

WHY DON'T MEN EVER STOP TO ASK FOR DIRECTIONS? GENDER, SOCIAL INFLUENCE, AND THEIR ROLE IN TECHNOLOGY ACCEPTANCE AND USAGE BEHAVIOR¹

By: Viswanath Venkatesh
Robert H. Smith School of Business
University of Maryland, College Park
College Park, MD
U.S.A.
vvenkate@rhsmith.umd.edu

Michael G. Morris
Air Force Institute of Technology
Wright-Patterson AFB, OH
U.S.A.
mmorris@afit.af.mil

Abstract

Using the Technology Acceptance Model (TAM), this research investigated gender differences in the overlooked context of individual adoption and sustained usage of technology in the workplace. User reactions and technology usage behavior were studied over a five-month period among 342 workers being introduced to a new software system. At all three points of measurement, compared to women, men's technology usage deci-

sions were more strongly influenced by their perceptions of usefulness. In contrast, women were more strongly influenced by perceptions of ease of use and subjective norm, although the effect of subjective norm diminished over time. These findings were robust even after statistically controlling for key confounding variables identified in prior organizational behavior research (i.e., income, occupation, and education levels), and another possible confound from technology research, prior experience with computers in general. Thus, in addition to identifying key boundary conditions in the role of the original TAM constructs (perceived usefulness and perceived ease of use), this research provides the basis for the integration of subjective norm into the model. In light of these findings, implications for theory and practice are discussed.

Keywords: User acceptance, adoption, technology acceptance model, social influences, gender differences

ISRL Categories: AA01, AA07, AC0401, AI0108

Introduction

While advances in hardware and software capabilities continue at an unprecedented pace, the

¹Ron Weber was the accepting senior editor for this paper.

problem of underutilized systems remains (Johansen and Swigart 1996; Moore 1991; Norman 1993; Weiner 1993). Importantly, low usage has been listed as one of the underlying causes behind the so-called "productivity paradox" (Laudauer 1995; Sichel 1997). Understanding the conditions under which information systems are or are not accepted and used within organizations continues to be an important issue. Information systems research has examined user acceptance and usage behavior from several different perspectives. Among the different models that have been proposed, the Technology Acceptance Model (TAM) (Davis 1989; Davis et al. 1989), adapted from the Theory of Reasoned Action (TRA) (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), offers a powerful and parsimonious explanation for user acceptance and usage behavior. TAM posits that user acceptance is determined by two key beliefs, namely perceived usefulness and perceived ease of use. Perceived usefulness (U) is defined as the extent to which a person believes that using a particular technology will enhance her/his job performance, while perceived ease of use (EOU) is defined as the degree to which a person believes that using a technology will be free from effort (Davis 1989). The robustness of TAM has been established through several applications and replications (Adams et al. 1992; Chin and Todd 1995; Davis 1989, 1993; Davis et al. 1989; Davis and Venkatesh 1996; Gefen and Straub 1997; Igbaria et al. 1997; Mathieson 1991; Morris and Dillon 1997; Segars and Grover 1993; Subramanian 1994; Szajna 1994, 1996; Taylor and Todd 1995b; Venkatesh 1999; Venkatesh and Davis 1996).

Two important constructs that have received very little attention in the context of TAM research are social influence and gender (cf. Gefen and Straub 1997). These two constructs are potentially critical to our understanding of user acceptance since they could both play an important role in determining how users make their decisions about adopting and using new technologies. In fact, there is a significant body of evidence outside the domain of information systems in general supporting the viewpoint that social influence and gender do indeed play a critical role in influencing behaviors in a wide variety of domains.

Interestingly, TAM's referent theory (i.e., TRA) includes social influence via a construct called subjective norm. Much prior research in psychology (see Ajzen 1991 for a review) found subjective norm to be an important determinant of intention and/or behavior. However, TAM excluded this construct due to theoretical and measurement problems (see Davis et al. 1989). Although subjective norm can be expected to be important in determining technology acceptance and usage based on TRA and the Theory of Planned Behavior (TPB) (Ajzen 1985, 1991), empirical evidence supporting the role of the construct has been somewhat mixed. Some investigations have omitted the construct completely (e.g., Adams et al. 1992; Szajna 1994, 1996). Others have found the construct to be non-significant (e.g., Davis et al. 1989; Mathieson 1991). Still others have found the construct to be significant (e.g., Hartwick and Barki 1994; Taylor and Todd 1995b). Nonetheless, given that other theoretical perspectives emphasize the importance of social aspects of technology use including critical mass (Markus 1990), social influence (Fulk et al. 1987), adaptive structuration (Poole and DeSanctis 1990), hermeneutic interpretation (Lee 1994), and critical social theory (Ngwenyama and Lee 1997), we believe it is important to investigate whether social influence should be integrated into TAM. Since the development of TAM, even within the context of rational perspectives (e.g., TRA, TPB, and TAM), recent research has successfully operationalized subjective norm (see Mathieson 1991; Taylor and Todd 1995a, 1995b).

Perhaps surprisingly, gender's role within TAM has been investigated only recently (Gefen and Straub 1997). So far, however, research has studied only gender-based perceptual differences and not gender-based differences in decision making processes about technology. Nonetheless, psychology research that has studied gender differences in decision making processes indicates that schematic processing by women and men is different (cf. Bem and Allen 1974). For instance, from an information processing perspective, there are known differences in determinants of self-esteem between both sexes (Tashakkori 1993). Such a view is consistent with Bem (1981), who argues that women and men encode and

process information using different socially-constructed cognitive structures that, in turn, help determine and direct an individual's perceptions. As a result, individuals tend to make decisions which reflect biases inherent in the individual's perceptions and actions (e.g., Nisbett and Ross 1980). This means that gender schemas can be considered to be a normative guide (Kagan 1964; Kohlberg 1966) that causes unconscious or internalized action consistent with the schema.

Given these important missing elements in TAM research, in this paper, we describe research that seeks to extend TAM to include subjective norm and gender. Specifically, taking a longitudinal approach with data gathered from five organizations, we seek to achieve three primary objectives:

1. Understand gender differences in the relative influence of the original TAM constructs (perceived usefulness and perceived ease of use) on intention to use a new technology.
2. Integrate subjective norm into TAM using gender as a moderator.
3. Understand gender differences over the long term as it relates to sustained usage of technology with increasing experience.

Theoretical Development

Figure 1 shows TAM, as developed by Davis et al. (1989), together with the extensions proposed in this paper. Specifically, we propose that gender will moderate the perceived usefulness-intention, perceived ease of use-intention, subjective norm-intention, and perceived ease of use-perceived usefulness relationships. We further examine the role of experience as an additional moderator of the different relationships. In studying acceptance and use of a technology, it is important to examine the phenomenon over a duration of time since users will evolve from being novices to experienced users of the new system (e.g., Davis et al. 1989). This is of particular importance since during the earliest stages of technology introduction, users are making an "acceptance" decision, which has been shown to differ systematically from "usage" decisions over the long term

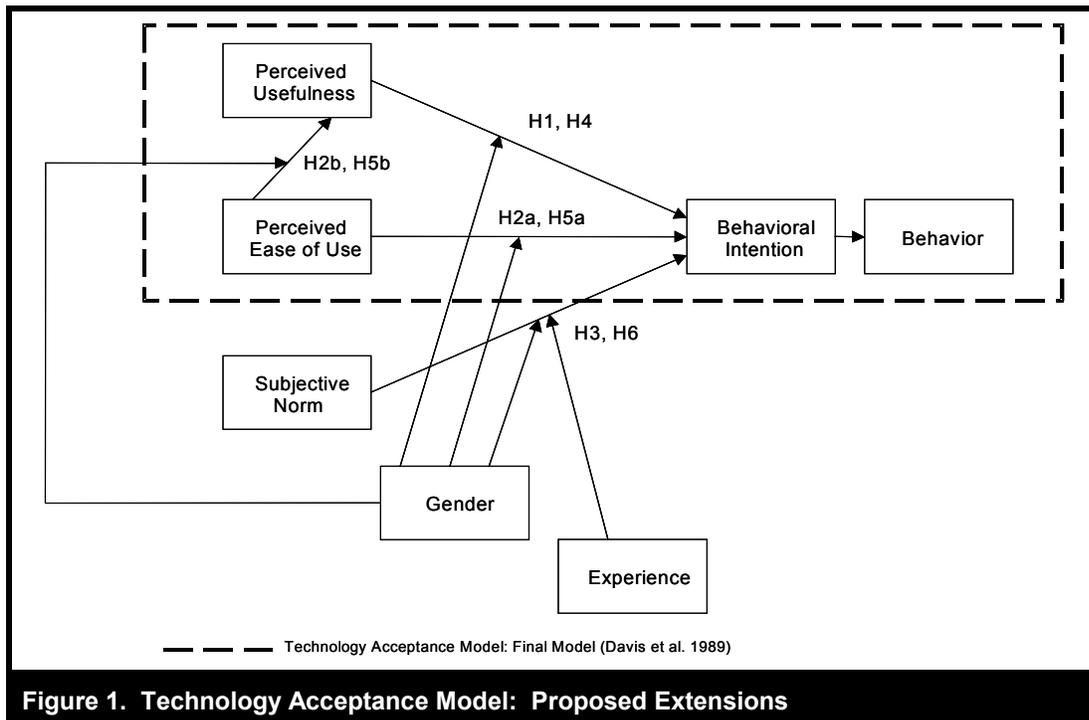
as user experience increases (e.g., Davis et al. 1989). Therefore, to help gain a thorough understanding of the underlying phenomena, this research studies the role of gender in initial technology acceptance decisions and continued usage behavior decisions. The moderating role of gender is expected to continue with increasing user experience (with the target system) with one exception: subjective norm is not expected to be a significant determinant of intention with increasing experience for women or men.

Short-Term Effects

Perceived Usefulness

Perceived usefulness (U) is defined as the extent to which a person believes that using a particular technology will enhance her/his job performance (Davis 1989). Perceived usefulness, which reflects perceptions of the performance-use contingency, has been closely linked to outcome expectations, instrumentality, and extrinsic motivation (Davis 1989, 1993; Davis et al. 1989, 1992). A significant body of TAM research has shown that perceived usefulness is a strong determinant of user acceptance, adoption, and usage behavior (e.g., Davis 1989; Davis et al. 1989; Mathieson 1991; Taylor and Todd 1995a, 1995b; Venkatesh and Davis forthcoming).

In understanding gender differences in the role of perceived usefulness as a determinant of technology acceptance, we draw from research on gender differences in the salience of outcomes as determinants of behavior. Prior research has indicated that men's work role is typically their most salient, while the family role is often only of secondary importance (e.g., Barnett and Marshall 1991). For example, O'Neill (1982) suggests that men may place great emphasis on work, accomplishment, and eminence. Hoffman (1972) points out that men are motivated by achievement needs to a greater extent than women. These arguments suggest that men, more than women, are directed toward individualistic tasks and goals (Carlson 1971; Gill et al. 1987; see also Stein and Bailey 1973). Other gender-related differences have also been reported in the literature. For example, some researchers have shown that male-valued traits include "objective" and "logical"



(Rosenkrantz et al. 1968). Furthermore, as operationalized by Bem's Sex Role Inventory (BSRI) (Bem 1981), men tend to exhibit more "masculine" traits (e.g., assertiveness) compared to women. Meta-analytic evidence by Taylor and Hall (1982) indicates that masculine scales are highly correlated with instrumental behaviors. Hofstede's (1980) seminal work on culture found that men rate the potential for advancement and earning power—two classic extrinsic motivators—as more important than women. Given the weight of the evidence, Minton and Schneider (1980) conclude that men may be more *task* oriented than women. In this context, task orientation refers to the accomplishment of organizational tasks that may require technology use. Therefore, we expect factors that are related to productivity enhancement to be more salient for men.

H1: Perceived usefulness will influence behavioral intention to use a system more strongly for men than it will influence women.

Perceived Ease of Use

Perceived ease of use (EOU) is defined as the degree to which a person believes that using the system will be free from effort (Davis 1989). Perceived ease of use has been shown to have an effect on intention via two causal pathways: (1) a direct effect on intention and (2) an indirect effect on intention via perceived usefulness (EOU-U-BI). The direct effect suggests that perceived ease of use could be a potential catalyst to increasing the likelihood of user acceptance. The indirect effect is explained as stemming from a situation where, other things being equal, the easier a technology is to use, the more useful it can be (Davis et al.(1989). With little or no prior experience, prior research has demonstrated that the direct causal pathway (i.e., EOU-BI) is most relevant, and the indirect effect via perceived usefulness is somewhat less important (see Davis et al. 1989; Szajna 1996). To understand gender differences in the role of perceived ease of use, therefore, we must understand differences in both the direct and indirect effects of perceived ease of use on intention.

Beginning with the theoretical development and operationalization of the construct, perceived ease of use has been closely related to self-efficacy (Bandura 1977, 1982, 1986). There is much evidence in psychology (Chan and Fishbein 1993; Sparks 1994; see also Fishbein and Stasson 1990) and information systems (Venkatesh forthcoming; Venkatesh and Davis 1996) supporting computer self-efficacy (one's judgment about one's ability to use a computer for a specific task) as a determinant of perceptions of ease/difficulty. In the context of technology acceptance and usage in the workplace, evidence indicates that providing support staff is a very important organizational response to help users overcome barriers and hurdles to technology use especially during the early stages of learning and use (e.g., Bergeron et al. 1990). This is consistent with Hofstede's contention that women rate the importance of service aspects and physical environment more highly than men. Therefore, we expect perceived ease of use to be more salient for women when compared to its salience for men.

There is additional theoretical justification supporting such an effect. Women typically display lower computer aptitude (Felter 1985) and higher levels of computer anxiety (Morrow et al. 1986; see Rosen and Maguire 1990 for a review) compared to men. IS research also supports the existence of higher levels of computer anxiety among women (e.g., Igbaria and Chakrabarti 1990). Further, there is recent evidence from real-world settings that women tend to be more anxious than men about computer use (Bozionelos 1996). A significant body of research in psychology (e.g., Hunt and Bohlin 1993) has shown an inverse relationship between computer anxiety and computer self-efficacy, a known determinant of perceived ease of use (Venkatesh and Davis 1996). Thus, given the intertwining of anxiety and self-efficacy, higher levels of computer anxiety among women can be expected to lead to lowering of self-efficacy, which in turn could lead to lowering of ease of use perceptions. Since perceived ease of use has typically been seen as a hurdle to user acceptance (Venkatesh and Davis 1996), low evaluations of ease of use can cause an increase in the salience of such perceptions in determining user acceptance decisions.

H2a: Perceived ease of use will influence behavioral intention to use a system more strongly for women than it will influence men.

As proposed in H1, men appear highly motivated by productivity-related factors like usefulness (Minton and Schneider 1980). Davis et al. (1989) showed that perceived ease of use is a determinant of perceived usefulness. They interpret this relationship by stating that systems that are easier to use may ultimately be more useful. Thus, systems that are perceived as easier to use will facilitate system use and task accomplishment more than systems that are seen as difficult to use. In other words, the system that is easier to use will generate the best cost/benefit ratio for achievement-oriented individuals. For example, users of modern personal computers generally consider graphical user interfaces to be more productive than older text-based interfaces because they are easier to use—although objectively, they may not be more “useful” than the older style interface. It seems that individuals for whom task achievement is most salient would be influenced more significantly by perceived ease of use.

H2b: Perceived ease of use will influence perceived usefulness more strongly for men than it will influence women.

Subjective Norm

Subjective norm (SN) is defined as the degree to which an individual believes that people who are important to her/him think she/he should perform the behavior in question (Fishbein and Ajzen 1975). In the technology domain, both peer and superior influences have been shown to be strong determinants of subjective norm (Mathieson 1991; Taylor and Todd 1995b). Therefore, in examining gender differences in subjective norm, it is useful to understand the degree to which women/men can be influenced and the extent to which they respond to information provided by other referents.

As implied earlier, women exhibit more “feminine” traits (e.g., tenderness), as operationalized by the

BSRI (Bem 1981). Meta-analytic evidence also suggests that women are more “expressive” compared to men (Taylor and Hall 1982). Additional evidence indicates that women are strongly motivated by affiliation needs (Hoffman 1972) and prefer person-oriented professions (Weller et al. 1976). Consistent with this view, other studies show that women are more disposed toward interpersonal goals and success in interpersonal relationships (see Carlson 1971; Gill et al. 1987; Stein and Bailey 1973). This outcome may be attributed to women having a greater awareness of others’ feelings compared to men (Rosenkrantz et al. 1968). In related research, Skitka and Maslach (1996) reported that women used constructs more related with the harmonious functioning of groups, interrelationships, and concern with the overall “communion” of the group in the process of describing others. Within the organizational environment, Landau and Leventhal (1976) found that women were more likely to retain less productive employees for social reasons compared to men. Overall, women tend to rate the importance of pleasing others more highly than men (e.g., Miller 1986).

Research dating back over a decade suggests that women and men also differ in the extent to which they can be influenced by others (Becker 1986; Eagly and Carli 1981). For example, research shows that women tend to be more compliant while men are more likely to rebel against requests or orders from others (e.g., Minton et al. 1971). Similarly, women appear more likely to conform with majority opinions (Eagly 1978; Maccoby and Jacklin 1974). Based on their extensive review of the literature, Minton and Schneider concluded that women were more people-oriented while men tend to be somewhat more independent and self-confident. Due to different socialization patterns of women in today’s society compared to two decades ago, it is possible to argue that some of the findings about women being more susceptible to influence than men may be dated. Nonetheless, even recent evidence is consistent with a gender schema view that women tend to be more compliant (e.g., Crawford et al. 1995).

A separate and distinct body of research has examined differences in susceptibility to influence but has suggested an alternative causal mechanism. For example, evidence suggests that women are more attentive to social cues in the environment while men attend to other stimuli such as objects and/or visual patterns (e.g., Garai and Scheinfeld 1968; Parsons and Bales 1955; Williams and Best 1982). Others have suggested that women and men are equally attentive to social cues in the environment (e.g., Roberts 1991); however, women are more responsive to those cues (i.e., they yield more to social pressures). Roberts suggests that this may be because men adopt a competitive, potentially overconfident attitude (see Lundeberg et al. 1994) about others’ evaluations, while women are more accepting of others’ opinions. This suggests that women may look at others’ opinions as opportunities to learn more about their own abilities. This line of reasoning implies that women may weight the opinion of other people in considering new technology and may factor those opinions into the overall decision-making process about adopting that technology more than men. Although the context of investigation in prior research was not technology acceptance and use, we expect that the importance of social factors and increased deference to others’ opinions will generalize to the context of decisions about technology and manifest itself in normative pressures being more salient for women.

H3: Subjective norm will influence behavioral intention to use a system more strongly for women than it will influence men.

Long-Term Effects

Perceived Usefulness

Prior research on TAM provides valuable insight into the role of perceived usefulness and perceived ease of use over time with increasing direct experience. A significant body of research supports the role of perceived usefulness as a strong determinant of user intentions and usage behavior over time. For example, Davis et al. (1989) found that the perceived usefulness-inten-

tion relationship remained strong over 14 weeks of use across multiple systems. More recently, longitudinal studies by Taylor and Todd (1995b) (12 weeks), Szajna (1996) (15 weeks), and Venkatesh and Davis (1996) (five weeks) all found that perceived usefulness remains a significant determinant of behavioral intention over time. Related psychology research also supports the notion that attitudinal components (such as perceived usefulness and perceived ease of use) tend to be strong determinants of intention and behavior with increasing direct experience with the target behavior (Doll and Ajzen 1992; Fazio and Zanna 1978a, 1978b, 1981; Regan and Fazio 1977) for up to a year (Reinecke et al. 1996). Thus, it is clear that instrumental factors (such as perceived usefulness) are not simply important *initial* determinants of intention: they remain important over the *long term*. Given that task-oriented factors are more important for men than for women (e.g., Minton and Schneider 1980) on an ongoing basis, we expect that gender differences in the salience of instrumental factors that were present at the time of the initial acceptance decision will be sustained over time with increasing direct technology experience.

H4: With increasing direct experience with the technology, perceived usefulness will influence behavioral intention to use a system more strongly for men than it will influence women.

Perceived Ease of Use

Recall that two causal pathways (EOU-BI, EOU-U-BI) are important in determining user intentions. Recent research has found that even with increasing experience, both pathways remain significant (Venkatesh forthcoming; Venkatesh and Davis 1996). Prior research (e.g., Bergeron et al. 1990) indicates that providing support staff is a crucial element in alleviating constraints to technology usage. As with the short-term impact of perceived ease of use, in the long run also, we expect that perceived ease of use, driven by availability of support staff to alleviate constraints to technology use, will be more salient to women compared to men. This is further corroborated by the higher levels of computer anxiety (Bozionelos

1996; Morrow et al. 1986; see Rosen and Maguire 1990 for a review) and lower computer aptitude (Felter 1985) among women that may necessitate tapping into support staff during the early stages of learning/experience and practice. Another potential reason for the higher salience of perceived ease of use to women is based on the notion that support staff will be more important to women than men from a social/affiliation perspective. Following their early interactions with support staff in the context of the new technology, the influence of perceived ease of use on women's technology usage can be expected to be additionally motivated from the standpoint of social/affiliation needs and interpersonal interaction.

H5a: With increasing direct experience with the technology, perceived ease of use will influence behavioral intention to use a system more strongly for women than it will influence men.

Research has shown that while the direct effects of perceived ease of use remain important, over time, the indirect effect of perceived ease of use (through perceived usefulness) becomes stronger. Therefore, given the greater achievement orientation for men in the long run (see H4), factors that are seen as facilitating or inhibiting task accomplishment (i.e., the EOU-U link) are likely to be weighed more strongly by men as direct experience with the target system increases. Thus, we propose that while the direct influence of perceived ease of use on intention is more salient for women (see H5a), because the indirect effects operate through instrumental factors (U), the indirect effects of perceived ease of use on intention (via perceived usefulness) will be more strongly weighted by men.

H5b: With increasing direct experience with the technology, perceived ease of use will influence perceived usefulness more strongly for men than it will influence women.

Subjective Norm

To understand gender differences in subjective norm over the long term, it is necessary to consider the role of experience and how that

experience can influence the importance of others' opinions in determining intentions for any one individual. In the short term, we proposed that women will weight the opinions of others' more highly than men (see H3). Others' opinions can be expected to be critical in the short-term when one has little or no prior experience with a specific technology (i.e., in the early stages of acceptance and usage). Even though the contexts of technology usage examined in this research are voluntary usage contexts, normative pressures from peers, superiors, IS staff, etc. can nonetheless play an important role in determining individual intentions and behavior. In the early stages of user experience where user interaction with the target system has been somewhat limited, even if an individual does not have a favorable reaction to the system, the individual will tend to comply with others' views and intend/use the target system to attain a favorable reaction from important referents. Such an effect of subjective norm on intention is referred to as "compliance" (Warshaw 1980).

As direct experience with technology increases over time, individuals have a better assessment of the benefits and costs associated with using that technology. Even if their original decision was based on others' opinions, individuals begin to "internalize" others' opinions especially if they are consistent with the results of their own direct experience. Thus, the direct effect of subjective norm on behavioral intention is reduced (Oliver and Bearden 1985; Warshaw 1980). The shifting causal mechanism (i.e., from compliance to internalization) operative with increasing experience can also be justified from an anchoring and adjustment perspective from behavioral decision theory. A significant body of research (e.g., Bettman and Sujan 1987; Mervis and Rosch 1980), including recent IS research (Venkatesh forthcoming), has suggested that in the absence of direct behavioral experience with the target object, individuals anchor their perceptions to general/ abstract criteria, which in this case includes complying with the ideas of peers and superiors. With increasing experience, user judgments reflect specific/ concrete criteria that result from the interaction with the target object (i.e., new system) and less from normative influences. Consistent with this view, research in

psychology has shown that the direct effect of subjective norm on intention is strong in the early stages of a new behavior and tends to wear off over time (e.g., Reinecke et al. 1996). In the context of technology acceptance in voluntary usage settings, this suggests that the influence of peers and superiors will diminish to non-significance over time with increasing experience with the target system.

H6: With increasing direct experience with the technology, subjective norm will not influence behavioral intention to use a system for either women or men.

In sum, the current research proposes important extensions to the Technology Acceptance Model using gender as a potential moderator. The hypotheses proposed deal with gender differences in roles of perceived usefulness and perceived ease of use as determinants of technology acceptance and usage. In addition, the current work attempts to integrate subjective norm into TAM by taking a gender-oriented approach. Table 1 summarizes the hypotheses.

Method

Participants and Systems

A total of 445 individuals from five organizations agreed to participate in the study. Consistent with the original development and purpose of TAM, all participants were in the process of being introduced to a new technology, use of which was voluntary within the organization. In each organization, the new technology being introduced could be broadly classified as a system for data and information retrieval. Although the specific system introduced in each organization was different, the general characteristics of the technology introduction and usage processes (e.g., training, voluntariness of use) were comparable. Conceptually, these were considered important to permit the pooling of data across technologies/organizations. (Note: We discuss the statistical analysis issues related to pooling in the results section.) Pooling data across different technologies/organizations is consistent with prior research in user acceptance (e.g., Compeau and Higgins 1995b; Davis et al. 1989; Venkatesh and Davis 1996).

Table 1. Summary of Hypotheses

	Relationship	Hypothesis
Short-term Effects		
H1	U-BI	Men > Women
H2a	EOU-BI	Women > Men
H2b	EOU-U	Men > Women
H3	SN-BI	Women > Men
Long-term Effects		
H4	U-BI	Men > Women
H5a	EOU-BI	Women > Men
H5b	EOU-U	Men > Women
H6	SN-BI	Non-significant

Given the authors' prior agreement with the field sites, all members of the relevant departments where the new system was being introduced were participants in this research study. A 77% response rate (342 usable responses including 156 women and 186 men) was achieved across all three points of measurement. The responses for any one individual were dropped if responses from that individual were not received for all three periods. On average, participants had an average of 5.5 years of prior experience using computers, with a range from six months to 16 years. As expected, based on a pre-study questionnaire, it was found that none of the participants had any prior knowledge about the system being introduced.

Procedure and Measurement

User reactions and usage behavior were measured over a period of five months. Participants in each organization participated in a one-day training program on the system. The training included two hours of lecture, followed by two hours of lecture combined with hands-on use, and two hours of independent interaction with the system (with consultants being available for help). Between 20 and 25 participants were included in each session, with multiple sessions of training being conducted in each organization. Neither the lecturers nor the training assistants (software consultants) knew about the research

or its objectives. User reactions to the technology were gathered across three points in time: immediately after the initial training (t_1), after one month of experience (t_2), and after three months of experience (t_3). Actual usage behavior (USE) was measured over the five-month period from the time of initial introduction of the technology. For purposes of this research, t_1 represented the measurement point to study short-term effects (i.e., initial user reactions), and t_2 and t_3 represented measurements to study long-term effects (i.e., situations of significant direct experience with the technology). U, EOU, and SN measured in a specific time period (e.g., t_1) were used to predict intention measured in the same time period. Intention measured in a given time period was used to predict subsequent usage behavior. Figure 2 presents a summary of the design and points of measurement of this research.

Validated items were used to measure perceived usefulness, perceived ease of use, subjective norm, and behavioral intention (Davis 1989; Davis et al. 1989; Mathieson 1991; Taylor and Todd 1995a, 1995b). Actual usage behavior (USE), operationalized as the frequency of use (number of user queries for information), was gathered from system logs. Consistent with prior research in sociology and organization behavior, we measured demographic variables of interest: gender, income, education, and organizational position. Appendix A presents a list of the items used in this research.

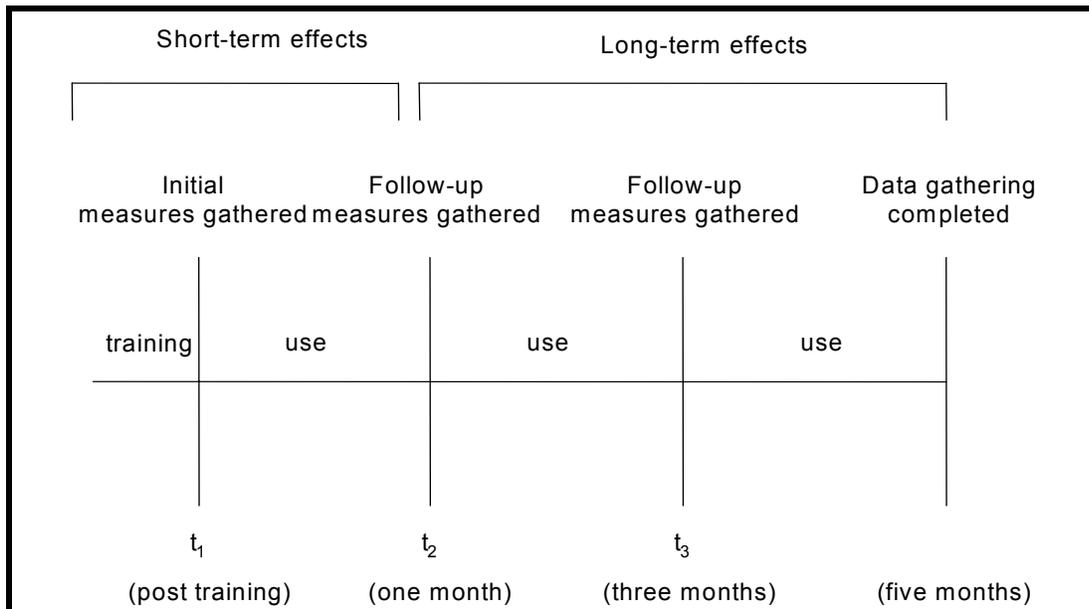


Figure 2. Research Design and Timing of Measurement

Results

Measurement Model Estimation

Partial Least Squares (PLS) was used to analyze the data. PLS is an extremely powerful structural equation modeling (SEM) technique that has been used extensively in information systems research (see Chin et al. 1996; Compeau and Higgins 1995a, 1995b; Sambamurthy and Chin 1994). The software package used to perform the analysis was PLS Graph, Version 2.91.03.04.

The measurement model was assessed separately for each of the five organizations at each of the three different points of measurement, thus resulting in 15 examinations. All constructs in all models satisfied the criteria of reliability (ICR > .80) and discriminant validity (shared variance across items measuring a construct was higher than correlations across constructs), thus requiring no changes to the constructs. The basic structure of the measurement model analyses was consistent across all 15 estimations. This pattern of high reliability and validity was consistent with our expectations given that the scales for the

constructs pertaining to TAM (e.g., Adams et al. 1992) and subjective norm (e.g., Mathieson 1991) have been extensively tested and validated in prior research.

Once the measurement models were found to be acceptable, it was important to ascertain if the structural models were comparable across organizations. This was considered particularly important if the data were to be pooled across organizations. To examine this issue, the data were pooled across organizations at each of the three points of measurement and dummy variables were introduced to distinguish data from the different organizations. The coding scheme used four dummy variables (DUMMY1, DUMMY2, DUMMY3, and DUMMY4) that were coded as follows: 0,0,0,0 to represent organization #1; 0,0,0,1 to represent organization #2; 0,0,1,0 to represent organization #3; 0,1,0,0 to represent organization number #4; 1,0,0,0 to represent organization #5. In this case, each of the dummy variables employed represented their own latent variable with one indicator variable with a factor loading of 1.00. In addition to the main effects, interaction terms incorporating the dummy variables to represent organizations (e.g., U X

DUMMY1 X DUMMY2 X DUMMY3 X DUMMY4) were introduced in models estimated for the entire sample, women only, and men only at each of the three points of measurement. If any of the interaction terms were significant, it would indicate differences in the corresponding structural path coefficients across different organizations. In the current data set, none of the interaction terms were significant, suggesting that the results from each of the five organizations were statistically equivalent. Armed with the high degree of consistency in the measurement and structural model analyses across organizations and consistent with prior research (e.g., Compeau and Higgins 1995b; Davis et al. 1989; Venkatesh and Davis 1996), we pooled the data across organizations to increase power and facilitate brevity of results reporting.

The results of the measurement model estimation based on the data pooled across organizational sites at t_1 are summarized in Appendix B (B1 reports the factor structure and B2 reports the reliability and discriminant validity coefficients). The pattern of measurement model results was consistent at the other two points of measurement as well. Table 2 presents the descriptive statistics (means and standard deviations) of the different variables, categorized by gender, at each point of measurement. With the exception of U at t_1 and SN at t_3 (SN was a non-significant determinant of intention at t_3 —see hypothesis testing, discussed later), the mean values between women and men were statistically significantly different ($p < .05$) at all three points of measurement.

Pretesting Checks for Potential Confounds

In prior organizational behavior research, a number of demographic variables have been shown to potentially confound observed gender differences. Income, occupation, and educational levels are considered to be the most important confounds (see Lefkowitz 1994 for a discussion). In addition, prior experience with computers is a variable that could possibly confound gender differences in technology perceptions and usage. Therefore, in addition to the confounding variables identified in organizational behavior research,

prior experience with computers was also included. The direct effect of each of these variables on model relationships was examined (e.g., effect of INCOME on U-BI) as well as interactive effects with gender (e.g., U-BI as moderated by both INCOME and GENDER). All tests for confounding effects were non-significant, thus demonstrating that income, occupation, educational level, and prior experience did not confound gender differences.

Hypotheses Testing

Table 1 summarizes the hypotheses being tested. For the purpose of this research, we expect that the short-term vs. long-term differences will help us glean an understanding of the influence of experience in this context. To that end, using the different points of measurement as a proxy for user experience with the system is consistent with prior research (e.g., Davis et al. 1989; Venkatesh and Davis 1996).

At each of the three points of measurement, the structural model was tested with the data from the entire sample (i.e., women and men pooled together) and each of the subsamples (i.e., women taken separately and men taken separately). Table 3 presents the path coefficients for each of the subsamples so that the reader may clearly see the magnitude of any differences—and thus the *practical* significance—between men and women across each of the constructs. Following the model tests, we conducted a test of the differences in path coefficients between the two subsamples; also, we conducted a test of the differences in path coefficients between each of the subsamples and the entire sample.

After initial exposure, compared to women, men placed a greater emphasis on U in determining BI, as hypothesized (H1). On the other hand, women weighted EOU more strongly in determining BI than men did at t_1 , consistent with H2a. In fact, EOU was not a significant determinant of BI for men, possibly due to variance suppression in EOU ($SD = 0.6$). Contrary to H2b, there were no gender differences in the role of EOU in determining U. Finally, in the short term, SN was a significant factor influencing BI for women after

Table 2. Descriptive Statistics by Gender					
	Women		Men		Significance of Difference Between Women and Men
	M	SD	M	SD	
Post Training					
U	4.5	1.1	5.0	1.0	ns
EOU	4.2	0.8	5.3	0.6	*
SN	4.1	0.8	5.0	0.8	*
BI	3.8	1.0	5.1	1.1	**
After one month					
U	4.2	1.2	5.1	0.8	*
EOU	3.9	1.1	5.7	0.9	***
SN	4.4	1.0	5.1	0.7	*
BI	3.6	0.8	4.9	1.2	**
USE ₁₂	4.7	1.1	8.8	2.0	**
After three months					
U	4.1	1.0	5.2	0.7	*
EOU	3.7	1.0	5.7	0.8	***
SN	4.1	0.9	4.1	0.8	ns
BI	3.7	1.1	5.0	0.8	**
USE ₂₃	5.9	1.4	11.2	2.8	***
USE ₃₄	6.2	1.3	10.1	3.2	***

Notes:

1. Use₁₂ refers to the average weekly usage between measurement 1 (post training) and measurement 2 (after one month), Use₂₃ refers to the average weekly usage between measurement 2 (after one month) and measurement 3 (after three months), and Use₃₄ refers to the average weekly usage between measurement 3 (after three months) and measurement 4 (after five months).
2. Weekly usage is reported so as to allow a direct comparison of usage across time periods ($t_1 - t_2$, $t_2 - t_3$, and $t_3 - t_4$) since the time lapsed in each interval is different.
3. The significance of difference column reports the results corresponding to an independent samples difference of means test.

ns: non-significant; * $p < .05$; ** $p < .01$; *** $p < .001$

Table 3. Gender Differences in the Saliency of Perceived Usefulness, Perceived Ease of Use, and Subjective Norm in Determining Behavioral Intention

	Entire Sample		Women		Men		Diff Sample vs. Women	Diff Sample vs. Men	Diff Women vs. Men
	R ²	β	R ²	β	R ²	β			
Time 1	.41		.42		.40				
U-BI		.47***		.30***		.61***	***	***	***
EOU-BI		.20**		.33***		.10	*	*	**
SN-BI		.12*		.33***		.08	**	*	**
EOU-U		.18**		.20**		.18**	ns	ns	ns
Time 2	.40		.40		.39				
U-BI		.49***		.32***		.62***	***	***	***
EOU-BI		.18*		.31***		.01	*	*	**
SN-BI		.14*		.33***		.04	**	*	**
EOU-U		.18**		.21**		.19**	ns	ns	ns
Time 3	.41		.42		.40				
U-BI		.51***		.36***		.62***	**	***	***
EOU-BI		.21**		.36***		.05	*	**	***
SN-BI		.04		.10		.09	ns	ns	ns
EOU-U		.20**		.20**		.20**	ns	ns	ns

Notes:

1. The three difference columns present the significance of difference in path coefficients between the entire sample and subsample of women, the entire sample and subsample of men, and the subsamples of women and men respectively. Specifically, the significance of difference was calculated using the procedure described in Cohen and Cohen (1988, pp. 55-56).
2. The R² reported corresponds to the structural equations BI = U + EOU + SN. The EOU-U path coefficient is reported from the structural equation U = EOU. The R² corresponding to the EOU-U path in each case is the square of the coefficient reported.

ns: non-significant; * $p < .05$; ** $p < .01$; *** $p < .001$

initial training; however, SN did not play a significant role in determining BI among men, providing support for H3.

Over the long term, men were more strongly influenced by U in determining BI, compared to women, as hypothesized (H4). Similarly, women continued to weight EOU as a direct determinant of BI more strongly than men, providing support for H5a. Consistent with the results in the short term and contrary to H5b, there were no differences in the EOU-U relationship between men and women. While SN did not influence men at t_2 and t_3 (partially supporting H6), women were still influenced by subjective norm after one month of sustained technology use (t_2), contrary to H6. The increased salience of subjective norm at t_1 and t_2 is particularly interesting given the somewhat lower level of perceived normative pressure among women compared to men (see Table 2). However, the salience of SN for women became non-significant at t_3 , as predicted. The support for the null hypothesis in that subjective norm was not a determinant at t_3 calls for a power test to understand the potential for type II error (Cohen 1988). We found the power to be just under 0.85 for small effects and over 0.90 for medium effects, thus largely alleviating concerns about type II error. Table 4 summarizes the results of the hypotheses testing.

To enhance the nomological validity of the findings, we examined how usage behavior fit with the proposed extensions to TAM. Usage data gathered in the time period from t_1 to t_2 was used as the dependent variable in the structural model corresponding to t_1 ; similarly, usage data gathered from t_2 to t_3 was used as the dependent variable in the structural model corresponding to t_2 , and usage data gathered for two months after t_3 was used to test the model corresponding to t_3 . The direct path coefficients between the determinant beliefs and usage behavior were examined. The direct paths from U, EOU, and SN to usage behavior were found to be non-significant in all cases (women and men at all points of measurement), thus indicating that the effects of U, EOU, and SN on usage behavior were fully mediated by behavioral intention. The intention-behavior path coefficient was found to be between 0.49 and 0.56. This consistent with Sheppard et

al. (1988), who found an intention-behavior correlation of about 0.50 based on a meta-analysis of 87 studies and recent technology acceptance research (Venkatesh and Speier 1999).

Discussion

This research has addressed the question: "Are men and women different with respect to technology adoption?" Rather than examining *mean* differences between women and men, this research focused on a longitudinal examination of gender differences in the *relationships* among theoretically grounded determinants of technology acceptance and usage. The focus on the relative influence of different determinants (beta differences) demonstrates how women and men differ in their decision making processes regarding technology acceptance and use. Several important and interesting findings, both over the short- and long-term, regarding the roles of perceived usefulness, perceived ease of use, and subjective norm emerged from this work.

The current research revealed that men consider perceived usefulness to a greater extent than women in making their decisions regarding the use of a new technology, both in the short- and long-term. On the other hand, perceived ease of use was more salient to women compared with men both after initial training and over time with increasing experience with the system. In fact, perceived ease of use was not a salient factor to men at any point in time. Interestingly, men's assessment of ease of use of the system went up somewhat with time/experience and women's assessment went down. This adds further evidence to the differential salience observed because men perceive the system to be easier to use with increasing experience, thus resulting in perceptions of ease of use receding into the background and being a non-significant factor in determining their intention to use the system. In contrast, the declining perceptions of ease of use of the system observed in women appear to make system ease of use more of an issue to them, thus to some extent accounting for the increased salience of ease of use for women relative to other usage determinants.

Table 4. Summary of Results

	Relationship	Hypothesis	Remarks
Short-term Effects			
H1	U-BI	Men > Women	Supported
H2a	EOU-BI	Women > Men	Supported
H2b	EOU-U	Men > Women	Not supported
H3	SN-BI	Women > Men	Supported
Long-term Effects			
H4	U-BI	Men > Women	Supported
H5a	EOU-BI	Women > Men	Supported
H5b	EOU-U	Men > Women	Not supported
H6	SN-BI	Non-significant	Partially supported (significant for women at t_2)

For subjective norm, the contrasts were equally striking. Subjective norm did not influence men's decisions at any point in time. In contrast, women did consider normative influences at the initial stage of technology introduction and after one month of experience. After three months of experience, women no longer placed significant emphasis on subjective norm. This outcome was contrary to our expectation that subjective norm would not be significant with increasing experience (i.e., during measurement after one and three months of use) due to internalization of normative influences. One possible explanation for this outcome is that one month (t_2) was not enough time to gain direct experience that leads to cementing of one's own views regarding the new system. Women may still have been receiving and considering input from peers/superiors and had not fully internalized others' views. However, it appears that three months (i.e., t_3) was long enough for internalization to take place, rendering subjective norm non-significant. Usage statistics (see Table 2) indicated that it is possible that this outcome occurred because the frequency of usage by women was about half the use by men. Interestingly, although women, in contrast to men, considered normative influences in their decision making process, the perceptions of normative pressure among women were actually lower than the perceived pressure among men.

Based on our results, several important inferences can be made. First, given the findings, one could argue that men are more driven by instrumental factors (i.e., perceived usefulness) while women are more motivated by process (perceived ease of use) and social (subjective norm) factors. However, perhaps a more qualitative interpretation would suggest that men are more focused in their decision making regarding new technologies, while women are more balanced in their decision-making process. In other words, while men only consider productivity-related factors, women consider inputs from a number of sources including productivity assessments when making technology adoption and usage decisions. This notion is supported by the fact that all three determinants (U, EOU, and SN) together explain nearly identical variance in initial intention for women as perceived usefulness (U) alone explains in initial intention for men. This basic pattern held true in explaining sustained usage of technology as well. Furthermore, these gender differences were robust to the most important potential confounds of gender studies in the organizational behavior research and technology research, thus providing compelling evidence for the notion that gender plays a vital role in shaping initial and sustained technology adoption decisions by today's knowledge workers.

Contributions and Implications

The current research presents important contributions and implications for research and practice. TAM has been replicated and applied in a wide variety of settings for nearly a decade. However, extensions to the model have been limited. Specifically, research has not yet investigated the “conditions and mechanisms governing the impact of social influences on usage behavior” called for by Davis et al. (1989, p. 999). Thus, the proposed extensions to TAM—the integration of subjective norm, examination of gender differences in the role of the original TAM constructs, and the related role of experience—represent important theoretical advances in technology acceptance and usage. The current research integrates subjective norm into TAM and delineates *when* subjective norm will play a role from the perspective of target user category (i.e., women) and timing (i.e., short-term rather than long-term). Further, identifying boundary conditions (i.e., moderation by gender) associated with the role played by the original TAM constructs of perceived usefulness and perceived ease of use helps us refine, sharpen, and, quite possibly, better apply TAM to the study of user acceptance and usage in the workplace. The robustness of the findings over a five-month period in a real-world setting provides strong evidence supporting the proposed extensions and boundary conditions. The basic TAM hypothesis that the effect of external variables (e.g., gender) will be completely mediated, with no moderating effects, was not supported. Such a pattern is consistent with psychology research (e.g., Tashakkori and Thompson 1991). This calls for research into other situations and circumstances when there is partial mediation of external variables by TAM constructs, and the need to identify other potential moderators and boundary conditions of TAM.

The importance of subjective norm in determining technology adoption decisions among women merits further attention by researchers and practitioners alike. Peer pressure and superiors’ influence have been shown to be determinants of subjective norm in technology adoption contexts. Future research should focus on clarifying the underlying cognitive mechanisms for the greater importance placed by women on normative in-

fluences. As discussed earlier, Minton and Schneider (1980) and Roberts (1991) suggest two potentially competing causal mechanisms. Although both lines of argument suggest similar outcomes, the information processing models proposed are different. It is important to understand the circumstances in which different mechanisms are operational in order to facilitate the design of appropriate organizational interventions for increased buy-in for technologies being introduced. More broadly, it is important to understand the cognitive mechanisms underlying the formation and change of perceived usefulness and perceived ease of use in general (see Davis et al. 1992; Venkatesh and Davis 1996), and among women and men separately.

Much prior research on TAM has presented a cross-sectional snapshot (e.g., Mathieson 1991), or has used student subjects in a longitudinal study (e.g., Venkatesh and Davis 1996). Thus, one important strength of this research is the longitudinal nature (five months) of the study combined with the real organizational contexts (five different organizations) to study user reactions and usage behavior. In a real-world setting, this research presented the opportunity to study user reactions to a new technology as users progressed from novices on the new system to experienced users. The findings, therefore, help us better understand gender differences in technology acceptance, adoption, and usage, thus providing valuable insights into implementation and diffusion of new technologies in organizational settings. The current work combined with our other recent work (Venkatesh et al. forthcoming), which presents a longitudinal analysis, provides a more complete picture of gender and technology adoption/usage. Unfortunately, the role of age could not be studied due to restrictions imposed by the participating organizations. However, in other work, we have studied the role of age but not gender, once again due to practical constraints (Morris and Venkatesh forthcoming). Future research should examine the role of gender and age in the context of a single research study.

There are also important practical implications for these findings. Organizations today invest over \$20 billion in technology training programs

(Industry Report 1996). Training represents the key method for successful knowledge transfer to users, implementation, and diffusion of new technologies, and is the most popular mechanism used to smooth the transition to new technology in the workplace. However, if such training programs are to be effective in helping organizations overcome barriers to adoption, the current research suggests that trainers are faced with a dilemma: Do they emphasize productivity benefits, or do they emphasize process/usability issues and social factors? Trainers should be careful not to treat this issue as a "zero sum game" (i.e., emphasizing one factor at the expense of another). Rather, they may wish to emphasize usefulness issues for men, while offering women a more balanced analysis that includes productivity aspects, process issues, and testimonials from peers or superiors. These recommendations also have implications for marketing professionals who may find these findings useful in designing advertising campaigns designed to appeal to a specific target group within the population. Again, by targeting outcome expectations vs. process expectations and/or social factors, one may pinpoint important issues related to technology adoption for men and women, respectively. The overall pattern of gender differences also presents organizations with important information in terms of designing organizational and managerial interventions that can foster acceptance and use of new technologies both in the short- and the long-term.

Limitations and Future Research Directions

One potential limitation of this research surrounds the measure of gender employed. The dichotomous measurement is consistent with the treatment of gender as "biological sex." As noted in the literature review, gender may also be conceptualized as a psychological construct (e.g., Bem 1981). If so, gender (as operationalized in this study) may be a surrogate for other psychological constructs. For example, our research suggests that subjective norm is more important for women because, as a group, they are more expressive, more aware of others' feelings, and more compliant than men. Future

research should measure expressiveness, awareness of others' feelings, and motivation to comply to examine the underlying psychological dimensions captured via gender. This would be useful for several reasons. First, men and women are not at bipolar extremes on these dimensions. Thus, they might vary based on degrees of femininity or masculinity (Bem 1981). Furthermore, TAM is a psychological model. While the consideration of gender as a biological construct in this research is consistent with previous conceptualizations of the construct, it adds a layer of abstraction to TAM that might be alleviated by a psychological examination of gender or its underlying dimensions in future research.

Another measurement limitation was the operationalization of the prior computer experience construct in this study. The construct was measured by the number of years of experience the user had with computers in general. Because none of the participants had any prior experience with the target system, we believe the experience measure used in this study was reasonable. Future research might use a finer grain of detail in its conceptualization of experience. For example, two years using solely word processing is much different from two years of programming experience. Future research might also target self-efficacy (Compeau and Higgins 1995a, 1995b) or domain-specific experience as alternative measures to employ. Another limitation in the current work is the measurement of usage as frequency of use. While there are precedents to such a measurement of usage (e.g., Davis et al. 1989), future research should employ duration of use and/or other measures that more completely capture the intensity of usage.

A number of other measurement issues with respect to the demographic variables employed in this study offer important avenues for extensions of this work. Different categorizations of the occupational variable (for example, into technical and non-technical) may be valuable. Educational level could measure domain-specific knowledge (e.g., computer aptitude tests) or more generalized measures of intelligence (e.g., IQ tests) to extend the educational level as was measured in this research. Income level could also be operationalized as household income given the prevalence

of dual incomes today. Such a conceptualization may more accurately reflect socialization patterns and schematic processing related to socio-economic status.

Conclusions

While TAM is a parsimonious and powerful model for understanding technology acceptance, social influence is a notable omission from the model. This research addresses this issue by investigating gender as a potential key to understanding the role of social influence in initial technology adoption decisions and sustained usage of new technologies. In addition to gender differences in the role of social influence, the current research also reveals gender differences in the role of perceived usefulness and perceived ease of use as determinants of technology acceptance and usage behavior. Importantly, the gender differences reported here were robust to the key confounds identified in prior organizational behavior literature and information technology research, thus further supporting the proposed extension to TAM. While men still represent a majority of the work force, the number of women at all levels of the organizational hierarchy continues to rise. Therefore, technology acceptance theories and models that overlook gender as an important factor may overestimate the influence of productivity-oriented factors while simultaneously underestimating the importance of ease of use perceptions and social influences.

Acknowledgements

We are indebted to the senior editor, Professor Ron Weber, the anonymous associate editor, and three reviewers whose insightful comments and suggestions significantly enhanced the quality of this paper. We would like to express our sincerest thanks to Tracy Ann Sykes (University of Maryland) for her editorial work that helped improve the readability of this paper.

References

- Adams, D. A., Nelson, R. R., and Todd, P. A. "Perceived Usefulness, Ease of Use and Usage of Information Technology: A Replication," *MIS Quarterly* (16:2), 1992, pp. 227-250.
- Ajzen, I. "From Intentions to Actions: A Theory of Planned Behavior," in *Action Control: From Cognition to Behavior*, J. Kuhl and J. Beckmann (eds.), Springer Verlag, New York, 1985, pp. 11-39.
- Ajzen, I. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50), 1991, pp. 179-211.
- Ajzen, I., and Fishbein, M. *Understanding Attitudes and Predicting Social Behavior*, Prentice-Hall, Englewood Cliffs, NJ, 1980.
- Bandura, A. "Self-Efficacy: Toward a Unifying Theory of Behavioral Change," *Psychological Review* (84:2), 1977, pp. 191-215.
- Bandura, A. "Self-Efficacy Mechanism in Human Agency," *American Psychologist* (37:2), 1982, pp. 122-147.
- Bandura, A. *Social Foundations of Thought and Action: A Social Cognitive Theory*, Prentice-Hall, Englewood Cliffs, NJ, 1986.
- Barnett, R. C., and Marshall, N. L. "The Relationship Between Women's Work and Family Roles and Their Subjective Well-Being and Psychological Distress," in *Women, Work and Health: Stress and Opportunities*, M. Frankenhaeuser, V. Lundberg, and M. A. Chesney (eds.), Plenum, New York, 1991, pp. 111-136.
- Becker, B. J. "Influence Again: An Examination of Reviews and Studies of Gender Differences in Social Influence," in *The Psychology of Gender: Advances Through Meta-Analysis*, J. S. Hyde and M. C. Linn (eds.), Johns Hopkins University Press, Baltimore, MD, 1986, pp. 178-209.
- Bem, S. L. "The BSRI and Gender Schema Theory: A Reply to Spence and Helmreich," *Psychological Review* (88), 1981, pp. 369-371.
- Bem, D. J., and Allen, A. "On Predicting Some of the People Some of the Time: The Search for Cross-Situational Consistencies in Behavior," *Psychological Review* (81), 1974, pp. 506-520.
- Bergeron, F., Rivard, S., and De Serre, L. "Investigating the Support Role of the Information Center," *MIS Quarterly* (14:3), 1990, pp. 247-259.

- Bettman, J. R., and Sujan, M. "Effects of Framing on Evaluations of Comparable and Noncomparable Alternatives by Expert and Novice Consumers," *Journal of Consumer Research* (14:2), 1987, pp. 141-154.
- Bozionelos, N. "Psychology of Computer Use: XXXIX. Prevalence of Computer Anxiety in British Managers and Professionals," *Psychological Reports* (78), 1996, pp. 995-1002.
- Carlson, R. "Sex Differences in Ego Functioning: Exploratory Studies of Agency and Communion," *Journal of Consulting and Clinical Psychology* (37), 1971, pp. 267-277.
- Chan, D. K. S., and Fishbein, M. "Determinants of College Women's Intention to Tell Their Partners to Use Condoms," *Journal of Applied Social Psychology* (23), 1993, pp. 1455-1470.
- Chin, W. W., Marcolin, B. L., and Newsted, P. R. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and Voice Mail Emotion/Adoption Study," in *Proceedings of the Seventeenth International Conference on Information Systems*, J. I. DeGross, S. Jarvenpaa, and A. Srinivasan (eds.), Cleveland, OH, 1996, pp. 21-41.
- Chin, W. W., and Todd, P. A. "On the Use, Usefulness, and Ease of Use of Structural Equation Modeling in MIS Research: A Note of Caution," *MIS Quarterly* (19), 1995, pp. 237-246.
- Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, Lawrence Erlbaum Associates, Hillsdale, NJ, 1988.
- Cohen, J., and Cohen, P. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences* (2nd ed.), Lawrence Erlbaum Associates, Hillsdale, NJ, 1988.
- Compeau, D. R., and Higgins, C. A. "Application of Social Cognitive Theory to Training for Computer Skills," *Information Systems Research* (6:2), 1995a, pp. 118-143.
- Compeau, D. R., and Higgins, C. A. "Computer Self-Efficacy: Development of a Measure and Initial Test," *MIS Quarterly* (19:2), 1995b, pp. 189-211.
- Crawford, M., Chaffin, R., and Fitton, L. "Cognition in Social Context," *Special Issue, Psychological and Psychobiological Perspectives on Sex Differences in Cognition: I. Theory and Research, Learning and Individual Differences* (7:4), 1995, pp. 341-362.
- Davis, F. D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), 1989, pp. 319-339.
- Davis, F. D. "User Acceptance of Information Technology: System Characteristics, User Perceptions and Behavioral Impacts," *International Journal of Man-Machine Studies* (38:3), 1993, pp. 475-487.
- Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science* (35), 1989, pp. 982-1002.
- Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. "Extrinsic and Intrinsic Motivation to Use Computers in the Workplace," *Journal of Applied Social Psychology* (22:14), 1992, pp. 1111-1132.
- Davis, F. D., and Venkatesh, V. "A Critical Assessment of Potential Measurement Biases in the Technology Acceptance Model: Three Experiments," *International Journal of Human Computer Studies* (45), 1996, pp. 19-45.
- Doll, J., and Ajzen, I. "Accessibility and Stability of Predictors in the Theory of Planned Behavior," *Journal of Personality and Social Psychology* (63), 1992, pp. 754-765.
- Eagly, A. H. "Sex Differences in Influenceability," *Psychological Bulletin* (85), 1978, pp. 86-116.
- Eagly, A. H., and Carli, L. L. "Sex of Researchers and Sex-Typed Communications as Determinants of Sex Differences in Influenceability: A Meta-Analysis of Social Influence Studies," *Psychological Bulletin* (90), 1981, pp. 1-20.
- Fazio, R. H., and Zanna, M. "Attitudinal Qualities Relating to the Strength of the Attitude-Perception and Attitude-Behavior Relationship," *Journal of Experimental Social Psychology* (14), 1978a, pp. 398-408.
- Fazio, R. H., and Zanna, M. "On the Predictive Validity of Attitudes: The Roles of Direct Experience and Confidence," *Journal of Personality* (46), 1978b, pp. 228-243.
- Fazio, R. H., and Zanna, M. "Direct Experience and Attitude-Behavior Consistency," in *Advances in Experimental Social Psychology* (14) L. Berkowitz (ed.), Academic Press, San Diego, CA, 1981, pp. 161-202.
- Felter, M. "Sex Differences on the California State-wide Assessment of Computer Literacy," *Sex Roles* (13), 1985, pp. 181-192.

- Fishbein, M., and Ajzen, I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Addison-Wesley, Reading, MA, 1975.
- Fishbein, M., and Stasson, M. "The Role of Desires, Self-Predictions, and Perceived Control in the Prediction of Training Session Attendance," *Journal of Applied Social Psychology* (20), 1990, pp. 173-198.
- Fulk, J., Steinfield, C. W., Schmitz, J., and Power, J. G. "A Social Information Processing Model of Media Use in Organizations," *Communications Research* (14), 1987, pp. 529-552.
- Garai, J. E., and Scheinfeld, A. "Sex Differences in Mental and Behavioral Traits," *Genetic Psychology Monographs* (77), 1968, pp. 169-299.
- Gefen, D., and Straub, D. W. "Gender Differences in the Perception and Use of E-mail: An Extension to the Technology Acceptance Model," *MIS Quarterly* (21:4), 1997, pp. 389-400.
- Gill, S., Stockard, J., Johnson, M., and William, S. "Measuring Gender Differences: The Expressive Dimension and Critique of Androgyny Scales," *Sex Roles* (17), 1987, pp. 375-400.
- Hartwick, J., and Barki, H. "Explaining the Role of User Participation in Information System Use," *Management Science* (40), 1994, pp. 440-465.
- Hoffman, L. W. "Early Childhood Experiences and Women's Achievement Motives," *Journal of Social Issues* (28:2), 1972, pp. 129-155.
- Hoffman, L. W. "Changes in Family Roles, Socialization, and Sex Differences," *American Psychologist* (32), 1977, pp. 644-657.
- Hofstede, G. *Culture's Consequences: International Differences in Work Related Values*, Sage, London, 1980.
- Hunt, N. P., and Bohlin, R. M. "Teacher Education and Students' Attitudes Toward Using Computers," *Journal of Research on Computing in Education* (25), 1993, pp. 487-497.
- Igbaria, M., and Chakrabarti, A. "Computer Anxiety and Attitudes Toward Microcomputer Use," *Behaviour and Information Technology* (9:3), 1990, pp. 229-241.
- Igbaria, M., Zinatelli, N., Cragg, P., and Cavaye, A. L. M. "Personal Computing Acceptance Factors in Small Firms: A Structural Equation Model," *MIS Quarterly* (21:3), 1997, pp. 279-305.
- Industry Report. *Training* (33:10) 1996, pp.37-79.
- Johansen, R., and Swigart, R. *Upsizing the Individual in the Downsizing Organization: Managing in the Wake of Reengineering, Globalization, and Overwhelming Technological Change*, Addison-Wesley, Reading, MA, 1996.
- Kagan, J. "Acquisition and Significance of Sex-Typing and Sex Role Identity," in *Review of Child Development Research* (1), M. L. Hoffman and L. W. Hoffman (eds.), Russell Sage Foundation, New York, 1964, pp. 137-167.
- Kohlberg, L. A. "A Cognitive-Developmental Analysis of Children's Sex-Role Concepts and Attitudes," in *The Development of Sex Differences*, E. E. Maccoby (ed.), Stanford University Press, Stanford, CA, 1966, pp. 82-173.
- Landau, S. B., and Leventhal, G. A. "A Simulation Study of Administrators' Behavior Toward Employees Who Receive Job Offers," *Journal of Applied Social Psychology* (6), 1976, pp. 291-306.
- Landauer, T. K. *The Trouble with Computers: Usefulness, Usability, and Productivity*, MIT Press, Cambridge, MA, 1995.
- Lapan, R. T., McGrath, E., and Kaplan, D. "Factor Structure of the Basic Interest Scales by Gender Across Time," *Journal of Counseling Psychology* (37:2), 1990, pp.216-222.
- Lee, A. "Electronic Mail as a Medium for Rich Communication: An Empirical Investigation Using Hermeneutic Interpretation," *MIS Quarterly* (18:2), 1994, pp. 143-157.
- Lefkowitz, J. "Sex-Related Differences in Job Attitudes and Dispositional Variables: Now You See Them....", *Academy of Management Journal* (37:2), 1994, pp. 323-349.
- Lueptow, L. B., Garovich, L., and Lueptow, M. B. "The Persistence of Gender Stereotypes in the Face of Changing Sex Roles: Evidence Contrary to the Sociocultural Model," *Ethnology and Sociobiology* (16), 1995, pp. 509-530.
- Lundeberg, M. A., Fox, P. W., and Puncochar, J. "Highly Confident But Wrong: Gender Differences and Similarities in Confidence Judgments," *Journal of Educational Psychology* (86), 1994, pp. 114-121.
- Maccoby, E. E., and Jacklin, C. N. *The Psychology of Sex Differences*, Stanford University Press, Stanford, CA, 1974.
- Markus, M. L. "Toward a 'Critical Mass' Theory of Interactive Media," in *Organizations and Communication Technology*, J. Fulk and C. W. Steinfield (eds.), Sage, Newbury Park, CA, 1990, pp. 491-511.

- Mathieson, K. "Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior," *Information Systems Research* (2), 1991, pp. 173-191.
- Mervis, C. B., and Rosch, E., "Categorization of Natural Objects," *Annual Review of Psychology* (32), 1980, pp. 89-115.
- Miller, J. B. *Toward a New Psychology of Women*, Beacon Press, Boston, 1986.
- Minton, H. L., and Schneider, F. W. *Differential Psychology*, Waveland Press, Prospect Heights, IL, 1980.
- Minton, C., Kagan, J., and Levine, J. A. "Maternal Control and Obedience in the Two-year-old," *Child Development* (42), 1971, pp. 1873-1894.
- Moore, G. A. *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers*, Harper-Collins, New York, 1991.
- Morris, M., and Dillon, A. "How User Perceptions Influence Software Use," *IEEE Software* (14:4), 1997, pp. 58-65.
- Morris, M. G., and Venkatesh, V. "Age Differences in Technology Adoption Decisions: Implications for a Changing Work Force," *Personnel Psychology*, forthcoming.
- Morrow, P. C., Presll, E. R., and McElroy, J. C. "Attitudinal and Behavioral Correlates of Computer Anxiety," *Psychological Reports* (59), 1986, pp. 1199-1204.
- Ngwenyama O. J., and Lee A. S. "Communication Richness in Electronic Mail: Critical Social Theory and the Contextuality of Meaning," *MIS Quarterly* (21:2), 1997, pp. 145-168
- Nisbett, R. E., and Ross, L. *Human Inference: Strategies and Shortcomings of Social Judgment*, Prentice-Hall, Englewood Cliffs, NJ, 1980.
- Norman, D. A. *Things That Make Us Smart: Defending Human Attributes in the Age of the Machine*, Addison-Wesley, Reading, MA, 1993.
- O'Neil, J. M. "Gender-Role Conflict and Strain in Men's Lives: Implications for Psychiatrists, Psychologists, and Other Human-Service Providers," in *Men in Transition: Theory and Therapy*, K. Solomon and N. B. Levy (eds.), Plenum, New York, 1982, pp. 5-44.
- Oliver, R. L., and Bearden W. O. "Crossover Effects in the Theory of Reasoned Action: A Moderating Influence Attempt," *Journal of Consumer Research* (12), 1985, pp. 324-340.
- Parsons, J. E., and Bales, R. F. *Family: Socialization and Interaction Process*, Free Press, Glencoe, IL, 1955.
- Poole, M. S., and DeSanctis, G. "Understanding the Use of Group Decisions Support Systems: The Theory of Adaptive Structuration," in *Organizations and Communication Technology*, J. Fulk, and C. Steinfield (eds.), Sage, Newbury Park, CA, 1990, pp.173-191.
- Regan, D. T., and Fazio, R. H. "On the Consistency Between Attitudes and Behavior: Look to the Method of Attitude Formation," *Journal of Experimental Social Psychology* (13), 1977, pp. 38-45.
- Reinecke, J., Schmidt, P., and Ajzen, I. "Application of the Theory of Planned Behavior to Adolescents' Condom Use: A Panel Study," *Journal of Applied Social Psychology* (26), 1996, pp. 749-772.
- Roberts, T. "Gender and the Influence of Evaluations in Self-Assessments in Achievement Settings," *Psychological Bulletin* (109), 1991, pp. 297-308.
- Rosen, L. D., and Maguire, P. D. "Myths and Realities in Computerphobia: A Meta-Analysis," *Anxiety Research* (3), 1990, pp. 175-191.
- Rosenkrantz, P., Vogel, P., Bee, H., Broverman, I., and Broverman, D. M. "Sex-Role Stereotypes and Self-Concepts in College Students," *Journal of Consulting and Clinical Psychology* (32), 1968, pp. 287-295.
- Sambamurthy, V., and Chin, W. W. "The Effects of Group Attitudes Toward Alternative GDSS Designs on the Decision-Making Performance of Computer-Supported Groups," *Decision Sciences* (25:2), 1994, pp. 215-241.
- Segars, A. H., and Grover, V. "Re-examining Perceived Ease of Use and Usefulness: A Confirmatory Factor Analysis," *MIS Quarterly* (18:4), 1993, pp. 517-525.
- Sheppard, B. H., Hartwick, J., and Warshaw, P. R. "The Theory of Reasoned Action: A Meta-Analysis of Past Research with Recommendations for Modifications and Future Research," *Journal of Consumer Research*, (15), 1988, pp. 325-343.
- Sichel, D. E. *The Computer Revolution: An Economic Perspective*, The Brookings Institution, Washington, DC, 1997.
- Skitka, L. J., and Maslach, C. "Gender as Schematic Category: A Role Construct Approach," *Social Behavior and Personality* (24:1), 1996, pp. 53-74.

- Sparks, P. "Attitude Towards Food: Applying, Assessing, and Extending the Theory of Planned Behavior," in *The Social Psychology of Health and Safety: European Perspectives*, D. R. Rutter and L. Quine (eds.), Aldershot, Avebury, England, 1994, pp. 25-46.
- Stein, A. H., and Bailey, M. M. "The Socialization of Achievement Orientation in Females," *Psychological Bulletin* (80), 1973, pp. 345-366.
- Subramanian, G. H. "A Replication of Perceived Usefulness and Perceived Ease of Use Measurement," *Decision Sciences* (25:5/6), 1994, pp. 863-874.
- Szajna, B. "Software Evaluation and Choice: Predictive Validation of the Technology Acceptance Instrument," *MIS Quarterly* (18), 1994, pp. 319-324.
- Szajna, B. "Empirical Evaluation of the Revised Technology Acceptance Model," *Management Science* (42), 1996, pp. 85-92.
- Tashakkori, A. "Gender, Ethnicity, and the Structure of Self-Esteem: An Attitude Theory Approach," *Journal of Social Psychology* (133), 1993, pp. 479-488.
- Tashakkori, A., and Thompson, V. D. "Race Differences in Self-Perception and Locus of Control During Adolescence and Early Adulthood: Methodological Implications," *Genetic, Social, and General Psychology Monographs* (117), 1991, pp. 133-152.
- Taylor, M. C., and Hall, J. A. "Psychological Androgyny: Theories, Methods, and Conclusions," *Psychological Bulletin* (92), 1982, pp. 347-366.
- Taylor, S., and Todd, P. A. "Assessing IT Usage: The Role of Prior Experience," *MIS Quarterly* (19:4), 1995b, 561-570.
- Taylor, S., and Todd, P. A. "Understanding Information Technology Usage: A Test of Competing Models," *Information Systems Research* (6), 1995a, pp.144-176.
- Venkatesh, V. "Creation of Favorable User Perceptions: Exploring the Role of Intrinsic Motivation," *MIS Quarterly* (23:2), June 1999, pp. 239-260.
- Venkatesh, V. "Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion Into the Technology Acceptance Model," *Information Systems Research*, forthcoming.
- Venkatesh, V., and Davis, F. D. "A Model of the Perceived Ease of Use Development and Test," *Decision Sciences* (27:3), 1996, pp. 451-481.
- Venkatesh, V., and Davis, F. D. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Studies," *Management Science*, forthcoming..
- Venkatesh, V., Morris, M. G., and Ackerman, P. L. "A Longitudinal Investigation of Gender Differences in Individual Technology Adoption Decision Making Processes," *Organizational Behavior and Human Decision Processes*, forthcoming..
- Venkatesh, V., and Speier, C. "Computer Technology Training in the Workplace: A Longitudinal Investigation of the Effect of Mood," *Organizational Behavior and Human Decision Processes* (79), 1999, pp. 1-28.
- Warshaw, P. R. "A New Model for Predicting Behavioral Intentions: An Alternative to Fishbein," *Journal of Marketing Research* (17), 1980, pp.153-172.
- Weiner, L. R. *Digital Woes: Why We Should Not Depend on Software*, Addison-Wesley, Reading, MA. 1993.
- Weissman, M. M., Bland, R., Joyce, P. R., Newman, S., Wells, J. E., and Witchen, H. U. "Sex Differences in Rates of Depression: Cross-National Perspectives," *Journal of Affective Disorders* (29), 1993, pp. 77-84.
- Weller, L., Shlomi, A., and Zimont, G. "Birth Order, Sex, and Occupational Interest," *Journal of Vocational Behavior* (8), 1976, pp. 45-50.
- Wilder, G., Macki, D., and Cooper, J. "Gender and Computers: Two Surveys of Computer-Related Attitudes," *Sex Roles* (13), 1985, pp.215-228
- Williams, J. E., and Best, D. L. *Measuring Sex Stereotypes: A Thirty-Nation Study*, Sage, Beverly Hills, CA, 1982.

About the Authors

Viswanath Venkatesh is an assistant professor in Decision and Information Technologies in the Robert H. Smith School of Business at the University of Maryland at College Park. He was named the school's first Tyser Fellow in 1999. He received his Ph.D. in Information and Decision Sciences from the University of Minnesota in

1998. His research focuses on understanding user acceptance of computer and information technologies in the workplace and homes. In addition, he has a keen interest, from a research and teaching perspective, in developing effective methods of user training. His research has been published (or is forthcoming) in *Management Science*, *MIS Quarterly*, *Information Systems Research*, *Organizational Behavior and Human Decision Processes*, *Decision Sciences*, *International Journal of Human-Computer Studies* and *Personnel Psychology*. He was a recipient of the Smith School's Teaching Innovation Award in 1998.

Michael G. Morris is an assistant professor of Information Systems Management at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio. He received his Ph.D. in Management Information Systems from Indiana University in 1996. His research interests center around socio-cognitive aspects of human response to information technology, including technology acceptance and usability evaluation. His research has been published (or is forthcoming) in *Organizational Behavior and Human Decision Processes*, *Decision Sciences*, *IEEE Software*, *International Journal of Human-Computer Studies* and *Personnel Psychology*.

Appendix A

Questionnaire Items

Intention to Use

Assuming I had access to the system, I intend to use it.
Given that I had access to the system, I predict that I would use it.

Perceived Usefulness

Using the system improves my performance in my job.
Using the system in my job increases my productivity.
Using the system enhances my effectiveness in my job.
I find the system to be useful in my job.

Perceived Ease of Use

My intention with the system is clear and understandable.
Interacting with the system does not require a lot of my mental effort.
I find the system to be easy to use.
I find it easy to get the system to do what I want it to do.

Subjective Norm

People who influence my behavior think that I should use the system.
People who are important to me think that I should use the system.

Gender: Female
 Male

Educational Level: Some high school or less Some college
 Graduated high school Graduated college
 Vocational/technical school Post-graduate study

Annual Individual Income: Less than \$20,000 \$60,000 – \$69,999
(Before Taxes) \$20,000 – \$29,999 \$70,000 – \$79,999
 \$30,000 – \$39,999 \$80,000 – \$89,999
 \$40,000 – \$49,999 \$90,000 – \$99,999
 \$50,000 – \$59,999 \$100,000 or more

Position: Executive/Top Management Administrative/Clerical
 Middle Management Technical
 Supervisory Other: _____
(please specify)

Prior Computer Experience

How many years of experience do you have using computers in general?

Note: Intention to use, perceived usefulness, perceived ease of use, and subjective norm were measured using a seven-point Likert scale.

Appendix B

Measurement Model Estimation

Factor Structure Matrix

	1	2	3	4
U1	0.92	0.09	0.12	0.07
U2	0.89	0.20	0.19	0.12
U3	0.88	0.15	0.21	0.19
U4	0.95	0.11	0.11	0.04
EOU1	0.13	0.88	0.10	0.21
EOU2	0.02	0.90	0.09	0.22
EOU3	0.14	0.85	0.21	0.03
EOU4	0.09	0.93	0.12	0.07
SN1	0.24	0.07	0.81	0.19
SN2	0.22	0.14	0.83	0.09
BI1	0.27	0.19	0.11	0.87
BI2	0.25	0.16	0.16	0.81

U1 through U4: Perceived Usefulness items
 EOU1 through EOU4: Perceived Ease of Use items
 SN1 through SN4: Subjective Norm items
 BI1 through BI2: Behavioral Intention items

Reliability and Discriminant Validity Coefficients

	ICR	1	2	3	4
Perceived Usefulness	0.93	.91			
Perceived Ease of Use	0.92	.22*	.88		
Subjective Norm	0.85	.37***	.20*	.82	
Behavioral Intention	0.88	.49***	.30***	.34	.84

Note: Diagonal elements are the square root of the shared variance between the constructs and their measures. Off-diagonal elements are the correlations between the different constructs.

ICR = Internal Consistency Reliability

* $p < .05$; *** $p < .001$