MANAGEMENT SCIENCE
Vol. 35, No. 8, August 1989
Printed in U.S.A.

USER ACCEPTANCE OF COMPUTER TECHNOLOGY: A COMPARISON OF TWO THEORETICAL MODELS*

FRED D. DAVIS, RICHARD P. BAGOZZI AND PAUL R. WARSHAW
School of Business Administration, University of Michigan, Ann Arbor, Michigan 48109-1234
School of Business Administration, University of Michigan, Ann Arbor, Michigan 48109-1234
School of Business Administration, California Polytechnic State University, San Luis Obispa, California 93407

Computer systems cannot improve organizational performance if they aren't used. Unfortunately, resistance to end-user systems by managers and professionals is a widespread problem. To better predict, explain, and increase user acceptance, we need to better understand why people accept or reject computers. This research addresses the ability to predict peoples' computer acceptance from a measure of their intentions, and the ability to explain their intentions in terms of their attitudes, subjective norms, perceived usefulness, perceived ease of use, and related variables. In a longitudinal study of 107 users, intentions to use a specific system, measured after a one-hour introduction to the system, were correlated 0.35 with system use 14 weeks later. The intention-usage correlation was 0.63 at the end of this time period. Perceived usefulness strongly influenced peoples' intentions, explaining more than half of the variance in intentions at the end of 14 weeks. Perceived ease of use had a small but significant effect on intentions as well, although this effect subsided over time. Attitudes only partially mediated the effects of these beliefs on intentions. Subjective norms had no effect on intentions. These results suggest the possibility of simple but powerful models of the determinants of user acceptance, with practical value for evaluating systems and guiding managerial interventions aimed at reducing the problem of underutilized computer technology.
(INFORMATION TECHNOLOGY; USER ACCEPTANCE; INTENTION MODELS)

1. Introduction

Organizational investments in computer-based tools to support planning, decision-making, and communication processes are inherently risky. Unlike clerical paperwork-processing systems, these "end-user computing" tools often require managers and professionals to interact directly with hardware and software. However, end-users are often unwilling to use available computer systems that, if used, would generate significant performance gains (e.g., Alavi and Henderson 1981; Nickerson 1981, Swanson 1988). The raw power of computer technology continues to improve tenfold each decade (Peled 1987), making sophisticated applications economically feasible. As technical barriers disappear, a pivotal factor in harnessing this expanding power becomes our ability to create applications that people are willing to use. Identifying the appropriate functional and interface characteristics to be included in end-user systems has proven more challenging and subtle than expected (March 1987; Mitroff and Mason 1983). Recognizing the difficulty of specifying the right system requirements based on their own logic and intuition, designers are seeking methods for evaluating the acceptability of systems as early as possible in the design and implementation process (e.g., Alavi 1984; Bewley et al. 1983; Branscomb and Thomas 1984; Gould and Lewis 1985). Practitioners and researchers require a better understanding of why people resist using computers in order to devise practical methods for evaluating systems, predicting how users will respond to them, and improving user acceptance by altering the nature of systems and the processes by which they are implemented.

Understanding why people accept or reject computers has proven to be one of the most challenging issues in information systems (IS) research (Swanson 1988). Investigators have studied the impact of users' internal beliefs and attitudes on their usage

* Accepted by Richard M. Burton; received November 10, 1987. This paper has been with the authors 4 months for 2 revisions.

0025-1909/89/3508/0982$01.25

behavior (DeSanctis 1983; Fuerst and Cheney 1982; Ginzberg 1981; Ives, Olson and Baroudi 1983; Lucas 1975; Robey 1979; Schultz and Slevin 1975; Srinivasan 1985; Swanson 1974, 1987), and how these internal beliefs and attitudes are, in turn, influenced by various external factors, including: the system's technical design characteristics (Benbasat and Dexter 1986; Benbasat, Dexter and Todd 1986; Dickson, DeSanctis and McBride 1986; Gould, Conti and Hovanyecz 1983; Malone 1981); user involvement in system development (Baroudi, Olson and Ives 1986; Franz and Robey 1986); the type of system development process used (e.g., Alavi 1984; King and Rodriguez 1981); the nature of the implementation process (Ginzberg 1978; Vertinsky, Barth and Mitchell 1975; Zand and Sorensen 1975); and cognitive style (Huber 1983). In general, however, these research findings have been mixed and inconclusive. In part, this may be due to the wide array of different belief, attitude, and satisfaction measures which have been employed, often without adequate theoretical or psychometric justification. Research progress may be stimulated by the establishment of an integrating paradigm to guide theory development and to provide a common frame of reference within which to integrate various research streams.

Information systems (IS) investigators have suggested intention models from social psychology as a potential theoretical foundation for research on the determinants of user behavior (Swanson 1982; Christie 1981). Fishbein and Ajzen's (1975) (Ajzen and Fishbein 1980) theory of reasoned action (TRA) is an especially well-researched intention model that has proven successful in predicting and explaining behavior across a wide variety of domains. TRA is very general, "designed to explain virtually any human behavior" (Ajzen and Fishbein 1980, p. 4), and should therefore be appropriate for studying the determinants of computer usage behavior as a special case.

Davis (1986) introduced an adaptation of TRA, the technology acceptance model (TAM), which is specifically meant to explain computer usage behavior. TAM uses TRA as a theoretical basis for specifying the causal linkages between two key beliefs: perceived usefulness and perceived ease of use, and users' attitudes, intentions and actual computer adoption behavior. TAM is considerably less general than TRA, designed to apply only to computer usage behavior, but because it incorporates findings accumulated from over a decade of IS research, it may be especially well-suited for modeling computer acceptance.

In the present research we empirically examine the ability of TRA and TAM to predict and explain user acceptance and rejection of computer-based technology. We are particularly interested in how well we can predict and explain future user behavior from simple measures taken after a very brief period of interaction with a system. This scenario characterizes the type of evaluations made in practice after pre-purchase trial usage or interaction with a prototype system under development (e.g., Alavi 1984). After presenting the major characteristics of the two models, we discuss a longitudinal study of 107 MBA students which provides empirical data for assessing how well the models predict and explain voluntary usage of a word processing system. We then address the prospects for synthesizing elements of the two models in order to arrive at a more complete view of the determinants of user acceptance.

2. Theory of Reasoned Action (TRA)

TRA is a widely studied model from social psychology which is concerned with the determinants of consciously intended behaviors (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975). According to TRA, a person's performance of a specified behavior is determined by his or her behavioral intention (BI) to perform the behavior, and BI is jointly determined by the person's attitude (A) and subjective norm (SN) concerning the behavior in question (Figure 1), with relative weights typically estimated by regression:

$$BI = A + SN \quad (1)$$

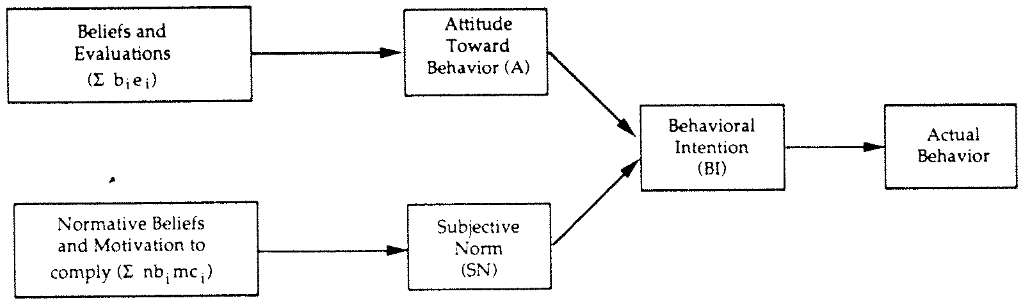

FIGURE 1. Theory of Reasoned Action (TRA).

BI is a measure of the strength of one's intention to perform a specified behavior (e.g., Fishbein and Ajzen 1975, p. 288). A is defined as an individual's positive or negative feelings (evaluative affect) about performing the target behavior (e.g., Fishbein and Ajzen 1975, p. 216). Subjective norm refers to "the person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen 1975, p. 302).

According to TRA, a person's attitude toward a behavior is determined by his or her salient beliefs (b_i) about consequences of performing the behavior multiplied by the evaluation (e_i) of those consequences:

$$A = \sum b_i e_i. \tag{2}$$

Beliefs (b_i) are defined as the individual's subjective probability that performing the target behavior will result in consequence i. The evaluation term (e_i) refers to "an implicit evaluative response" to the consequence (Fishbein and Ajzen 1975, p. 29). Equation (2) represents an information-processing view of attitude formation and change which posits that external stimuli influence attitudes only indirectly through changes in the person's belief structure (Ajzen and Fishbein 1980, pp. 82–86).

TRA theorizes that an individual's subjective norm (SN) is determined by a multiplicative function of his or her normative beliefs (nb_i), i.e., perceived expectations of specific referent individuals or groups, and his or her motivation to comply (mc_i) with these expectations (Fishbein and Ajzen 1975, p. 302):

$$SN = \sum nb_i mc_i. \tag{3}$$

TRA is a general model, and, as such, it does not specify the beliefs that are operative for a particular behavior. Researchers using TRA must first identify the beliefs that are salient for subjects regarding the behavior under investigation. Fishbein and Ajzen (1975, p. 218) and Ajzen and Fishbein (1980, p. 68) suggest eliciting five to nine salient beliefs using free response interviews with representative members of the subject population. They recommend using "modal" salient beliefs for the population, obtained by taking the beliefs most frequently elicited from a representative sample of the population.

A particularly helpful aspect of TRA from an IS perspective is its assertion that any other factors that influence behavior do so only indirectly by influencing A, SN, or their relative weights. Thus, variables such as system design characteristics, user characteristics (including cognitive style and other personality variables), task characteristics, nature of the development or implementation process, political influences, organizational structure and so on would fall into this category, which Fishbein and Ajzen (Ajzen and Fishbein 1975) refer to as "external variables." This implies that TRA mediates the impact of uncontrollable environmental variables and controllable interventions on user behavior. If so, then TRA captures the *internal* psychological variables through which numerous *external* variables studied in IS research achieve their influence on user acceptance, and may provide a common frame of reference within which to integrate various disparate lines of inquiry.

A substantial body of empirical data in support of TRA has accumulated (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975; Ryan and Bonfield 1975; Sheppard, Hartwick and Warshaw in press). TRA has been widely used in applied research settings spanning a variety of subject areas, while at the same time stimulating a great deal of theoretical research aimed at understanding the theory's limitations, testing key assumptions and analyzing various refinements and extensions (Bagozzi 1981, 1982, 1984; Saltzer 1981; Warshaw 1980a, b; Warshaw and Davis 1984, 1985, 1986; Warshaw, Sheppard and Hartwick in press).

3. Technology Acceptance Model (TAM)

TAM, introduced by Davis (1986), is an adaptation of TRA specifically tailored for modeling user acceptance of information systems. The goal of TAM is to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified. Ideally one would like a model that is helpful not only for prediction but also for explanation, so that researchers and practitioners can identify why a particular system may be unacceptable, and pursue appropriate corrective steps. A key purpose of TAM, therefore, is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions. TAM was formulated in an attempt to achieve these goals by identifying a small number of fundamental variables suggested by previous research dealing with the cognitive and affective determinants of computer acceptance, and using TRA as a theoretical backdrop for modeling the theoretical relationships among these variables. Several adaptations to the basic TRA approach were made, supported by available theory and evidence, based on these goals for TAM.

TAM posits that two particular beliefs, *perceived usefulness* and *perceived ease of use*, are of primary relevance for computer acceptance behaviors (Figure 2). Perceived usefulness (U) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context. Perceived ease of use (EOU) refers to the degree to which the prospective user expects the target system to be free of effort. As discussed further below, several studies have found variables similar to these to be linked to attitudes and usage. In addition, factor analyses suggest that U and EOU are statistically distinct dimensions (Hauser and Shugan 1980; Larcker and Lessig 1980; Swanson 1987).

Similar to TRA, TAM postulates that computer usage is determined by BI, but differs in that BI is viewed as being jointly determined by the person's attitude toward using the system (A) and perceived usefulness (U), with relative weights estimated by regression:

$$BI = A + U. \tag{4}$$

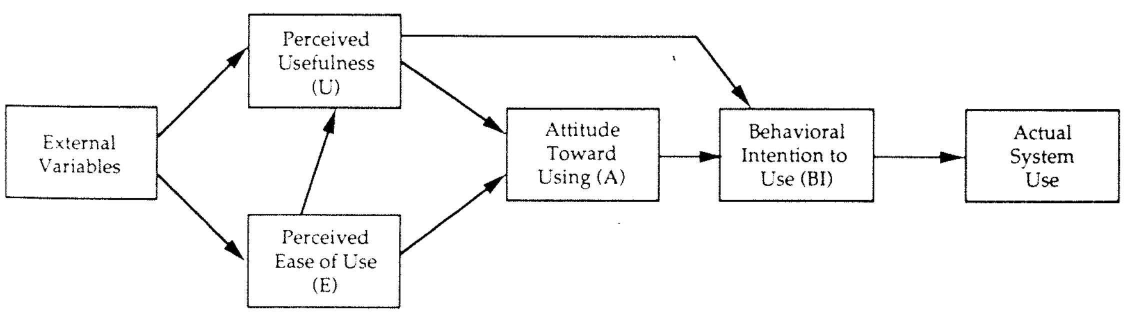

FIGURE 2. Technology Acceptance Model (TAM)

The A-BI relationship represented in TAM implies that, all else being equal, people form intentions to perform behaviors toward which they have positive affect. The A-BI relationship is fundamental to TRA and to related models presented by Triandis (1977) and Bagozzi (1981). Although the direct effect of a belief (such as U) on BI runs counter to TRA, alternative intention models provide theoretical justification and empirical evidence of direct belief-intention links (Bagozzi 1982; Triandis 1977; Brinberg 1979). The U-BI relationship in equation (4) is based on the idea that, within organizational settings, people form intentions toward behaviors they believe will increase their job performance, over and above whatever positive or negative feelings may be evoked toward the behavior per se. This is because enhanced performance is instrumental to achieving various rewards that are extrinsic to the content of the work itself, such as pay increases and promotions (e.g., Vroom 1964). Intentions toward such means-end behaviors are theorized to be based largely on cognitive decision rules to improve performance, without each time requiring a reappraisal of how improved performance contributes to purposes and goals higher in one's goal hierarchy, and therefore without necessarily activating the positive affect associated with performance-contingent rewards (Bagozzi 1982; Vallacher and Wegner 1985). If affect is not fully activated when deciding whether to use a particular system, one's attitude would not be expected to completely capture the impact of performance considerations on one's intention. Hence, the U-BI relationship in TAM represents the resulting direct effect, hypothesizing that people form intentions toward using computer systems based largely on a cognitive appraisal of how it will improve their performance.

TAM does not include TRA's subjective norm (SN) as a determinant of BI. As Fishbein and Ajzen acknowledge (1975, p. 304), this is one of least understood aspects of TRA. It is difficult to disentangle direct effects of SN on BI from indirect effects via A. SN may influence BI indirectly via A, due to internalization and identification processes, or influence BI directly via compliance (Kelman 1958; Warshaw 1980b). Although it is generally thought that computer use by managers and professionals is mostly voluntary (DeSanctis 1983; Robey 1979; Swanson 1987), in some cases people may use a system in order to comply with mandates from their superiors, rather than due to their own feelings and beliefs about using it. However, as Warshaw (1980b) points out, standard measures of SN do not appear to differentiate compliance from internalization and identification. Complicating matters further, A may influence SN, for example due to the "false consensus" effect in which people project their own attitudes to others (e.g., Oliver and Bearden 1985). Because of its uncertain theoretical and psychometric status, SN was not included in TAM. However, since we measured SN in our study in order to examine TRA, we can test whether SN explains any of BI's variance beyond that accounted for by A and U.

Previous IS research contains empirical evidence in favor of the A-BI and U-BI relationships represented in equation (4). Although BI per se has seldom been measured in IS research, several studies have measured A, using a variety of measurement methodologies, and have observed a significant link between A and usage (for review, see Swanson 1982). Usefulness, and variables similar to it such as perceptions of performance impacts, relevance and importance, have also been linked to usage (DeSanctis 1983; Robey 1979; Schultz and Slevin 1975; Swanson 1987). Although the measures employed in these studies were quite varied, and often unvalidated, the similarity of the findings obtained from differing contexts suggests the possibility of fairly robust underlying relationships.

According to TAM, A is jointly determined by U and EOU, with relative weights statistically estimated by linear regression:

$$A = U + EOU. \tag{5}$$

This equation is inspired by TRA's view that attitudes toward a behavior are determined by relevant beliefs. As discussed above, TAM posits that U has a direct effect on BI over and above A. Equation (5) indicates that U influences A as well. Although we contend that one's affect toward a behavior need not fully incorporate affect toward any rewards due to performance outcomes contingent on that behavior, we acknowledge that, through learning and affective-cognitive consistency mechanisms (Bagozzi 1982), positively valued outcomes often increase one's affect toward the means to achieving those outcomes (Peak 1955; Rosenberg 1956; Vroom 1964). Hence, U is hypothesized to have a positive influence on A (as shown in equation (5), above). Previous IS research contains empirical evidence consistent with a U-A link (Barrett, Thornton and Cabe 1968; Schultz and Slevin 1975).

EOU is also hypothesized to have a significant effect on A. TAM distinguishes two basic mechanisms by which EOU influences attitudes and behavior: self-efficacy and instrumentality. The easier a system is to interact with, the greater should be the user's sense of efficacy (Bandura 1982) and personal control (Lepper 1985) regarding his or her ability to carry out the sequences of behavior needed to operate the system. Efficacy is thought to operate autonomously from instrumental determinants of behavior (Bandura 1982), and influences affect, effort persistence, and motivation due to inborn drives for competence and self-determination (Bandura 1982; Deci 1975). Efficacy is one of the major factors theorized to underly intrinsic motivation (Bandura 1982; Lepper 1985). The direct EOU-A relationship is meant to capture this intrinsically motivating aspect of EOU (Carroll and Thomas 1988; Davis 1986; Malone 1981).

Improvements in EOU may also be instrumental, contributing to increased performance. Effort saved due to improved EOU may be redeployed, enabling a person to accomplish more work for the same effort. To the extent that increased EOU contributes to improved performance, as would be expected, EOU would have a direct effect on U:

$$\text{U} = \text{EOU} + \text{External Variables}. \tag{6}$$

Hence, we view U and EOU as distinct but related constructs. As indicated earlier, empirical evidence from factor analyses suggests these are distinct dimensions. At the same time, empirical associations between variables similar to U and EOU have been observed in prior research (Barrett, Thornton and Cabe 1968; Swanson 1987).

As equation (6) implies, perceived usefulness (U) can be affected by various external variables over and above EOU. For example, consider two forecasting systems which are equally easy to operate. If one of them produces an objectively more accurate forecast, it would likely be seen as the more useful (U) system, despite the EOU parity. Likewise, if one graphics program produces higher quality graphs than its equally easy-to-use counterparts, it should be considered more useful. Hence, the objective design characteristics of a system can have a direct effect on U in addition to indirect effects via EOU. Several investigators have found a significant relationship between system characteristics and measures similar to perceived usefulness (e.g., Benbasat and Dexter 1986; Benbasat, Dexter and Todd 1986; Miller 1977). Similarly, educational programs designed to pursuade potential users of the power offered by a given system and the degree to which it may improve users' productivity could well influence U. Learning based on feedback is another type of external variable apt to influence usefulness beliefs.

Perceived ease of use (E) is also theorized to be determined by external variables:

$$\text{EOU} = \text{External Variables}. \tag{7}$$

Many system features such as menus, icons, mice, and touch screens are specifically intended to enhance usability (Bewley et al. 1983). The impact of system features on EOU has been documented (e.g., Benbasat, Dexter and Todd 1986; Bewley et al. 1983;

Dickson, DeSanctis and McBride 1986; Miller 1977). Training, documentation, and user support consultants are other external factors which may also influence EOU.

Despite their similarity, TAM and TRA differ in several theoretical aspects, some of which warrant explanation. Both TAM and TRA posit that A is determined by one's relevant beliefs. Two key differences between how TAM and TRA model the determinants of A should be pointed out. First, using TRA, salient beliefs are elicited anew for each new context. The resulting beliefs are considered idiosyncratic to the specific context, not to be generalized, for example, to other systems and users (Ajzen and Fishbein 1980). In contrast, TAM's U and EOU are postulated a priori, and are meant to be fairly general determinants of user acceptance. This approach was chosen in an attempt to arrive at a belief set that more readily generalizes to different computer systems and user populations. Second, whereas TRA sums together all beliefs (b_i) multiplied by corresponding evaluation weights (e_i) into a single construct (equation (2) above), TAM treats U and EOU as two fundamental and distinct constructs. Modeling beliefs in this disaggregated manner enables one to compare the relative influence of each belief in determining A, providing important diagnostic information. Further, representing beliefs separately allows the researcher to better trace the influence of external variables, such as system features, user characteristics and the like, on ultimate behavior. From a practical standpoint, this enables an investigator to better formulate strategies for influencing user acceptance via controllable external interventions that have measurable influences on particular beliefs. For example, some strategies may focus on increasing EOU, such as providing an improved user interface or better training. Other strategies may target U, by increasing the accuracy or amount of information accessible through a system.

Following the view that U and EOU are distinct constructs, their relative influences on A are statistically estimated using linear regression (or related methods such as conjoint measurement or structural equations). Within TAM, U and EOU are not multiplied by self-stated evaluation weights. Given that neither beliefs nor evaluations are ratio-scaled, the estimated relationship (correlation or regression weight) between A and the product of a belief and evaluation is ambiguous, since it would be sensitive to allowable but theoretically irrelevant linear scale transformations of either the belief or evaluation (for further explanation, cf. Bagozzi 1984; Ryan and Bonfield 1975; Schmidt 1973). On the other hand, as Fishbein and Ajzen (1975, p. 238) point out, omitting the evaluation terms may be misleading in cases where some people in a sample hold positive evaluations while others hold negative evaluations of the same outcome. However, we expect U and EOU to be positively valued outcomes for most people. When the evaluative polarity of an outcome is fairly homogeneous across subjects, the corresponding belief tends to be monotonically related to attitudes, and statistically estimated weights tend to accurately capture the actual usage of information cues (Einhorn, Kleinmuntz and Kleinmuntz 1979; Hogarth 1974), and generally predict dependent variables at least as well as subjective weights (Bass and Wilkie 1973; Stahl and Grigsby 1987; Shoemaker and Waid 1982). A similar rationale underlies equation (1) of TRA, where the relative influences of A and SN on BI are statistically estimated as opposed to self-stated. One caveat is that, to the extent that individuals within a sample differ substantially with respect to the motivating impact of U and EOU, our statistically estimated weights may become distorted. In view of the tradeoffs involved, we chose to use statistically-estimated weights within TAM to gauge the comparative influence of U and EOU on A.

External variables, represented in equations (6) and (7), provide the bridge between the internal beliefs, attitudes and intentions represented in TAM and the various individual differences, situational constraints and managerially controllable interventions impinging on behavior. TRA similarly hypothesizes that external variables influence behavior only indirectly via A, SN or their relative weights. Although our primary interest in the particular study described below is to examine our ability to predict and explain user behavior with TAM, working from U and EOU forward to user acceptance, we explicitly include external variables in our description of the model to underscore the fact that one of its purposes is to provide a foundation for studying the impact of external variables on user behavior. Our goal in the study reported below is to examine the relationships among EOU, U, A, BI and system usage in order to see how well we can predict and explain user acceptance with TAM. In so doing, we hope to gain insight about TAM's strengths and weaknesses by comparing it to the well-established TRA.

4. Research Questions

Our analysis of TRA and TAM raises several research questions which the study, described below, was designed to address:

(1) How well do intentions predict usage? Both models predict behavior from behavioral intention (BI). Of particular interest is the ability to predict future usage based on a brief (e.g., one-hour) hands-on introduction to a system. This would mirror the applied situations in which these models may have particular value. If, after briefly exposing potential users to a candidate system that is being considered for purchase and organizational implementation, management is able to take measurements that predict the future level of adoption, a go/no-go decision on the specific system could be made from a more informed standpoint. Similarly, as new systems are being developed, early prototypes can be tested, and intention ratings used to assess the prospects of the design before a final system is built.

(2) How well do TRA and TAM explain intentions to use a system? We hypothesize that TRA and TAM will both explain a significant proportion of the variance in people's behavioral intention to use a specific system. Although prediction, in and of itself, is of value to system designers and implementors, explaining *why* people choose to use or not use a system is also of great value. Therefore, we are also interested in the relative impact on BI of TRA's A, SN and $\sum b_i e_i$ constructs and TAM's U and EOU.

(3) Do attitudes mediate the effect of beliefs on intentions? A key principle of TRA is that attitudes fully mediate the effects of beliefs on intentions. Yet, as discussed above, direct belief-intention relationships have been observed before. One of the theoretical virtues of the attitude construct is that it purports to capture the influence of beliefs. Much of its value is foregone if it only partially mediates the impact of beliefs.

(4) Is there some alternative theoretical formulation that better accounts for observed data? We recognize that any model is an abstraction of reality and is likely to have its own particular strengths and weaknesses. Our goal is less that of proving or disproving TRA or TAM, than in using them to investigate user behavior. We are therefore interested in exploring alternative specifications, perhaps bringing together the best of both models, in our pursuit of a theoretical account of user acceptance.

5. Empirical Study

In order to assess TRA and TAM, we gathered data from 107 full-time MBA students during their first of four semesters in the MBA program at the University of Michigan. A word processing program, WriteOne, was available for use by these students in two public computer laboratories located at the Michigan Business School. Word processing was selected as a test application because: (1) it is a voluntarily used package, unlike spreadsheets and statistical programs that students are required to use for one or more courses, (2) students would face opportunities to use a word processor throughout the MBA program for memos, letters, reports, resumes, and the like, and (3) word processors are among the most frequently used categories of software among practicing managers (Benson 1983; Honan 1986; Lee 1986).

At the beginning of the semester, MBA students are given a one-hour introduction to the WriteOne software as part of a computer orientation. At the end of this introduction, we administered the first wave of a questionnaire containing measures of the TRA and TAM variables. A second questionnaire, administered at the end of the semester 14 weeks later, contained measures of the TAM and TRA variables as well as a 2-item measure of self-reported usage.

Salient Belief Elicitation

To determine the modal salient beliefs for usage of the WriteOne software, telephone interviews were conducted with 40 MBA students who were about to enter their second year of the MBA program. We chose to elicit beliefs from second-year students since they are very similar to the entering first-year students in terms of background and abilities, and had just completed a year of study during which their introduction and access to the WriteOne system was identical to that which entering first-year students would face. Since we wanted to have the questionnaire prepared in advance of the first 1-hour exposure the first-year students would have with WriteOne, so we could track changes in their beliefs over time, it would not have been practical to ask first-year students their beliefs prior to this initial indoctrination. Although they are likely to have had similar basic concerns as the second-year students, first-year students were not expected to be in a position to articulate those concerns as well with regard to the WriteOne system specifically, since they would be unlikely to even know that such a system existed. We would have faced greater risk of omitting beliefs which would have become salient by the time first-year students completed their initial usage and learning and usage of WriteOne. On the other hand, using second year students increased the risk of including some beliefs that are nonsalient for first year students after their initial one-hour introduction. However, the consequences of omitting a salient belief are considered more severe than those of including a nonsalient one. To omit a salient belief, i.e., one that does significantly influence attitude, degrades the validity of the TRA belief summation term (by omitting a source of systematic variance), whereas including a nonsalient belief, i.e., one that does not influence attitude, degrades the reliability of the belief summation term (by adding a source of random variance). Moreover, beliefs lower in the salience hierarchy contribute less to one's total attitude than do more salient ones (Fishbein and Ajzen 1975, p. 223). In view of the tradeoffs involved, we elected to pursue a more inclusive belief set by eliciting it from second-year students.

Interviewees were asked to list separately the advantages, disadvantages, and anything else they associate with becoming a user of WriteOne. (This procedure is recommended by Ajzen and Fishbein 1980, p. 68.) Beliefs referring to nearly identical outcomes using alternative wording were classified as the same item, and the most common wording was utilized. The seven most frequently mentioned outcomes were chosen. This belief set complied with the criteria for modal beliefs, since each belief was mentioned by more than 20% of the sample and the set contained more than 75% of the beliefs emitted. The seven resulting belief items, in order of frequency of mention, are:

1. I'd save time in creating and editing documents.
2. I'd find it easier to create and edit documents.
3. My documents would be of a better quality.
4. I would not use alternative word processing packages.
5. I'd experience problems gaining access to the computing center due to crowdedness.
6. I'd become dependent on WriteOne.
7. I would not use WriteOne after I leave the MBA program.

Questionnaire

Both TRA and TAM are being used to explain a specific *behavior* (usage) toward a specific *target* (WriteOne) within a specific *context* (the MBA program). The time period of usage, although not explicitly indicated, is implicitly bounded by the context of the MBA program. The definition and measurement of model constructs correspond in specificity to these characteristics of the behavioral criterion, so that the measures of intentions, attitudes, and beliefs are worded in reference to the specific target, action and context elements, but are relatively nonspecific with respect to time frame (for further discussion of the correspondence issue, see Ajzen and Fishbein 1980). BI, A, SN, b_i and e_i were all operationalized according to Ajzen and Fishbein's (1980, Appendix A) recommended guidelines.

TAM's U and EOU are each operationalized with 4-item instruments resulting from an extensive measure development and validation procedure. As described in Davis (1986), the measure development process consisted of: generating 14 candidate items for each construct based on their definitions; pre-testing the items to refine their wording and to pare the item sets down to 10 items per construct, and assessing the reliability (using Cronbach alpha) and validity (using the multitrait-multimethod approach) of the 10-item scales. High levels of convergent and discriminant validity of the 10-item scales were observed, and Cronbach alpha reliabilities were 0.97 for U and 0.91 for EOU. Item analyses were used to streamline the scales to 6 items per construct, and new data again revealed high validity and reliability (alpha of 0.97 for U and 0.93 for EOU). Further item analyses were performed to arrive at the 4-item scales used in the present research. The four ease of use items were: "Learning to operate WriteOne would be easy for me," "I would find it easy to get WriteOne to do what I want it to do," "It would be easy for me to become skillful at using WriteOne," and "I would find WriteOne easy to use." The four usefulness items were: "Using WriteOne would improve my performance in the MBA program," "Using WriteOne in the MBA program would increase my productivity," "Using WriteOne would enhance my effectiveness in the MBA program," and "I would find WriteOne useful in the MBA program." The usefulness and ease of use items were measured with 7-point scales having likely-unlikely endpoints and the anchor points extremely, quite, slightly, and neither (identical to the format used for operationalizing TRA beliefs and recommended by Ajzen and Fishbein 1980, Appendix A).

System usage is measured using 2 questions regarding the frequency with which the respondent currently uses WriteOne. The first was a 7-point scale with the adjectives frequent and infrequent at the endpoints. The second was a "check the box" format, with categories for current use of: not at all; less than once a week; about once a week; 2 or 3 times a week; 4 to 6 times a week; about once a day, more than once a day. These are typical of the kinds of self-reported measures often used to operationalize system usage, particularly in cases where objective usage metrics are not available. Objective usage logs were not practical in the present context since the word processing software was located on personal computers and subjects use different computers, as well as different applications, from one session to the next. Self-reported frequency measures should not be regarded as precise measures of actual usage frequency, although previous research suggests they are appropriate as relative measures (Blair and Burton 1987; Hartley, et al. 1977).

Results

Scale Reliabilities. The two-item BI scale obtained a Cronbach alpha reliability of 0.84 at time 1 (beginning of the semester) and 0.90 at time 2 (end of the semester). The four-item A scale obtained reliabilities of 0.85 and 0.82 at times 1 and 2 respectively. The four-item U scale achieved a reliability of 0.95 and 0.92 for the two points in time, and the four-item EOU scale obtained reliability coefficients of 0.91 and 0.90 for time 1 and time 2. SN, the b_is and the e_is, were each operationalized with single-item scales, per TRA, and hence no internal consistency assessments of reliability are possible. The two-item usage scale administered in the second questionnaire achieved an alpha of 0.79. These scale reliabilities are all at levels considered adequate for behavioral research.

Explaining Usage. As expected, BI was significantly correlated with usage. Intentions measured right after the WriteOne introduction were correlated 0.35 with usage frequency 14 weeks later (Table 1). Intentions and usage measured contemporaneously at the end of the semester correlated 0.63. Also consistent with the theories, none of the other TRA or TAM variables (A, SN, $\sum b_i e_i$, U, or E) had a significant effect on usage over and

TABLE 1

Predicting and Explaining Usage, Intentions and Attitudes with the Theory of Reasoned Action (TRA) and the Technology Acceptance Model (TAM)

Equation	Time 1 Immediately After 1 Hr Intro		Time 2 14 Weeks Later	
	R^2	Beta	R^2	Beta
(1) Explaining Usage at Time 2 From BI Measured at Times 1 and 2 (Common to both Models)				
Usage (Time 2) = BI	0.12***		0.40***	
BI		0.35***		0.63***
(2) TRA				
BI = A + SN	0.32***		0.26***	
A		0.55***		0.48***
SN		0.07		0.10
A = $\sum b_i e_i$	0.07**		0.30***	
$\sum b_i e_i$		0.27**		0.55***
(3) TAM				
BI = A + U	0.47***		0.51***	
A		0.27**		0.16
U		0.48***		0.61***
A = U + EOU	0.37***		0.36***	
U		0.61***		0.50***
EOU		0.02		0.24**
U = EOU	0.01		0.05**	
EOU		0.10		0.23**

Note. * $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
BI = Behavioral Intention
A = Attitude
SN = Subjective Norm
U = Perceived Usefulness
$\sum b_i e_i$ = Sum of Beliefs Times Evaluations
EOU = Perceived Ease of Use

above intentions at either time 1 or time 2, which suggests that intentions fully mediated the effects of these other variables on usage.

Explaining Behavioral Intention (BI). As theorized, TRA and TAM both explained a significant proportion of the variance in BI (Table 1). TRA accounted for 32% of the variance at time 1 and 26% of the variance at time 2. TAM explained 47% and 51% of BI's variance at times 1 and 2 respectively. Looking at the individual determinants of BI, within TRA, A had a strong significant influence on BI ($\beta = 0.55$, time 1; $\beta = 0.48$, time 2), whereas SN had no significant effect in either time period ($b = 0.07$ and 0.10, respectively). Within TAM, U has a very strong effect in both time periods ($\beta = 0.48$ and 0.61, respectively), while A had a smaller effect in time 1 ($\beta = 0.27$) and a nonsignificant effect in time 2 ($\beta = 0.16$). The increased influence of U from time 1 to time 2 is noteworthy. Equation (1b), Table 2, shows that U adds significant explanatory power beyond A and SN, at both time 1 and time 2, underscoring the influential role of U.

In both models, unexpected direct belief-intention relationships were observed. Counter to TRA, the belief summation term, $\sum b_i e_i$, had a significant direct effect on BI over and above A and SN in time period 2 ($\beta = 0.21$) but not in time period 1 ($\beta = 0.08$) (Table 2). Counter to TAM, EOU had a significant direct effect on BI over and above A and U in time period 1 ($\beta = 0.20$) but not time period 2 ($\beta = 0.11$) (Table 2). Hence, attitude appears to mediate the effects of beliefs on intentions even less than postulated by TRA and TAM.

TABLE 2

Hierarchical Regression Tests for Relationships Expected to be Nonsignificant

Equation	Time 1 R^2	Time 1 Beta	Time 2 R^2	Time 2 Beta
(1) Behavioral Intention (BI)				
(a) BI = A + SN + $\sum b_i e_i$	0.33***		0.30***	
A		0.53***		0.37***
SN		0.06		0.08
$\sum b_i e_i$		0.08[a]		0.21*[b]
(b) BI = A + U + SN	0.47***		0.51***	
A		0.27**		0.16
U		0.48***		0.63***
SN		0.02[a]		−0.04[a]
(c) BI = A + U + E	0.51***		0.52***	
A		0.26**		0.19*
U		0.47***		0.62***
E		0.20**[b]		−0.11[a]
(2) Attitude (A)				
A = U + E + $\sum b_i e_i$	0.38***		0.44***	
U		0.58***		0.35***
E		0.01		0.18*
$\sum b_i e_i$		0.10[a]		0.32***[b]

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
a: Expected and found nonsignificant.
b: Expected nonsignificant but found significant.

Explaining Attitude. As expected, both TAM and TRA explain a significant percentage of variance in attitude (Table 1). TRA explained 7% of A's variance at time 1 and 30% at time 2. TAM explained 37% and 36% at times 1 and 2, respectively. U has a strong significant effect on A in both time periods ($\beta = 0.61$ and 0.50, respectively), although EOU is significant at time 2 only ($\beta = 0.24$).

In both models, there were some interesting developmental changes over time in the relationship among beliefs, A and BI. Within TAM, at time 1 EOU appears to have a direct effect on BI ($\beta = 0.20$), with no indirect effect through A or U, at time 2 EOU's effect is entirely indirect via U, and the A-BI link becomes nonsignificant. TRA's belief summation term, $\sum b_i e_i$, has a significant effect on A above and beyond U and EOU in time period 2 ($\beta = 0.32$) but not in time period 1 ($\beta = 0.10$) (Table 2). Our analysis below investigates the nature of these patterns further by analyzing the internal structure of TRA's beliefs and analyzing their relationship to U and EOU, A and BI.

Further Analysis of Belief Structure. In order to gain greater insight into the nature of TRA's beliefs, as well as their relationship to U and EOU, a factor analysis was conducted. Table 3 shows a varimax rotated principal components factor analysis of TRA's 7 belief items and TAM's 4 U items and 4 EOU items, using a 1.0 eigenvalue cutoff criterion. For time period 1, a five-factor solution was obtained, with the 7 TRA beliefs factoring into three distinct dimensions, the other two factors corresponding to TAM's U and EOU. TRA beliefs 1, 2 and 3 load on a common factor which taps specific aspects of "expected performance gains." Whereas TAM's U is a comparatively general assessment of expected performance gains (e.g., "increase my productivity"), TRA's first three items are more specific aspects (i.e., "saving time in creating and editing documents", "finding it easier to create and edit documents", and "making higher quality documents"). We will refer to this specific usefulness construct comprised of TRA's first three belief items as U_s. Consistent with this interpretation, U_s correlates significantly with U ($r = 0.46$, $p < 0.001$ for time 1 and $r = 0.65$, $p < 0.001$ for time 2). At time period 2, a four-factor solution was obtained, with U_s converging to TAM's U to form a single factor. We will denote this combined 7-item usefulness index U_t, for total usefulness. Cronbach alpha reliabilities for U_t were 0.85 and 0.93 for time 1 and 2, respectively.

In both time periods, TRA beliefs 4 and 6 loaded on a common factor which has to do with becoming *dependent* on WriteOne ("would become dependent . . .", "would not use alternatives . . ."), which we will denote D. TRA items 5 and 7 loaded on a common factor at time 1, and are concerned with *access* to WriteOne, both while in the MBA program (item 5), and after leaving the program (item 7). We will denote this factor ACC. At time 2, only item 5 loaded on this factor, with item 7 showing a tendency to load on U_t instead (loading = −0.45).

Hence, the factor analysis of TRA and TAM beliefs suggests the existence of belief dimensions concerning usefulness, ease of use, dependency, and accessibility. Overall perceived usefulness (U_t) appeared to have separate specific (U_s) and general (U) dimensions at time 1 which converged to form a common dimension at time 2. Perceived accessibility (ACC) was comprised of 2 items (TRA beliefs 5 and 7) at time 1 and only 1 item (belief 5) at time 2.

Hybrid Intention Models. The factor analysis above provided some interesting insights into the dimensional structure of the beliefs underlying user acceptance. Combining the beliefs of TRA and TAM into a single analysis may yield a better perspective on the determinants of BI than that provided by either model by itself. Given that A was generally not found to intervene between beliefs and intentions, our approach in this section is to first assess the impact on intentions of the beliefs identified in the factor analysis above, and then test whether A mediates these belief-intention relationships. We estimated the effect on BI of the five beliefs identified by the factor analysis: U, U_s, EOU, D and ACC

TABLE 3

Factor Analysis of TAM and TRA Belief Items

Belief Item	Time 1 Factors 1	2	3	4	5	Time 2 Factors 1	2	3	4
(a) TRA Items									
TRA1	0.28	0.05	*0.89*	0.10	−0.01	*0.82*	0.08	0.08	0.34
TRA2	0.27	0.13	*0.88*	0.11	−0.02	*0.84*	0.13	0.05	0.34
TRA3	0.18	0.03	*0.80*	0.13	−0.01	*0.74*	0.12	0.14	0.42
TRA4	0.17	−0.11	0.09	*0.81*	−0.04	0.20	0.01	*0.88*	−0.02
TRA5	0.02	0.09	0.06	0.24	*0.83*	−0.02	0.05	0.10	*0.82*
TRA6	0.08	−0.09	0.17	*0.79*	0.07	0.32	−0.06	*0.69*	0.30
TRA7	−0.26	0.00	−0.12	−0.34	*0.66*	−0.45	0.32	−0.07	−0.06
(b) TAM Usefulness (U) Items									
U1	*0.90*	−0.03	0.18	0.06	−0.02	*0.79*	0.11	0.31	−0.15
U2	*0.90*	−0.03	0.26	0.14	−0.04	*0.82*	0.07	0.22	−0.16
U3	*0.91*	0.01	0.16	0.06	−0.05	*0.84*	0.08	0.12	−0.24
U4	*0.85*	0.03	0.24	0.17	−0.13	*0.85*	0.17	0.18	−0.07
(c) TAM Ease of Use (EOU) Items									
EOU1	−0.08	*0.84*	0.08	−0.12	0.08	−0.09	*0.88*	−0.06	0.07
EOU2	0.01	*0.90*	0.03	−0.05	0.01	0.15	*0.85*	0.12	−0.05
EOU3	−0.05	*0.91*	0.03	−0.09	0.03	0.05	*0.89*	−0.04	0.07
EOU4	0.10	*0.91*	0.07	0.00	−0.01	0.30	*0.84*	−0.02	0.03
Eigen.	4.83	3.35	1.51	1.14	1.06	5.87	2.99	1.27	1.01
% Var	32.3	22.3	10.1	7.6	7.0	39.2	19.9	8.5	6.7
Cum %	32.3	54.6	64.7	72.3	79.3	39.2	59.1	67.6	74.3

(see Table 4). Together, these variables explained 51% of BI's variance in time 1 and 61% in time 2. U, U_s and EOU were significant for time 1, but EOU became nonsignificant in time 2. In addition, U_s increased in importance from time 1 ($b = 0.20$) to time 2 ($\beta = 0.39$). Next, we combined the two usefulness subdimensions to form the U_t index, and ran another regression. U_t was highly significant in both time periods ($\beta = 0.59$ and 0.71, respectively), and EOU was significant for time period 1 only ($\beta = 0.20$).

In order to test whether A fully mediated either the EOU-BI or U-BI relationships, we introduced A into the second equation. This had little effect on the coefficients for either U_t or EOU, suggesting that although A may partially mediate these relationships, it did not fully mediate them. The relationship between EOU and U_t, hypothesized by TAM, was nonsignificant for time 1, but became significant for time 2 ($\beta = 0.24$). Therefore, the causal structure suggested is that U_t had a direct impact on BI in both time periods and EOU had a direct effect on BI at time 1 and an indirect effect via U_t at time 2.

In order to obtain more precise estimates of these significant effects, regressions omitting nonsignificant variables were run (see Final Models, Table 4). At time 1, U_t and EOU accounted for 45% of the variance in intention, with coefficients of 0.62 and 0.20 respectively. At time 2, U_t by itself accounted for 57% of BI's variance ($\beta = 0.76$), and EOU had a small but significant effect on U_t ($\beta = 0.24$).

As mentioned earlier, to the extent that people are heterogeneous in their evaluation of or motivation toward performance, our statistical estimate of the usefulness-intention link may be distorted. In order to test for whether differences in motivation moderated

TABLE 4

Hybrid Intention Models

Equation	Time 1 R^2	Time 1 Beta	Time 2 R^2	Time 2 Beta
BI = U + U_s + EOU + D + ACC	0.51		0.61	
U		0.48***		0.35***
U_s		0.20*		0.39***
EOU		0.21**		−0.04
D		0.09		0.14
ACC		−0.11		−0.12
BI = U_t + EOU + D + ACC	0.50		0.61	
U_t		0.59***		0.71***
EOU		0.20**		−0.06
D		0.09		0.15
ACC		−0.12		−0.12
U_t = EOU	0.02	0.15	0.06	0.24*
Final Models:				
A. Time 1				
BI = U_t + EOU	0.45			
U_t		0.62***		
EOU		0.20**		
B. Time 2				
BI = U_t			0.57	0.76***
U_t = EOU			0.06	0.24*

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
Note: U = TAM's general perceived usefulness scale (4 items). U_s = TRA's specific usefulness scale (items 1–3). U_t = Total usefulness index (comprised of U and U_s; 7 items).

the usefulness-intention relationship, we asked subjects to report the extent to which they believed "performance in the MBA program is important to getting a good job." By hierarchical regression, this question did not significantly interact with U_t in either time period. We also used the sum of the three evaluation terms (e_i) corresponding to TRA belief items 1–3 as an indicant of subjects' evaluation of usefulness as an outcome. This also did not significantly interact with usefulness in either time period. Thus, in our sample, it appears that individuals did not differ enough in either (1) their perceived impact of performance in the MBA program on their getting a good job or (2) their evaluation of performance to seriously distort our estimate of the effect of U_t on BI.

The picture that emerges is that U is a strong determinant of BI in both time periods, and that EOU also has a significant effect on BI at time 1 but not at time 2. EOU's direct effect on BI in time period 1 developed into a significant indirect effect, through usefulness, in time period 2.

6. Conclusions

Our results yield three main insights concerning the determinants of managerial computer use:

(1) People's computer use can be predicted reasonably well from their intentions.

(2) Perceived usefulness is a major determinant of people's intentions to use computers.

(3) Perceived ease of use is a significant secondary determinant of people's intentions to use computers.

Although our data provided mixed support for the two specific theoretical models that guided our investigation, TRA and TAM, their confluence led to the identification of a more parsimonious causal structure that is powerful for predicting and explaining user behavior based on only three theoretical constructs: behavioral intention (BI), perceived usefulness (U) and perceived ease of use (EOU). Specifically, after the one-hour introduction to the system, people's intentions were jointly determined by perceived usefulness ($\beta = 0.62$) and perceived ease of use ($\beta = 0.20$). At the end of 14 weeks, intention was directly affected by usefulness alone ($\beta = 0.79$), with ease of use affecting intention only indirectly via usefulness ($\beta = 0.24$). This simple model accounted for 45% and 57% of the variance in intentions at the beginning and end of the 14-week study period, respectively.

Both TRA and TAM postulated that BI is the major determinant of usage behavior; that behavior should be predictable from measures of BI, and that any other factors that influence user behavior do so indirectly by influencing BI. These hypotheses were all supported by our data. Intentions measured after a one-hour introduction to a word processing system were correlated 0.35 with behavior 14 weeks later. This is promising for those who wish to evaluate systems very early in their development, and cannot obtain extensive user experience with prototypes in order to assess its potential acceptability. This is also promising for those who would like to assess user reactions to systems used on a trial basis in advance of purchase decisions. Intentions and usage measured contemporaneously correlated 0.63. Given that intentions are subject to change between the time of intention measurement and behavioral performance, one would expect the intention-behavior correlation to diminish with increased elapsed time (Ajzen and Fishbein 1975, p. 370). In addition, at time 1, given the limited experience with the system, peoples' intentions would not be expected to be extremely well-formed and stable. Consistent with expectations, hierarchical regression tests indicated that none of the other variables studied influenced behavior directly, over and above intention.

In order to place these intention-behavior correlations in perspective, we can compare them to (a) past experience using intention measures outside the IS domain and (b) correlations between usage and various predictors reported in the IS literature. In a meta-analysis of non-IS studies, Sheppard, Hartwick and Warshaw (in press) calculated a frequency-weighted average intention-behavior correlation of 0.38, based on 1514 subjects, for goal-type behaviors. The intention-usage correlations of 0.35 and 0.63 obtained in the present study compare favorably with this meta-analysis. Although the intention-usage relationship per se has been essentially overlooked in the IS literature, usage predictions based on numerous other variables have been investigated. Ginzberg (1981) obtained a correlation of 0.22 between a measure of users "realism of expectations" and usage. DeSanctis (1983) obtained correlations around 0.25 between "motivational force" and DSS usage. Swanson (1987) obtained a 0.20 correlation between usage and a variable referred to as "value" which is similar to perceived usefulness. Robey obtained a striking 0.79 between usage and Schultz and Slevin's (1975) performance factor, which is also similar to perceived usefulness. Baroudi, Olson and Ives (1986) found both user information satisfaction and user involvement to be correlated 0.28 with system usage. Srinivasan (1985) found relationships varying from −0.23 to 0.38 between various measures of user satisfaction and usage. Overall, the predictive correlations obtained in IS research have varied widely, from −0.23 up to the 0.79 correlation obtained by Robey (1979), with typical values falling in the 0.20–0.30 range. The 0.35 and 0.63 correlations obtained for the two time periods investigated in the present research compare favorably with these previous IS findings.

Both TRA and TAM hypothesized that expected performance impacts due to using the specified system, i.e., perceived usefulness, would be a major determinant of BI. Interestingly, the models arrived at this hypothesis by very different lines of reasoning. Within TAM, perceived usefulness was specified a priori, based on the observation that variables having to do with performance gains had surfaced as influential determinants of user acceptance in previous IS studies. In contrast, TRA called for eliciting the specific perceived consequences held by specific subjects concerning the specific system under investigation. Using this method, the first three beliefs elicited were specific performance gains. These three TRA beliefs, which were much more specific than TAM's perceived usefulness measures (e.g., "save time in creating and editing documents" versus "increase my productivity") loaded together on a single dimension in a factor analysis. Although TRA's specific usefulness dimension (U_s) was factorially distinct from TAM's U at time 1 (just after the one-hour demonstration), they were significantly correlated ($r = 0.46$). Fourteen weeks later (time 2), the general and specific items converged to load on single factor.

But why was it the case that U had more influence on BI than U_s right after the one-hour introduction, whereas U_s increased in influence, and converged to U, over time? One possibility relates to the concreteness-abstractness distinction from psychology (e.g., Mervis and Rosch, 1981). As Bettman and Sujan (1987) point out, novice consumers are more apt to process choice alternatives using abstract, general criteria, since they have not undergone the learning needed to understand and make judgments about more concrete, specific criteria. This learning process could account for the increased importance of U_s over time, as well as its convergence to U, as the subjects in our study gained additional knowledge about the consequences of using of WriteOne over the 14-week period following the initial introduction. The implication is that, since people form general impressions of usefulness quickly after a brief period of using a system, the more general usefulness construct provides a somewhat better explanation of intentions at such a point in time.

Combining the 3 specific TRA usefulness beliefs and the 4 general TAM usefulness beliefs yielded a total index of usefulness U_t, that had a major impact on BI in both time periods. Indeed, subjects appeared to form their intentions toward using the word processing system based principally on their expectations that it would improve their performance within the MBA program. Among the other beliefs studied, only EOU had a significant effect on BI, and only at time 1. Over time, as users learned to effectively operate the word processor, the direct effect of ease of use on BI disappeared, being supplanted by an indirect effect via U_t. Following our theorizing, early on, people appeared to process EOU from a self-efficacy perspective, appraising how likely they would be to succeed at learning to use the system given they tried. As learning progressed over time, this concern became less salient, and EOU evolved into a more instrumental issue, reflecting considerations of how the relative effort of using the system would affect the overall performance impact the system offered (U_t).

The lack of a significant SN-BI effect was surprising, given previous IS research stressing the importance of top management support and user involvement. There are two reasons to interpret this finding narrowly. First, as pointed out in our discussion of TAM, compared to other measures recommended for TRA (Ajzen and Fishbein 1980), the SN scale is particularly weak from a psychometric standpoint. More sophisticated methods for assessing the specific types of social influence processes at work in a computer acceptance context are clearly needed. Second, the specific application studied, word processing, is fairly personal and individual, and may be driven less by social influences compared to more multi-person applications such as electronic mail, project management or group decision support systems. Further research is needed to address the generalizability of our SN findings, to better understand the nature of social influences, and to investigate conditions and mechanisms governing the impact of social influences on usage behavior.

The absence of a significant effect of accessibility on intentions or behavior was also surprising in light of the importance of this variable in studies of information source usage (Culnan 1983; O'Reilly 1982). Since our measure of accessibility was nonvalidated, having been developed by exploratory factor analysis, psychometric weaknesses may be partly at fault. In addition, although access was a salient concern frequently mentioned in the belief elicitation, the system under investigation was fairly uniformly accessible to all respondents. Accessibility may well have played a more predominant role if greater variations in system accessibility were present in the study. Also surprising was the finding that attitudes intervened between beliefs and intentions far less than hypothesized by either TRA or TAM. Although some work on the direct effect of beliefs has been done (e.g., Bagozzi 1982; Brinberg 1979; Triandis 1977), more research is needed to identify the conditions under which attitudes mediate the belief-intention link. In either case, the attitude construct did little to help elucidate the causal linkages between beliefs and intentions in the present study since, at best, it only partially mediated these relationships.

There are several aspects of the present study which circumscribe the extent to which our findings generalize. MBA students are not completely representative of the entire population of managers and professionals whose computer usage behavior we would like to model. These students are younger and, as a group, probably more computer literate than their counterparts in industry. Hence, EOU may have been less an issue for this sample than it would have been for managers and professionals more generally. The WriteOne system, while typical of the types of systems available to end users, is still only one system. With more complex or difficult systems, ease of use may have had a greater impact on intentions. These subjects were also probably more highly motivated to perform well than the general population, which may have caused perceived usefulness to take on greater importance than it generally would. Further research on these variables and relationships in other settings will sharpen our understanding of their generalizability. Additional theoretical constructs such as computer anxiety and instrinsic motivation may profitably be brought into the analysis. There is reason for optimism, however. Extensive experience with intention measures in other contexts has consistently supported their role as predictors of an individual's behavior (e.g., Ajzen and Fishbein 1980). In addition, the usefulness-intention relationship observed in the present data is so strong that it seems unlikely to be totally idiosyncratic. If models similar to the final models presented in Table 4 do generalize to other contexts, we will be moving to a situation in which powerful yet simple models for predicting and explaining user acceptance are available.

7. Practical Implications

What do our results imply for managerial practice? When planning a new system, IS practitioners would like to be able to predict whether the new system will be acceptable to users, diagnose the reasons why a planned system may not be fully acceptable to users, and to take corrective action to increase the acceptability of the system in order to enhance the business impact resulting from the large investments in time and money associated with introducing new information technologies into organizations. The present research is relevant to all of these concerns.

As Ginzberg (1981) pointed out in his discussion of "early-warning" techniques for anticipating potential user acceptance problems, at the initial design stages of a system development effort, a relatively small fraction of a project's resources has been expended, and yet, many of the design decisions concerning the functional and interface features of the new system are made. Moreover, at this early point in the process, there is greatest flexibility in altering the proposed design since little if any actual programming or equipment procurement has occurred. Hence, this would appear to represent an ideal time to measure user assessments of a proposed system in order to get an early reading on its acceptability. Standing in the way, however, has been the lack of good predictive models. The present research contributes to the solution of this dilemma by helping to identify and provide valid measures of key variables linked to user behavior.

A key challenge facing "user acceptance testing" early in the development process is the difficulty of conveying to users in a realistic way what a proposed system will consist of. The "paper designs" that typify the status of a system at the initial design stage may not be an adequate stimulus for users to form accurate assessments. However, several techniques can be used to overcome this shortcoming. Rapid prototypers, user interface management systems, and videotape mockups are increasingly being used to create realistic "facades" of what a system will consist of, at a fraction of the cost of building the complete system. This raises the question whether a brief exposure (e.g., less than an hour) to a prototype system is adequate to permit the potential user to acquire stable, well-formed beliefs. Especially relevant here is our finding that, after a one-hour hands-on introduction, people formed general perceptions of a system's usefulness that were strongly linked to usage intentions, and their intentions were significantly correlated with their future acceptance of the system. Further research into the effectiveness of noninteractive mockups, such as videotapes, is important in order to establish how far upstream in the development process we can push user acceptance testing. Throughout such evaluation programs, practitioners and researchers should not lose sight of the fact that usage is only a necessary, but not sufficient, condition for realizing performance improvements due to information technology; if a system is not really useful (even if users perceive it to be) it should not be "marketed" to users.

Our findings have implications for improving user acceptance as well. Many designers believe that the key barrier to user acceptance is the lack of user friendliness of current systems, and that adding user interfaces that increase usability is the key to success (e.g., Branscomb and Thomas 1985). Yet our data indicates that, although ease of use is clearly important, the usefulness of the system is even more important and should not be overlooked. Users may be willing to tolerate a difficult interface in order to access functionality that is very important, while no amount of ease of use will be able to compensate for a system that doesn't do a useful task. Diagnostic measurements of the kind we're proposing should augment designers' intuition, and help them identify and evaluate strategies for enhancing user acceptance. Future research is needed to test the generality of the observed usefulness-ease of use tradeoff, and to assess the impact of external interventions on these internal behavioral determinants.

Overall, research in this direction should yield practical techniques to evaluate and improve the acceptability of end-user systems. The ability to take robust, well-formed measures of the determinants of user acceptance early in the development process is undoubtedly going to have an impact on our ability to weed out bad systems, refine the rest, and generally cut the risk of delivering finished systems that get rejected by users.

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