather than assessments of one's ability to carry out some task and is thus an inadequate reflection of self-efficacy. The Hill, et al. measure, and to some extent the Webster and Martocchio measure, incorporated other constructs in addition to self-efficacy. Thus, while existing measures could provide useful insights into the measurement of computer self-efficacy, we felt it was important to develop a measure that would overcome these limitations.

The current approach to measurement

In developing a new measure of computer self-efficacy, reference was made to the existing measures, in particular the works of Gist, et al. (1989), Webster and Martocchio (1992; 1993), and Burkhardt and Brass (1990). While each of these measures has some limitations, they offer insights that were incorporated into our measure.

Based on these existing scales and the definition of computer self-efficacy as an individual's perception of his or her ability to use a computer in the accomplishment of a job task, a 10-item measure of computer self-efficacy was developed (see Appendix). The measure is task focused. That is, it does not reflect simple component skills like starting software packages and saving files. The measure also incorporates elements of task difficulty (in the different levels of support presented in each item) that capture differences in self-efficacy magnitude. This approach is similar to one taken by Frayne and Latham (1987) in measuring attendance self-efficacy, and by Condiotte and Lichenstein (1981) and Diclemente (1981) in measuring self-efficacy concerning smoking cessation. Self-efficacy strength is captured in the response scale (which measures level of confidence in the judgments of ability). In our study, self-efficacy generalizability is not directly studied. The focus for this work is on self-efficacy with respect to using

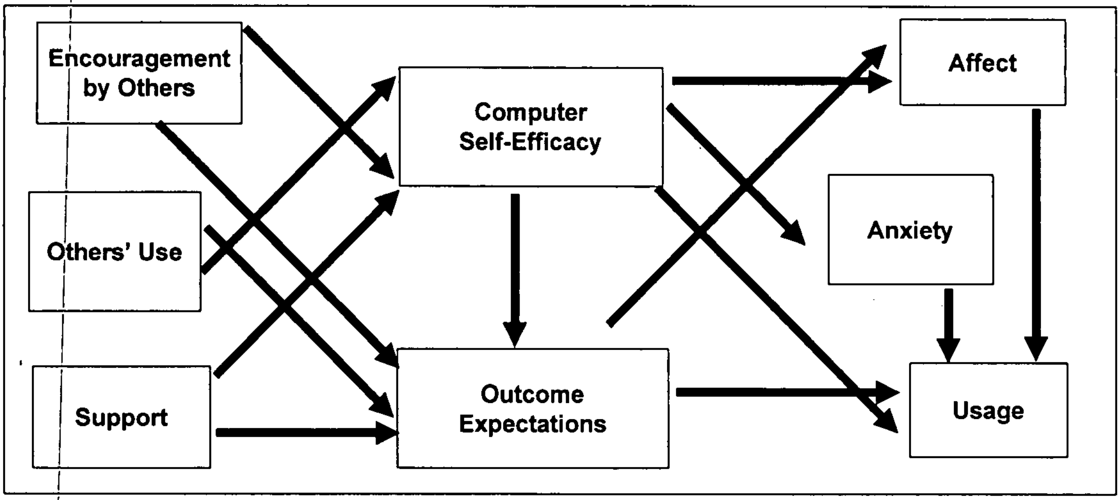

Figure 2. Research Model

computers in general. Future research is needed to assess generalizability.

Scoring the self-efficacy measure can be accomplished in two ways. First, the number of "YES" answers can be counted, which provides an indication of self-efficacy magnitude. Second, the responses on the confidence scale can be summarized, counting 0 for a "NO" response. This approach encompasses both self-efficacy magnitude and strength and is thus most useful for data analysis.

Research Model and Hypotheses

The research model tested in this study (Figure 2) was developed with reference to the Social Cognitive Theory literature, and the existing base of research in the information systems literature. As noted earlier, Social Cognitive Theory posits an ongoing reciprocal interaction between cognitive factors, environment and behavior. While the richness of this conceptualization cannot be completely conveyed in a linear, recursive model, important insights into the relationships among such variables can be achieved nonetheless.

Elements of all three forces (cognitive, environmental, and behavioral) were incorporated into the research model. The choice of which specific elements to include for each factor was based on existing IS research. Thus, the model helps to integrate the findings from previous IS research by considering several key constructs within the context of Social Cognitive Theory. As Figure 2 indicates, the encouragement of use by others in the individuals' reference group, the actual use of computers by others in that reference group, and the organizational support for computer use, are each held to influence self-efficacy and outcome expectations. Self-efficacy influences usage directly, as well as indirectly, through outcome expectations, affect,[1] and anxiety. Outcome expectations influence usage directly, as well as indirectly, through affect. Finally, affect and anxiety are each held to influence usage. Thus, the research model encompasses 14 hypotheses regarding individual reactions to computing technologies. The following paragraphs state the theoretical rationale for each of these hypotheses. Empirical evidence from both the Social Cognitive Theory

[1] The term *affect* is used throughout this study to refer to positive affect. Negative affect was not investigated.

and information systems literature is used to reinforce these arguments.

Encouragement by others

The encouragement of others within the individual's reference group—the people to whom an individual looks to obtain guidance on behavioral expectations—can be expected to influence both self-efficacy and outcome expectations. Encouragement of use represents "verbal persuasion," one of the four major sources of efficacy information (Bandura, 1986). Individuals rely, in part, on the opinions of others in forming judgments about their own abilities. Thus, encouragement from others influences self-efficacy, if the source of encouragement is perceived as credible (Bandura, 1986). Encouragement of use may also exert an influence on outcome expectations. If others in the reference group, particularly those in the individual's work organization, encourage the use of computing technology, the individual's judgments about the likely consequences of the behavior will be affected. At the very least, the individual will expect that his or her coworkers will be pleased by the behavior. Thus, the first two hypotheses are as follows:

H1: The higher the encouragement of use by members of the individual's reference group, the higher the individual's computer self-efficacy.

H2: The higher the encouragement of use by members of the individual's reference group, the higher the individual's outcome expectations.

Others' use

Encouragement of use is one source of influence on self-efficacy and outcome expectations. The actual behavior of others with respect to the technology is a further source of information used in forming self-efficacy and outcome expectations. Learning by observation, or behavior modeling, has been shown to be a powerful means of behavior acquisition (Latham and Saari, 1979; Manz and Sims, 1986; Schunk, 1981). Behavior modeling influences behavior in part through its influence on self-efficacy (Bandura, et al., 1977) and also through its influence on outcome expectations by demonstrating the likely consequences of the behavior (Bandura, 1971). Thus, Hypotheses 3 and 4 reflect the influence of the modeling behavior of others in the individual's reference group:

H3: The higher the use of the technology by others in the individual's reference group, the higher the individual's computer self-efficacy.

H4: The higher the use of the technology by others in the individual's reference group, the higher the individual's outcome expectations.

Support

The support of the organization for computer users can also be expected to influence individuals' judgments of self-efficacy. The availability of assistance to individuals who require it should increase their ability and thus, their perceptions of their ability. Support can also be expected to influence outcome expectations because this support reflects the formal stance of the organization toward the behavior, and may therefore provide clues about the likely consequences of using the computer. Thus, Hypotheses 5 and 6 are as follows:

H5: The higher the support for computer users in the organization, the higher the individual's computer self-efficacy.

H6: The higher the support for computer users in the organization, the higher the individual's outcome expectations.

Computer self-efficacy

Social Cognitive Theory affords a prominent role to self-efficacy perceptions. Self-efficacy judgments are purported to influence outcome expectations since "the outcomes one expects derive largely from judgments as to how well one can execute the requisite behavior" (Bandura, 1978, p. 241). The hypothesis is:

H7: The higher the individual's computer self-efficacy, the higher his/her outcome expectations.

Self-efficacy judgments are held to have a substantial influence on the emotional responses of the individual. Individuals will tend to prefer and enjoy behaviors they feel they are capable of performing and to dislike those they do not feel they can successfully master. Several studies in psychology provide support for this contention. One found that self-efficacy perceptions were significantly related to affect (or interest) for particular occupations (Betz and Hackett, 1981). Others found that individuals experience anxiety in attempting to perform behaviors they do not feel competent to perform (Bandura, et al., 1977); Stumpf, et al., 1987). These relationships are predicted by Hypotheses 8 and 9 as follows:

H8: The higher the individual's computer self-efficacy, the higher his/her affect (or liking) of computer use.

H9: The higher the individual's computer self-efficacy, the lower his/her computer anxiety.

Self-efficacy perceptions are predicted to be a significant precursor to computer use. This hypothesis is supported by research regarding computer use (Burkhardt and Brass, 1990; Hill, et al., 1987) and research in a variety of other domains (Bandura, et al., 1977; Betz and Hackett, 1981; Frayne and Latham, 1987). While self-efficacy has not been explicitly measured in other IS research, there is some evidence to support the influence of self-efficacy. Maish (1979) included a variable that measured the extent to which the user felt "prepared to use" the new system. This variable is conceptually quite similar to self-efficacy and was found to be related to the degree of use. Similarly, the "willingness to change" construct measured by Barki and Huff (1990), which in part reflects self-efficacy, was found to be related to use of a decision support system.

H10: The higher the individual's computer self-efficacy, the higher his/her use of computers.

Outcome expectations

Outcome expectations also exert a significant influence on individuals' reactions to computing technology. The expected consequences of a behavior may be construed as an influence on affect (or liking) for the behavior, through a process of association. The satisfaction derived from the favorable consequences of the behavior becomes linked to the behavior itself, causing an increased affect for the behavior (Bandura, 1986). This gives rise to the following hypothesis:

H11: The higher the individual's outcome expectations, the higher his/her affect (or liking) for the behavior.

Outcome expectations are also an important precursor to usage behavior. According to Social Cognitive Theory, individuals are more likely to engage in behavior they expect will be rewarded (or will result in favorable consequences). Support for this contention can be found in a study of aggressive behavior in children (Bandura, 1971). The hypothesis is also supported by IS research (Davis, et al., 1989; Hill, et al., 1987; Pavri, 1988; Thompson, et al., 1991). Thus, the hypothesis is:

H12: The higher the individual's outcome expectations, the higher his/her use of computers.

Affect

Individuals' affect (or liking) for particular behaviors can, under some circumstances, exert a strong influence on their actions. Television preferences, for example, are almost solely based on affect (Bandura, 1986). Consumer choices are also often made on the basis of affective reactions (Engle, et al., 1986). With respect to computers, the evidence is not clear. Thompson, et al. (1991), for example, found no relationship between affect for PC use and the use of personal computers among managers. However, as the authors acknowledge, the measure of affect was somewhat weak, and thus, the finding may simply be a reflection of the measurement.

Given the theoretical support for such a link, within Social Cognitive Theory and other behavior theories (ie., Fishbein and Ajzen, 1975; Triandis, 1980), the relationship between an individual's liking for computer use and his or her actual behavior is worthy of further study. Thus, the next hypothesis is:

H13: The higher the individual's affect for computer use, the higher his/her use of computers.

Anxiety

Feelings of anxiety surrounding computers are expected to negatively influence computer use. Not surprisingly, people are expected to avoid behaviors that invoke anxious feelings. A number of studies have demonstrated a relationship between computer anxiety and the use of computers (Igbaria, et al., 1989; Webster, et al., 1990).

H14: The higher the individual's computer anxiety, the lower his/her use of computers.

Research Design

Subjects

The target population for the validation study was knowledge workers—individuals whose work requires them to process large amounts of information. This category includes most managers, as well as professionals such as insurance adjusters, financial analysts, researchers, consultants, and accountants. The subscriber list of a Canadian business periodical was obtained as a sampling frame to reach this population. A recent readership survey of this periodical indicated that the subscribers were primarily employed in managerial positions, at all levels of the organization. Over 88 percent have college or university degrees. Forty percent have graduate degrees (mostly MBAs). They represented all functional areas of business and a broad range of industries, including manufacturing, services, finance, communications, advertising, government, oil and gas, and retailing. Eighty percent use a personal computer in their work. One hundred of these subscribers were randomly selected for the pilot study, and 2000 were randomly selected for the main study.

Measures

In addition to the self-efficacy measure described earlier, scales were required for each of the other constructs in the model. A review of the literature was undertaken to identify construct definitions and any existing measures. Based on this review, scales were formed for each of the constructs in the model. Previously developed and validated instruments were adopted directly. A few constructs required adaptations of existing measures. Each of the measures used in the study is described below.

Encouragement by Others. The extent to which use of computers was encouraged by others in the individual's reference group was measured by seven items. Respondents were asked to assess, on a five-point scale, the extent to which their use of computers was encouraged by: (1) their peers in their work organization, (2) their peers in other organizations, (3) their family, (4) their friends, (5) their manager, (6) other management, and (7) their subordinates.

Others' Use. The extent to which computers were actually used by others in the individual's reference group was also assessed using seven items. Respondents were asked to indicate, on a five-point scale, the extent to which (1) their peers in their work organization, (2) their peers in other organizations, (3) their family, (4) their friends, (5) their manager, (6) other management, and (7) their subordinates actually used computers.

Support. The organizational support for computer users was measured by six items, drawn from Thompson, et al. (1991). The respondents were asked to indicate, on a five-point scale, the extent to which assistance was available in terms of equipment selection, hardware difficulties, software difficulties, and specialized instruction. They also rated (on the same scale) the extent to which their coworkers were a source of assistance in overcoming difficulties and their perception of the organization's overall support for computer users.

Outcome Expectations. An 11-item measure of outcome expectations was developed based on a review of existing measures in the IS literature. For example, Davis' (1989) measure of usefulness deals primarily with outcome expectations. Similarly, Pavri's (1988) beliefs construct, and three of Thompson, et al.'s (1991) constructs reflect the expected consequences of using a computer. The measure presented a variety of outcomes that might be associated with computer use, including increased productivity, decreased reliance on clerical support, enhanced quality of work output, feelings of accom- plishment, and enhanced status. Respondents were asked to indicate, on a five-point scale, how likely they thought it was that each of these outcomes would result from their use of computers.

Affect. Affect was measured in this study by five items, drawn from the Computer Attitude Scale (Loyd and Gressard, 1984). Respondents indicated, on a five-point scale, the extent to which they agreed or disagreed with items such as "I like working with computers," and "Once I get working on the computer, I find it hard to stop."

Anxiety. Anxiety was measured by the 19-item Computer Anxiety Rating Scale (Heinssen, et al., 1987). This scale was found to be valid for measuring computer anxiety (Webster, et al., 1990). Respondents indicated, on a five-point scale, the extent to which they agreed or disagreed with statements such as "I feel apprehensive about using computers."

Use. Computer use was measured by four items, reflecting the duration and frequency of use of computers at work and the duration of use of computers at home on weekdays and weekends.

Procedures

A pretest of the questionnaire (including all construct measures) was conducted with 40 people, including both academics and practitioners. Each of the respondents completed the questionnaire and provided feedback about the process and the measures. Overall, the respondents indicated that the questionnaire was relatively clear and easy to complete. A number of suggestions were made concerning the wording of particular items and the overall structure of the questionnaire, and these suggestions were incorporated into the revised instrument.

A pilot study involving 100 individuals from the sampling frame was also conducted. The purpose of the pilot study was (a) to gain additional feedback about the questionnaire instrument and (b) to assist in determining the size of the mailing for the main study. With respect to the first objective, respondents were asked to provide any comments on the questionnaire content or structure. Moreover, they were asked to indicate whether they would be willing to participate in an interview with the authors. Five of the respondents were interviewed. During the interviews, the respondents were probed about their responses to the different questionnaire items, in order to ensure that questionnaire responses were consistent with other statements regarding computer attitudes and beliefs. With respect to the second objective, determining sample size for the main study, the response rate was estimated and compared with the data requirements for analyzing structural equations models. For maximum flexibility in analyzing the data, a minimum of 400 responses was considered necessary (five times the number of variables in the questionnaire). However, in order to provide enough data for a holdback sample (so that measurement revisions could be made with one set of data and then confirmed with the other), this figure was doubled. The response rate for the pilot study was 60 percent. Assuming a more conservative 50 percent response rate, at least 1600 surveys were required.

For the main study, 2,000 people were randomly selected from the subscriber list. The survey was mailed to the selected individuals with a cover letter indicating the purpose and importance of the study. In order to maximize the response rate, a stamped return envelope was provided with the survey, and a reminder letter was sent to those individuals who had not responded after three weeks. These procedures have been found to aid in maximizing responses to mail surveys (Dillman, 1978).

Responses

Of the 2,000 surveys mailed, 1,020 were completed and returned, and 91 were returned as undeliverable. Thus, the response rate was 53.4 percent. While this response rate is acceptable for research of this nature, non-response bias was a concern. Normally, non-response bias would be assessed by contacting a sample of non-respondents and obtaining information from them about the survey measures, in order to assess whether they differed from respondents. Armstrong and Overton (1977), however, argue that comparing early respondents to late respondents also provides information that can be used to predict non-response bias. Essentially, they claim that late respondents are likely to be similar to non-respondents, since they required prompting to respond and were therefore presumably less eager. Thus, if late respondents and early respondents do not differ in their scores, it is less likely that non-respondents will differ significantly from respondents. While this is a less strong approach to assessing non-response bias, it does provide some indication. Using the early (first week) and late (after 6 weeks) responses to the questionnaire, a multivariate analysis of variance was undertaken to determine whether differences in response time (early versus late) were associated with different responses. The test indicated no significant differences in any of the variables of interest (Wilks' $\Lambda = 0.97$; $p = 0.735$).

The 1,020 respondents were mostly male (83 percent) and had an average age of 41 years. They represented all levels of management and were evenly split between line and staff positions. They worked in a variety of functional areas, including accounting and finance (18 percent), general management (30 percent), and marketing (16 percent). Forty-three percent had completed one college or university degree; a further 40 percent had completed post-graduate degrees.The respondents' educational backgrounds were primarily in business (61 percent), arts (10 percent), science (14 percent), and social science (5 percent).

Data Analysis

Assessment of the research model was conducted using Partial Least Squares (PLS). PLS is a regression-based technique that can analyze structural models with multiple-item constructs and direct and indirect paths. PLS produces loadings between items and constructs (similar to principal components analysis) and standardized regression coefficients between constructs. R^2 values for dependent constructs are also produced. The technique has gained acceptance in marketing and organizational behavior research and was first used in the MIS literature by Rivard and Huff (1988) in an examination of the factors of success for end-user computing. It has subsequently been used by Grant and Higgins (1991) and Thompson, et al. (1991) in studies of computerized performance monitoring and personal computer utilization, respectively. Barclay, et al. (in press) provide a comprehensive description of PLS analysis.

PLS analysis involves two stages: (a) assessment of the measurement model, including the reliability and discriminant validity of the measures, and (b) assessment of the structural model. For the assessment of the measurement model, individual item loadings and internal consistency reliabilities are examined as a test of reliability. Individual item loadings and internal consistencies greater than 0.7 are considered adequate (Fornell and Larcker, 1981). For discriminant validity, items should load higher on their own construct than on other constructs in the model, and the average variance shared between the constructs and their measures should be greater than the variances shared between the constructs themselves.

The structural model and hypotheses are tested by examining the path coefficients (which are standardized betas). In addition to the individual path tests, the explained variance in the dependent constructs is assessed as an indication of model fit. Finally, it is often useful to assess the indirect effects and common cause effects, as in path analysis.

Initial measurement model

The measures of four constructs (support, self-efficacy, affect, and use) satisfied the criteria for reliability and discriminant validity in the initial model. Thus, no changes to these constructs were indicated. The remaining constructs evidenced some measurement problems. These problems, and the associated revisions, are discussed below.

Encouragement by Others. Three items in the encouragement-of-use construct did not correlate highly with the other measures. Encouragement of use from family ($\lambda = 0.40$), friends ($\lambda = 0.51$), and subordinates ($\lambda = 0.63$) did not appear to correlate highly with encouragement of use from peers and managers.

Encouragement of use represents the influence of social persuasion on self-efficacy and outcome expectations. The impact of this social persuasion depends on the perceived similarity of the individual as well as his or her credibility (Bandura, 1986). Thus, the influence of encouragement is, in effect, moderated by the characteristics of the individuals doing the encouraging. In this case, the low loadings for encouragement of use from family, friends, and subordinates may be viewed as reflecting a relative lack of attention to these sources of persuasion. It would appear that, in forming judgments about their ability to use computers and about the likely outcomes of using computers, these managers looked to their peers and their superiors, but not to their subordinates or to family and friends. Thus, the latter three items were dropped from the model in subsequent tests.

Others' Use. A similar problem was encountered in the measures of actual use by others. Actual use by family (λ = 0.16), friends (λ = 0.35), and subordinates (λ = 0.20) did not load highly on the construct. Moreover, actual use by subordinates loaded more highly on the encouragement-by-others construct (cross-loading = 0.27) than on the others'-use construct. Thus, as with the encouragement construct, these items were dropped from the subsequent analyses.

Outcome Expectations. Examination of the loadings for the outcome expectations construct indicated the possibility of multiple underlying dimensions for this construct. Loadings ranged from 0.42 to 0.83. Reconsideration of the items confirmed this hypothesis. Two distinct dimensions appeared to be represented in the scale, corresponding to the job-related and other, more personal, outcomes of computer use. Job-related outcomes included items such as "If I use a computer, I will increase the quality of output of my job," while the personal outcomes included "If I use a computer, I will increase my sense of accomplishment."

For the revised model, then, the outcome expectations construct was split into these two dimensions. This necessitated a splitting of hypotheses 2, 4, 6, 7, 11, and 12. In each case, the hypotheses were restated to include performance-related outcome expecations (H2a, H4a, H6a, H7a, H11a, H12a) and personal outcome expectations (H2b, H4b, H6b, H7b, H11b and H12b) specifically.

Anxiety. The individual item loadings for this construct were poor, indicating a problem in the measurement of anxiety. Re-examination of the measure and exploratory factor analysis revealed a number of underlying dimensions. Ray and Minch (1990) also found this instrument to be multi-dimensional and explained the results in terms of the construct of computer alienation. In our study, the sub-dimensions of the scale reflected, in addition to anxiety, a desire to learn more about computers, beliefs about learning to use computers, and beliefs about the appropriateness of computers in business and education. The latter three dimensions, while possibly influencing the formation of anxiety, do not represent anxiety itself. Thus, only the first dimension was of interest in this study. Four items formed the core of this dimension in the factor analysis. These items seemed to best capture the feelings of anxiety associated with computer use, and not the beliefs that might produce anxiety or other attitudes about computers. Thus, these four items were selected to represent the anxiety construct.

Revised model

The revisions to the measurement model were made as indicated by the data, and the resulting model (Figure 3, shown with results) was tested using the data from the holdback sample (n = 481). The measurement statistics were substantially improved from the first model. The Factor Structure Matrix (Table 1) presents the individual item loadings and cross loadings, and shows that the individual item loadings meet or exceed the 0.7 criteria except in 8 cases.[2] It also shows that none of the individual items load more highly on another construct than they do on the construct they were designed to measure. The reliability and discriminant validity coefficients are reported in Table 2. All of the

[2] Eight items do not meet the 0.7 criteria. However, given that one set of revisions had already been done, and given that the overall statistics (Table 2) were adequate, it was felt that another set of measurement revisions would be inappropriate.

measures exceed 0.80 for internal consistency reliability. In terms of discriminant validity, the variance shared between each construct and its measures (the diagonal elements in Table 2) exceeds the variance shared between each of the constructs (the off-diagonal elements). Thus, the measurement model tests were adequate, indicating that the revisions to the measures achieved the desired effects.

Once the measurement model was considered acceptable, the path coefficients were assessed. All but four of the paths provided support for the study's hypotheses. The relationship between others' use of computers and personal outcome expectations, while in the direction predicted by the model, was not significant. Moreover, contrary to the hypotheses, support was negatively related to self-efficacy (H5) and to both performance-related (H6a) and personal outcome expectations (H6b).

While all but one of the paths were statistically significant ($p < 0.01$), the substantive significance (or effect magnitudes) of the relationships must also be considered in the assessment of the model. The path coefficients in the PLS model represent standardized regression coefficients. The suggested lower limit of substantive significance for regression coefficients is 0.05 (Pedhazur, 1982). As a more conservative position, path coefficients of 0.10 and above are preferable. Thus, the path from Personal Outcome Expectations to Usage ($\beta = 0.03$), while statistically significant ($p < 0.01$), is not considered substantively significant.

The path coefficients represent the direct effects of each of the antecedent constructs. It is also important, however, to consider the total effects, including those that are mediated by other variables. Performance-related outcome expectations and self-efficacy have roughly equal direct effects on use. However, when the total effects are considered, self-efficacy emerges as a more powerful predictor (total effect = 0.423 versus 0.269 for outcome expectations), since it also influences use indirectly through outcome expectations, affect, and anxiety. Table 3 presents the direct effects, indirect effects, and spurious or unexplained correlations between each of the variables in the model.

In total, the model explained 37 percent of the variance in affect, 25 percent of the variance in anxiety, and 32 percent of the variance in use.

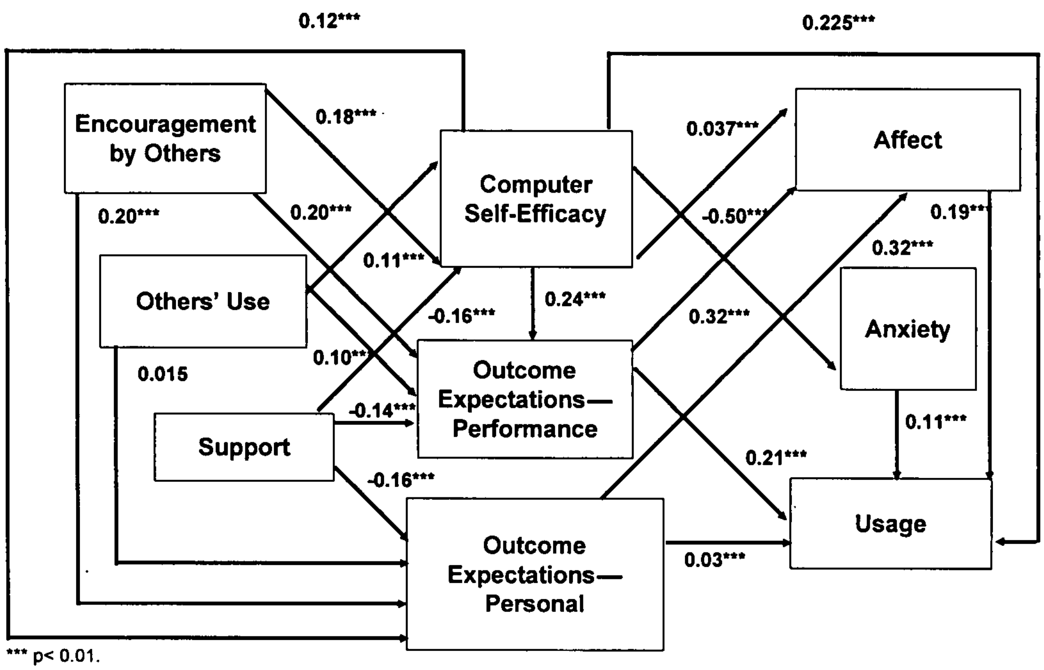

Figure 3. Revised Model and Path coefficients

Table 1. Factor Structure Matrix–Revised Model

	1	2	3	4	5	6	7	8	9
1	0.825	0.491	0.239	0.156	0.225	0.133	0.135	-0.089	0.114
2	0.738	0.340	0.054	0.142	0.221	0.147	0.188	-0.112	0.065
3	0.827	0.435	0.220	0.190	0.258	0.180	0.182	-0.087	0.219
4	0.800	0.397	0.273	0.143	0.144	0.153	0.119	-0.048	0.115
5	0.478	0.890	0.216	0.178	0.198	0.119	0.154	-0.070	0.233
6	0.371	0.851	0.046	0.152	0.208	0.087	0.133	-0.094	0.176
7	0.438	0.544	0.223	0.033	0.091	0.027	0.019	0.068	0.156
8	0.415	0.492	0.330	-0.022	0.025	0.013	-0.050	0.064	0.097
9	0.165	0.110	0.810	-0.046	-0.095	-0.100	-0.089	0.003	-0.075
10	0.170	0.095	0.773	-0.013	-0.039	-0.028	-0.051	-0.031	0.016
11	0.185	0.090	0.761	-0.004	-0.041	-0.064	-0.023	-0.038	0.044
12	0.189	0.125	0.794	-0.063	-0.066	-0.113	-0.102	0.007	-0.006
13	0.166	0.168	0.765	-0.147	-0.088	-0.108	-0.166	0.024	-0.105
14	0.271	0.206	0.825	-0.074	-0.073	-0.102	-0.084	-0.012	-0.007
15	0.128	0.083	-0.156	0.829	0.263	0.110	0.400	-0.402	0.338
16	0.133	0.092	-0.077	0.804	0.232	0.125	0.393	-0.378	0.323
17	0.163	0.199	-0.109	0.839	0.262	0.123	0.451	-0.497	0.411
18	0.178	0.154	-0.086	0.858	0.269	0.171	0.440	-0.405	0.380
19	0.145	0.127	-0.054	0.852	0.246	0.098	0.419	-0.452	0.375
20	0.222	0.166	-0.037	0.818	0.237	0.179	0.395	-0.344	0.325
21	0.145	0.135	-0.078	0.828	0.273	0.119	0.400	-0.399	0.408
22	0.124	0.150	-0.037	0.714	0.243	0.141	0.279	-0.323	0.331
23	0.174	0.160	-0.062	0.760	0.228	0.156	0.352	-0.356	0.286
24	0.207	0.154	-0.071	0.796	0.298	0.199	0.423	-0.435	0.411
25	0.168	0.055	-0.073	0.112	0.582	0.339	0.335	-0.108	0.227
26	0.233	0.172	-0.037	0.297	0.842	0.428	0.456	-0.252	0.406
27	0.242	0.168	-0.054	0.167	0.700	0.338	0.275	-0.137	0.224
28	0.210	0.246	-0.124	0.292	0.859	0.419	0.405	-0.168	0.340
29	0.204	0.207	-0.123	0.293	0.787	0.328	0.365	-0.168	0.311
30	0.112	0.078	0.042	0.140	0.504	0.234	0.201	-0.153	0.245
31	0.118	0.058	-0.089	0.108	0.339	0.718	0.232	-0.083	0.184
32	0.073	0.022	-0.064	0.067	0.409	0.624	0.273	-0.048	0.139
33	0.191	0.153	-0.035	0.170	0.413	0.842	0.286	-0.089	0.245
34	0.081	0.018	-0.177	0.123	0.296	0.763	0.184	0.045	0.104
35	0.228	0.128	-0.124	0.173	0.376	0.817	0.232	0.015	0.196
36	0.180	0.155	-0.121	0.461	0.455	0.280	0.872	-0.454	0.437
37	0.141	0.086	-0.124	0.375	0.431	0.342	0.822	-0.284	0.349
38	0.114	0.062	-0.151	0.218	0.292	0.251	0.620	-0.191	0.208
39	0.142	0.105	-0.060	0.441	0.290	0.113	0.697	-0.602	0.392
40	0.166	0.145	-0.045	0.303	0.326	0.227	0.733	-0.334	0.339
41	-0.104	-0.072	-0.003	-0.430	-0.235	-0.075	-0.486	0.814	-0.344
42	-0.056	-0.013	0.015	-0.304	-0.088	0.052	-0.264	0.736	-0.244
43	-0.085	-0.075	-0.001	-0.347	-0.159	-0.014	-0.364	0.771	-0.254
44	-0.091	-0.057	-0.004	-0.467	-0.225	-0.078	-0.463	0.852	-0.319
45	0.202	0.261	-0.065	0.381	0.374	0.236	0.415	-0.292	0.798
46	0.184	0.244	0.046	0.361	0.377	0.219	0.386	-0.334	0.790
47	0.018	0.049	-0.083	0.279	0.187	0.123	0.266	-0.227	0.648
48	0.013	0.074	-0.076	0.254	0.207	0.066	0.266	-0.202	0.667

Constructs:

1. Encouragement of Use
2. Others' Use
3. Support
4. Computer Self-Efficacy
5. Performance Outcome Expectations
6. Personal Outcome Expectations
7. Effect
8. Anxiety
9. Use

Table 2. Reliability and Discriminant Validity Co-Efficients—Revised Model

Construct	ICR§	1	2	3	4	5	6	7	8	9
1. Encouragement	0.87	0.80								
2. Others' Use	0.80	0.52*	0.72							
3. Support	0.91	0.24*	0.18*	0.79						
4. Self-Efficacy	0.95	0.20*	0.18*	-0.10**	0.81					
5. Outcome Exp.—Performance	0.87	0.27*	0.22*	-0.09**	0.32*	0.72				
6. Outcome Exp.—Other	0.87	0.19*	0.11**	-0.12*	0.17*	0.49*	0.76			
7. Affect	0.87	0.20*	0.15*	-0.13*	0.49*	0.48*	0.32*	0.75		
8. Anxiety	0.87	-0.11**	-0.07	-0.00	-0.50*	-0.23*	-0.05	-0.51*	0.79	
9. Use	0.82	0.17*	0.24*	-0.05	0.45*	0.41*	0.24*	0.47*	-0.37*	0.73

Note: Diagonal elements are the square root of the variance shared between the constructs and their measures. Off-diagonal elements are the correlations among constructs. For discriminant vallidity, diagonal elements should be larger than off-diagonal elements.

*p < 0.01; ** p < 0.05.

§ Internal Consistency Reliabilty.

In addition, 7 percent of the variance in self-efficacy, 17 percent of the variance in performance-related outcome expectations, and 8 percent of the variance in personal outcome expectations was explained. Since the objective of this study was primarily the understanding of behavioral outcomes (rather than prediction of self-efficacy), the model was acceptable in terms of explanatory power.

Discussion

The findings of this study provide support for the research model and the Social Cognitive Theory perspective on computing behavior. Self-efficacy was found to play an important role in shaping individuals' feelings and behaviors. Individuals in this study with high self-efficacy used computers more, derived more enjoyment from their use, and experienced less computer anxiety. In addition, outcome expectations, in particular those relating to job performance, were found to have a significant impact on affect and computer use. Affect and anxiety also had a significant impact on computer use.

The analysis also sheds light on the mediating role of self-efficacy and outcome expectations in the processing of environmental information. Several studies have demonstrated the influence of encouragement of use on computing behavior (e.g., Higgins, et al., 1990; Pavri, 1988). This study is consistent with those findings, but it also suggests the mechanisms through which encouragement by others operates. Previous research posited a direct relationship between encouragement and use. This research suggests that encouragement influences behavior indirectly, through its influence on self-efficacy and outcome expectations. Similarly, others' actual use of computers influences behavior through its influence on self-efficacy and outcome expectations.

A surprising, and somewhat puzzling, finding was the negative influence of support on self-efficacy and outcome expectations. From a theoretical perspective, it seemed logical to hypothesize that higher organizational support would result in higher judgments of self-efficacy on the part of individuals because they would have more resources to help them become more proficient. Moreover, support was believed to be an indication of organizational norms regarding use, and would thus positively influence outcome expectations in addition to self-efficacy. However, the data analysis suggests a negative relationship.

The reasons for these findings are not entirely clear, but several possibilities exist. With respect to self-efficacy in particular, it may be that individuals with lower self-efficacy are more aware of the existence of support within their organizations than those with high self-efficacy because they make more use of those systems. This explanation would indicate that the causal arrows between self-efficacy and support should be reversed. Alternatively, the presence of high support may in some ways actually hinder the formation of high self-efficacy judgments. If individuals can always call someone to help them when they encounter difficulties, they may never be forced to sort things out for themselves and thus may continue to believe themselves incapable of doing so. These alternative explanations have very different implications for organizations, and the data provide no indication as to which might be correct. Thus, additional research is needed to investigate this finding.

From a measurement standpoint, the data analysis provides evidence of the construct validity of the computer self-efficacy measure. The scale demonstrated high internal consistency (reliability), empirical distinctness (discriminant validity), and was related as predicted to the other constructs (nomological validity). Thus, based on this evidence, it appears to be useful as a measure of computer self-efficacy.

The development and validation of a measure of computer self-efficacy represents an important step in the development of theories about self-efficacy and computer use. Zmud and Boynton (1989) argue that too little attention has been paid to measure development in information systems research and that theoretical advancement has been constrained by the absence of validated measures. This research answers their call for careful development of measures and provides a valid measure of computer self-efficacy that can be used in a variety of research settings.

Table 3. Indirect and Spurious Effects

Relationship	Direct Effect	Indirect Effect	Spurious and Unexplained Correlation
Encouragement by Others—Others' Use	n.a.	n.a.	0.52
Encouragement by Others—Support	n.a.	n.a.	0.24
Encouragement by Others—Self-Efficacy	0.18	n.a.	0.02
Encouragement by Others—Performance Outcome Exp.	0.20	0.05	0.02
Encouragement by Others—Personal Outcome Exp.	0.20	0.02	-0.03
Encouragement by Others—Affect	n.a.	0.17	0.03
Encouragement by Others—Anxiety	n.a.	-0.09	-0.02
Encouragement by Others—Use	n.a.	0.14	0.03
Others' Use—Support	n.a.	n.a.	0.18
Others' Use—Self-Efficacy	0.11	n.a.	0.07
Others' Use—Performance Outcome Expectations	0.10	0.03	0.09
Others' Use—Personal Outcome Expectations	0.015	0.015	0.08
Others' Use—Affect	n.a.	0.08	0.07
Others' Use—Anxiety	n.a.	-0.05	-0.02
Others' Use—Use	n.a.	0.07	0.17
Support—Self-Efficacy	-0.16	n.a.	0.06
Support—Performance Outcome Expectations	-0.14	-0.04	0.09
Support—Personal Outcome Expectations	-0.16	-0.02	0.06
Support—Affect	n.a.	-0.13	0
Support—Anxiety	n.a.	0.08	-0.08
Support—Use	n.a.	-0.11	0.06
Self-Efficacy—Performance Outcome Expectations	0.24	n.a.	0.07
Self-Efficacy—Personal Outcome Expectations	0.12	n.a.	0.06
Self-Efficacy—Affect	0.37	0.09	0.03
Self-Efficacy—Anxiety	-0.50	n.a.	0
Self-Efficacy—Use	0.225	0.20	n.a.
Performance Outcome Expectations—Personal Outcome Exp	n.a.	n.a.	0.49
Performance Outcome Expectations—Affect	0.32	n.a.	0.17
Performance Outcome Expectations—Anxiety	n.a.	n.a.	-0.23
Performance Outcome Expectations—Use	0.21	0.06	0.14
Personal Outcome Expectations—Affect	0.10	n.a.	0.21
Personal Outcome Expectations—Anxiety	n.a.	n.a.	-0.05
Personal Outcome Expectations —Use	0.03	0.02	0.19
Affect—Anxiety	n.a.	n.a.	-0.51
Affect—Use	0.19	n.a.	0.28
Anxiety—Use	-0.11	n.a.	-0.26

Of course, the validity of a measure cannot be truly established on the basis of a single study. Validation of measures is an ongoing process, which requires the assessment of measurement properties over a variety of studies in similar and different contexts. Moreover, a comparison of this measure of computer self-efficacy with other methods of capturing the same construct was not conducted in this study. The absence of a test of convergent validity detracts to a degree from the conclusions drawn on the basis of these data. However, questionnaire measures are the standard format for measuring self-efficacy, and other methods upon which to draw were not available. Thus, this study represents the most comprehensive assessment of validity that could be made based on existing knowledge. The development of other means of assessing computer self-efficacy may be considered as an opportunity for future research.

Limitations

These findings must be considered in light of the study's limitations, in particular the use of cross-sectional survey data. Social Cognitive Theory predicts causal relationships between the constructs studied. PLS analysis, like other structural equations modeling, provides strong support for this interpretation relative to other techniques such as correlation and regression since all of the relationships (including those in the measurement model as well as in the structural model) are tested simultaneously. However, conclusive statements about causality cannot be made since alternative explanations cannot be ruled out. Moreover, Social Cognitive Theory is based on a continuous reciprocal interaction among the factors studied. Feedback mechanisms could not be modeled with the present data, and thus the model tested is incomplete. Further research, in particular experimental and longitudinal studies, are clearly needed to address these issues.

One limitation with respect to the self-efficacy measure is the use of a hypothetical scenario for responses. In answering the self-efficacy scale the respondent is asked to imagine he or she has been given a new software package for use in his or her job. The type of software package is not specified and is indicated as unimportant. The purpose of this approach was to force respondents to think about future behavior rather than past capability, and to think about generating novel responses rather than fixed patterns (Bandura, 1986). However, this approach raises two problems. First, does the hypothetical scenario represent actual situations? That is, are respondents capable of imagining all that is required of them to answer the items? This question was posed to respondents in the pretest and pilot studies. None of the respondents indicated any difficulty in answering the questions, and when probed with respect to their confidence in being able to use computers generally, the responses were consistent with the questionnaire responses. The second concern relates to self-efficacy with respect to learning versus using computers. By focusing on an unfamiliar software package, the notion of self-efficacy with respect to *learning to use computers* is introduced as an additional dimension of the construct. While the ability to adapt to new technology is a fundamental part of being a competent computer user, it is possible that self-efficacy with respect to learning is different than self-efficacy with respect to using computers.

Implications for research and practice

In spite of the above noted limitations, these findings demonstrate the value of Social Cognitive Theory. IS research to date has generally not considered how individuals' expectations of their capabilities influence their behavior and thus paints an incomplete picture. It suggests that individuals will use computing technology if they believe it will have positive outcomes. Social Cognitive Theory, on the other hand, acknowledges that beliefs about outcomes may not be sufficient to influence behavior if individuals doubt their capabilities to successfully use the technologies. Thus, the Social Cognitive Theory perspective suggests that an understanding of both self-efficacy and outcome expectations is necessary to understand computing behavior. This research, in developing and testing a measure of computer self-efficacy, lays the foundation for future research concerning the Social Cognitive Theory perspective on computing behavior and the unique influence of individuals' perceptions of their computing abilities.

Future research is necessary to address the limitations of this research. First, longitudinal evidence is required. This research relied on cross-sectional data, making interpretation of causality problematic. Second, additional dependent variables need to be studied. This study focused on self-reports of computer use. Self-efficacy, however, is also argued to influence the development of ability. Thus, future research should focus on how computer self-efficacy influences the development of computing skill. The generalizability of computer self-efficacy also warrants research attention. This study focuses on self-efficacy with respect to computers in general. Bandura (1986) argues the need to tailor self-efficacy measures to the domain of interest in order to maximize prediction. It is not clear, however, what constitutes the domain of interest with respect to computers. To what extent are computer self-efficacy perceptions with respect to specific software or hardware domains correlated? Is it reasonable to use general self-efficacy measures, or is it necessary to tailor the items to these specific hardware and/or software domains? Furthermore, the relationship between learning and using computers needs to be addressed. This measure of self-efficacy, using a hypothetical software package, incorporates an individual's confidence in his or her ability to learn to use computer software packages, in addition to the ability to use the package. Future research should investigate the extent to which these constructs are related.

From a managerial standpoint, these findings suggest the importance of understanding individuals' self-perceptions and finding ways in which to address them. For example, one of the interpretations of the negative relationship between organizational support and self-efficacy is that the way in which technical support is provided actually hinders the development of self-efficacy. When faced with a computer problem that he or she cannot resolve, a user will often call a technical support person for assistance. If the support person, as the authors' experience suggests they sometimes do, dashes into the office, sits down at the users' chair, bangs away at the keyboard for a few minutes and then proclaims that the problem is fixed, it would not be surprising that the user would begin to doubt his or her capabilities. While this explanation would account for the negative relationship between support and self-efficacy, it is not the only one possible. If it is true, however, it represents a problem for providing support. It suggests that support personnel must also attend to self-efficacy concerns, perhaps by explaining to the user what they are doing, suggesting reasons for why the problem arose, and giving information about what to do if the problem ever occurs again.

In a broader sense, organizations need to be aware of the concept of self-efficacy and the means for encouraging it. Bandura (1986) defines four sources of self-efficacy information: guided mastery, behavior modeling, social persuasion, and physiological states. The strongest source of information is guided mastery—actual experiences of success in dealing with the behavior. The more successful interactions individuals have with computers, the more likely they are to develop high self-efficacy. This has strong implications with respect to training. First, it suggests that hands-on practice is a key component of training, so that people can build their confidence along with their skill. More importantly, however, the need for *successful* experience in order to foster self-efficacy is a strong argument for why software training is so important to new users. If users are working with a new software package without adequate training, they are likely to experience problems. Because they are struggling, they may actually lower their sense of self-efficacy and become reluctant to use the technology, thus defeating the purpose of introducing new technology.

The second source of self-efficacy information is behavior modeling, which involves observing someone else performing the behavior as a means of learning. Compeau and Higgins (in press) demonstrate that a behavior modeling approach to computer training can enhance self-efficacy perceptions and performance in the training context. Social persuasion also exerts an influence on self-efficacy. Reassurance to users that they are capable of mastering the technology and using it successfully can help them to build confidence.

Finally, physiological states, specifically feelings of anxiety, can have a lowering effect on self-efficacy. Bandura (1986) argues that individuals sometimes interpret their feelings of anxiety to a lack of ability. Thus, if an individual feels anxious when using a computer, he or she may decide that the reason for the feelings of anxiety is a lack of ability, thus lowering his or her self-efficacy. Webster, et al. (1990) found that computer anxiety in the training process can be reduced by encouraging playful behavior. Thus, there may be indirect ways of influencing physiological states, which can lessen their negative impact on self-efficacy.

Concluding Comments

This research has attempted to demonstrate the utility of the self-efficacy construct, borrowed from social psychology, to understand individual computing behavior. The results indicate that self-efficacy adds to our understanding of why people use computers, over and above concepts like outcome expectations, anxiety, and affect. In addition, the research has provided a reliable measure that satisfies the major conditions for construct validity (discriminant and nomological validity). Future research should focus on examining the impact of self-efficacy on development of computer skills and on understanding the generalizability of computer self-efficacy.

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Appendix

Computer Self-Efficacy Measure

Often in our jobs we are told about software packages that are available to make work easier. For the following questions, imagine that you were given a new software package for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before.

The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered "yes," please rate your confidence about your first judgment, by circling a number from 1 to 10, where 1 indicates "Not at all confident," 5 indicates "Moderately confident," and 10 indicates "Totally confident."

For example, consider the following sample item:

I COULD COMPLETE THE JOB USING THE SOFTWARE PACKAGE...

		NOT AT ALL CONFIDENT				MODERATELY CONFIDENT					TOTALLY CONFIDENT
...if there was someone giving me step by step instructions.	YES..... NO	1	2	3	4	5	6	7	8	9	10

The sample response shows that the individual felt he or she could complete the job using the software with step by step instructions (YES is circled), and was moderately confident that he or she could do so (5 is circled).

I COULD COMPLETE THE JOB USING THE SOFTWARE PACKAGE...

			NOT AT ALL CONFIDENT				MODERATELY CONFIDENT					TOTALLY CONFIDENT
Q-1.	...if there was no one around to tell me what to do as I go.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-2.	...if I had never used a package like it before.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-3.	...if I had only the software manuals for reference.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-4.	...if I had seen someone else using it before trying it myself.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-5.	...if I could call someone for help if I got stuck.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-6.	...if someone else had helped me get started.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-7.	...if I had a lot of time to complete the job for which the software was provided.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-8.	...if I had just the built-in help facility for assistance.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-9.	...if someone showed me how to do it first.	YES........ / NO	1	2	3	4	5	6	7	8	9	10
Q-10.	if I had used similar packages before this one to do the same job.	YES........ / NO	1	2	3	4	5	6	7	8	9	10