ASAC 1996
Montreal, Québec

Wynne W. Chin
Faculty of Management
University of Calgary

The Measurement And Meaning Of IT Usage: Reconciling Recent Discrepancies Between Self Reported And Computer Recorded Usage.

In a recent study, Straub, Limayem, and Karahanna-Evaristo (1995) found little similarity between self reported measures and computer recorded measures of Information Technology (IT) usage. The between method correlation was assessed as 0.293 and the use of these two sets of measures within a nomological context consisting of perceived usefulness and perceived ease of use from the TAM model (Davis, Bagozzi, & Warshaw, 1989) resulted in different path estimates. The study indicated the possibility of methodological problems (both conceptually and operationally), but also suggested that "research that has relied on subjective measures for both independent variables . . . and dependent variables, such as system usage . . . may not be uncovering true, significant effect, but mere artifacts" (Straub et. al., 1995, p. 1336). Building upon the Straub et al. study, this paper examines these apparent discrepancies by 1) re-examining their study and 2) providing results from a new study using computer recorded measures of usage. In attempting to reconcile the discrepancies, potential misinterpretation due to methodological problems may be part of the reason. More importantly, this paper addresses the question of what constitutes "subjective" versus "objective" IT usage. By considering these issues in more detail, we suggest an alternative interpretation, where computer recorded measures of usage are not necessarily anymore "objective" than self-reported usage. Instead, greater focus is needed to understand the meaning that researchers attribute to such measures. This notion is further elaborated by providing results from the new study where computer recorded usage was found to be consistent with the TAM model.

Introduction

In a recent article by Straub, Limayem, and Karahanna-Evaristo (1995), the authors found little relationship between self reported measures and computer recorded measures of Information Technology (IT) usage. Using LISREL, the authors estimated a weak correlation (0.293) between these two approaches of measuring voice mail usage. Furthermore, when placed in a nomological network using the TAM model (Davis, 1989) consisting of Perceived Usefulness (PU) and Perceived Ease of Use (PEU), computer reported measures were found to have no significant relationship. Conversely and consistent with past studies, self-reported measures were found to be strongly related with PU and resulted in a better fitting model. Based on these results, the authors raised several issues. The first is the possibility that independent variables such as PU and PEU may be mere artifacts rather than uncovering true effects. The second is that PU and PEU may be more appropriate in predicting perceived system use rather than actual system use as "objectively" measured via the computer. The authors concluded that: 1) IT usage should be reformulated as two separate constructs: perceived usage using the "subjective" self report measures and actual usage using the "objective" computer recorded measures, and 2) TAM may require a substantial reformulation. Overall, the authors recommend new "studies to examine alternative explanations for the lack of correspondence between computer-recorded measures and perceived usefulness and perceived ease-of-use need to be undertaken" (Straub, et al., 1995, p. 1340).

This paper provides such a study by first re-examining the original study and then presenting the results of a new study linking computer-recorded usage within the TAM model. This paper suggests that discrepancies in the Straub et. al. study can be reconciled by considering the subjective/objective distinction, in general, and between self-report and computer-recorded usage specifically. Instead of automatically according computer-recorded measures as being closer to the "true" meaning of IT usage, this paper argues the need to examine the ontological and epistemical nature of such measures. Through such a process, a better understanding of their meaning may be obtained In re-examining the study by Straub et. al., an alternative interpretation of the results arises that suggests problems for both sets of usage measures, although the "subjective" self-report measures may actually be more appropriate than the "objective" computer recorded measures. The new study continues the dialogue by demonstrating how computer-recorded usage measures can be consistent within the TAM model independent of whether a significant relationship is found or not. Thus, this paper suggests that a connection between computer recorded measures of IT usage and perceptual measures such as PU and PEU can exist and that a reformulation may be premature. Furthermore, this paper concludes by suggesting that the distinction between "objective" versus "accurate" measures need to be made and that the meaning of any concept is dependent in part through the context in which it is embedded.

Objectivity versus Subjectivity in IT Usage

At the heart of the paper by Straub et. al. is the notion that self-reported usage measures are "subjective" in nature while computer-recorded measures are "objective." They state that the primary purpose of their paper is to "compare subjective and objective measures of system usage, namely, self-reported versus computer-recorded measures" (Straub et al., 1995, p. 1329). Straub et. al. go on to say "research that has relied on subjective measures for both independent variables . . . and dependent variables, such as system usage . . . may not be uncovering true, significant effect, but mere artifacts" (Straub et al., 1995, p. 1336). Implicit in this perspective is the notion that computer-recorded measures of behavior are more representative of the meaning of IT usage; that it is truer to an underlying "reality." Building upon this perspective, this paper makes the distinction between accuracy and "subjectivity." We suggest that while computer-recorded measures of IT usage may be more accurate than self-reported measures, the meaning of such measures can still be subjective. This subjectivity is due in part to the users and context of the study and in part with how the researcher conceptualizes the event.

Epistemical and ontological aspects of measurement

In order to elaborate on the subjective/objective distinction, this paper borrows heavily from the perspective and terminology provided by Searle (1995). Searle argues that the subjective/objective distinction is a matter of degree which can be partly assessed in at least two ways: ontological and epistemical. Ontological assumptions deal with the very essence of the phenomena under investigation; whether the "reality" to be investigated is external to the individual and imposed upon the consciousness of the individual or a product of the individual's consciousness (Burrell & Morgan, 1979; Orlikowski & Baroudi, 1991). The later position (i.e., nominalism) does not admit to there being any "real" structure to the phenomena that one experiences. As such, the "names" or concepts that one uses to describe any phenomena are regarded as artificial creations whose utility is based upon their convenience as tools for describing, making sense of. Realism, on the other hand, postulates that the social world external to the individual is real - made up of hard, tangible, stable structures. They still exist as empirical entities whether we label them or not. Epistemological assumptions, in turn, deal with the grounds of knowledge. Specifically, it is concerned with the basis by which the researcher comes to understand the phenomena of interest and, in turn, communicate this understanding to others. One assumption is that knowledge is hard, real and capable of being transmitted in tangible form. Alternatively, knowledge can be viewed as softer, based on experience and insight of the individual (Orlikowski & Robey, 1991).

According to Searle, the epistemical sense of "objective" and "subjective" are primarily predicates of judgments. To label a judgment as subjective is to mean that the truth or falsity cannot be settled "objectively" via a matter of fact, but depends on certain attitudes, feelings, and points of view of the makers and the hearers of the judgment. An example of such a judgment might be "Windows 95 is a better operating system than the MacOS." In contrast to this "subjective" judgment, we can offer an "objective" judgment such as "Windows 95 was released in Montreal in August of 1995." For this objective judgment, the facts in the world that make it true or false is independent of anybody's attitudes or feeling about them. In this epistemic sense, Searle suggests the correspondence of objective judgments to objective facts.

In terms of the Straub et. al. study, both sets of measures reflect epistemically "objective" judgments. In other words, the truth and falsity can, if necessary, be determined independent of the attitudes and perspective of the researcher. In both instance, four particular measures of voice mail usage (average messages sent, average messages received, overall usage, number of features used) were obtained. Overall, it can be argued that the computer-recorded measures are more accurate in accounting for each of these "usage" measures. The self-reported measures, in turn, may be biased and less accurate. In fact, they may actually be measuring some other "judgment" (to be discussed later). But, again, the truth and falsity can nonetheless be assessed "objectively."

In addition to the epistemic sense of the objective/subjective distinction, there is the ontological sense which are predicates of entities or types of entities and, in turn, ascribe modes of existence. In the ontological sense, Searle suggests pain as an example of subjective entities where the mode of existence depends on being felt by subjects. In contrast, mountains are ontologically objective because their mode of existence is independent of (i.e., external to) any perceiver or any mental state.

In the context of the Straub et. al. study, both the self-reported and computer-recorded measures of IT usage are ostensibly ontologically objective. The mode of existence does not exist within the subject, but is manifested as actual behaviors independent of the researcher or any other perceiver. Yet, as to be discussed in the next section, the subjective/objective distinction of IT usage may consist more than the intrinsic aspects discussed thus far.

Intrinsic versus Observer-Relative Features of a Phenomenon

The features of IT usage has so far been described in terms of a fundamental objective ontology (e.g., mountains and molecules which exist independently of our representation) and thus we might label **intrinsic** to nature. But we might also notice features of the IT usage that are **observer-relative** (i.e., those features that exist relative to the intentionality of observers, users, etc.). For example, Searle (1995, p. 9) describes how we can view the intrinsic feature of an object in terms of a certain mass and certain chemical composition. This object can, for example, be made of metal and wood. But, if we call this very same object a screwdriver, Searle suggests that we are specifying a feature of the object that is observer or user relative. It is a screwdriver because people use it as such. It can easily be a paperweight or a hammer with their own inherent observer-relative features. The existence of observer-relative features of the world does not add any new material objects to reality, but it can add epistemically objective features to reality where the features in question exist relative to observers and users. Thus, an epistemically objective feature of an object called a screwdriver has features that are ontologically subjective.[1]

An observer-relative example of IT usage would be the use of spreadsheets as word-processors. In the early days of personal computing, it was not uncommon to find people using spreadsheet software as a word-processing function. Partly due to the familiarity of the spreadsheet software, these individuals intentionally used it to produce reports and other office documents. After awhile, a common core or group of users developed who would produce and exchange such documents through the same spreadsheet software. In so doing, epistemically objective word-processing features from a spreadsheet software were created .

Whether a feature is intrinsic or observer-relative is not always obvious. One heuristic is to ask yourself if a feature could exist if there had never been any human beings or other sorts of sentient beings. Observer-relative features exist only relative to the attitudes or beliefs of the observers. Intrinsic features exist independently of observers. But, it should be noted that the acts of observing and using are themselves intrinsic. Thus, something is a screwdriver only relative to the fact that conscious agents regard it as a screwdriver; but the fact that conscious agents have that attitude is itself an intrinsic feature of conscious agents.

---

[1] While feature of being a screwdriver is observer-relative, the feature of thinking that something is a screwdriver (treating it as a screwdriver; using it as a screwdriver, etc.) is intrinsic to the thinkers (users, observers, etc.).

In summary, any phenomenon under consideration (such as an object or a behavior like IT usage), the meaning we attribute to it can be conceived of in two way.: as **intrinsic fact** and as **observer-relative fact**. The first, intrinsic fact, refers to statements of a phenomenon's attributes that exists quite independently of any attitude or stance we may take. Observer relative fact pertains to attribute features that exists only relative to our interests, attitudes, stances, and purposes. Searle (1995, p. 12) provide the following examples using pairs of statements regarding an object or event:

1a. intrinsic: That object is a stone.
1b. observer relative: That object is a paper weight.

2a.intrinsic: Earthquakes often occur where tectonic plates meet.
2b. observer relative: Earthquakes are bad for real estate values.

Observer relative phenomenon, thus, are created by the intrinsic mental phenomena of the users, observers, or researchers regarding the object or behavior (i.e., phenomenon) in question. These intrinsic mental phenomena, according to Searle, like all mental phenomena are ontologically subjective. This ontological subjectivity does not prevent claims about observer relative features from being epistemically objective.

Thus, certain features of IT usage as measured by a computer, while epistemically objective, can also be argued to be ontologically subjective when used in an observer-relative frame. Likewise, self-report measures can equally be considered as epistemically objective (merely with greater error), but again the ontological status needs clarification.

Observer-relative features of IT usage - the assignment of functions

We use the intrinsic/observer-relative notion to re-examine IT usage. While the behavior itself has intrinsic features which are ontologically and epistemically objective as described earlier, we can also suggest that it has features that are observer-relative. In other words, the meaning and reality attributable to IT usage is partially dependent on certain observer-relative features. Specifically, this paper suggest the meaning of measures for IT usage is partially dependent on what Searle describes as the "assignment of a function."

As human beings, Searle argues that we impose functions on objects, both naturally occurring objects or events and those created especially to perform the assigned functions. When we experience and describe an object such as a chair or table, we assign or impose a function on it. Functions, in short, are never intrinsic but are always observer-relative. For example, to say the heart pumps blood is to say "the function of the heart is to pump blood." This statement does more than record intrinsic facts. Searle states that "we are situating these facts relative to a system of values that we hold. It is intrinsic to us that we hold these values, but the attribution of these values to nature independent of us is observer-relative" (1995, p. 15). In essence, there is a necessary assignment of purposes and teleology prior to the discovery of a function. Otherwise statements of what constitutes a better or worst heart cannot be assessed unless it is predicated on the function assigned to it. Terms such as "malfunction" or "heart disease" implies that it is important that a heart continues to pump blood; that life and survival are values we take for granted and which we assign as the function for the heart. If, as Searle notes, we believe the most important value in the world is to glorify God by making loud thumping noises, a noisier heart would constitute a better heart.

Thus, the meaning we attribute to measures such as IT usage is partly due to the function we assign to it. In turn, the function we assign to it is accounted for through our own interpretive frames. In constructing the meaning of the particular items used to measure IT usage, we need to ask why it is important to do so. Why is it meaningful to consider such measures? This is partly determined by the values, the purposes, and teleology which the measures are situated. The function which we attribute to these measures consists not only of the items themselves, but the context in which they are to be applied (i.e., how they relate to the other phenomena and their respective measures). In other words, the function we assign to a concept such as IT usage exists by virtue of the totality of relationships of which it is a part.

The context, in part, consists of the items we use as indicators of the concept and the other concepts (and their respective indicators). IT usage, therefore, is assessed via the contextual and historical frame in which the measures are embedded.

Re-Examining The IT Usage Measures

Measures Alone

In the Straub et. al. study, both the computer-recorded and self-reported measures attempted to measure 4 types of voice mail usage: number of messages sent on an average day, number of messages received on an average day, general usage, and number of system features used. While the exact form of the self-report questions were never provided, the computer-recorded measures were reported to span a three week period. Except for the general usage measure (which was never elaborated on), the “intrinsic” features of these measures are clear. For example, the “average number of messages sent during a three week period” is simply a number referring to the total number of messages sent divided by the 3 week period. Likewise, the intrinsic aspect of the measure “number of system features used” refers to how many of the systems features an individual used over the three week period.

What is not clear from looking at these four measures in isolation is the question of why it is important for us to even consider them. What observer-relative features might these measures also hold? If we value busy workers, we might attribute the behavior of sending and receiving messages the function of occupying time. In the case of the behavior of system features used, what function might we attribute to it? On what basis does it constitute good or bad usage of system features? Is more good? Less? Or only certain features at certain time? Different individuals may have different answers by virtue of the interpretive frame they apply. Do those individuals surveyed accord the same meaning to each of these measures?

If we take a nomothetic perspective (Jaccard and Dittus, 1990), we can begin to answer this question by looking at the LISREL results provided by Straub et. al. for a two factor model of system usage (Figure 1). They stated that the results of the one factor usage model yielded unacceptable model fits (χ^2 = 628.39, GFI=0.692, ACFI=0.446). The two factor computer-recorded/self-reported usage model, in turn, resulted in an improvement in the model fit (χ^2 = 400.48, GFI=0.801, ACFI=0.623). But contrary to authors’ claim, this improvement does not mean that the two factor model is correct. The model fits, while better, are still far removed from generally accepted guidelines (Chin & Todd, 1995; Adams, Nelson, & Todd). Further evidence of poor model fit is the lack of convergence in the measures for the factor loadings which connect each factor to their respective measures. For the computer-recorded measures, we see high loadings (0.941 and 0.934 respectively) for the two measures related to messages sent and received. But the general usage and system features measures are quite low (0.404 and 0.404 respectively) suggesting they are influenced by other factors. This is also reflected in the self-reported case, although the general usage measure moved slightly higher to a borderline loading of 0.666.

Additional LISREL models would have helped to disentangle the problems indicated by the model fits and loadings. One approach is to view both self-reported and computer-recorded measures as two methods for measuring the various usage measures. As such, a model such as Figure 2 would be the starting point. In such a model, a single usage model is proposed, but the measures are also influenced by the method of measurement. The next step would be to examine the loadings from the single usage factor to see if they converge to high loadings. If not, we can begin the process of questioning how each of these measures may differ by asking whether different functions are assigned by those surveyed.[2]

Meaning Attributable to Other Measures

[2] Unfortunately, the Straub, et. al. paper did not provide the covariance matrice for the study. Had this been provided, we could have shed additional light on this issue by providing further analyses.

As we continue our consideration of the functions people may assign to the various usage measures, it becomes apparent that we need to consider them not just in isolation, but in the context in which those measures are embedded. Any attempt to answer the meaning of these usage measures involves the world-view which we bring to them. We need to explicate the inter-contextual relations in which usage is embedded.

Figure 1. Two Factor Model from Straub et al.

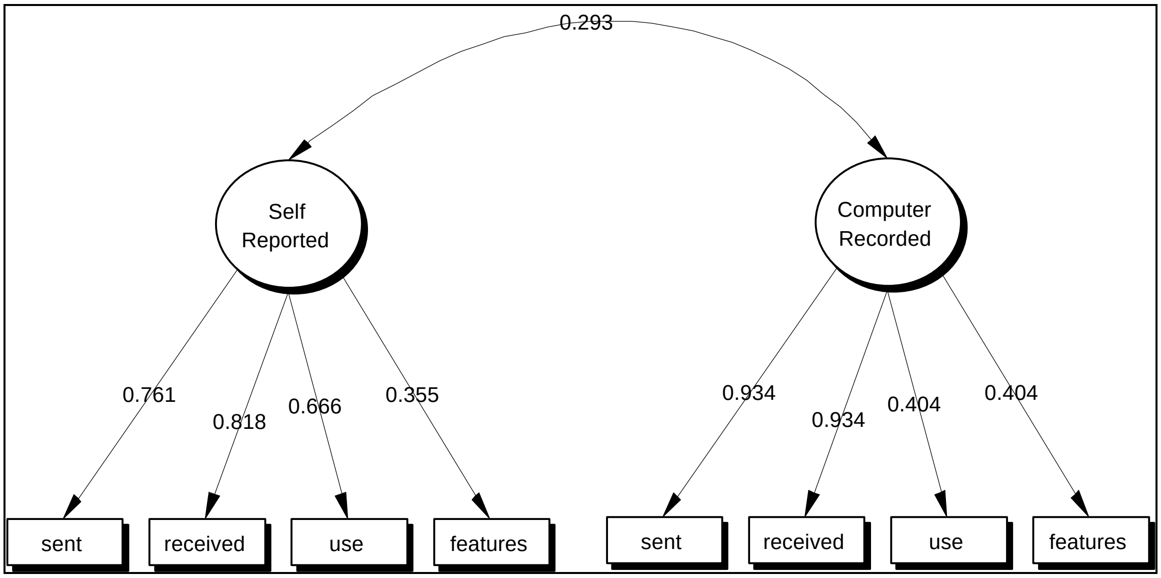
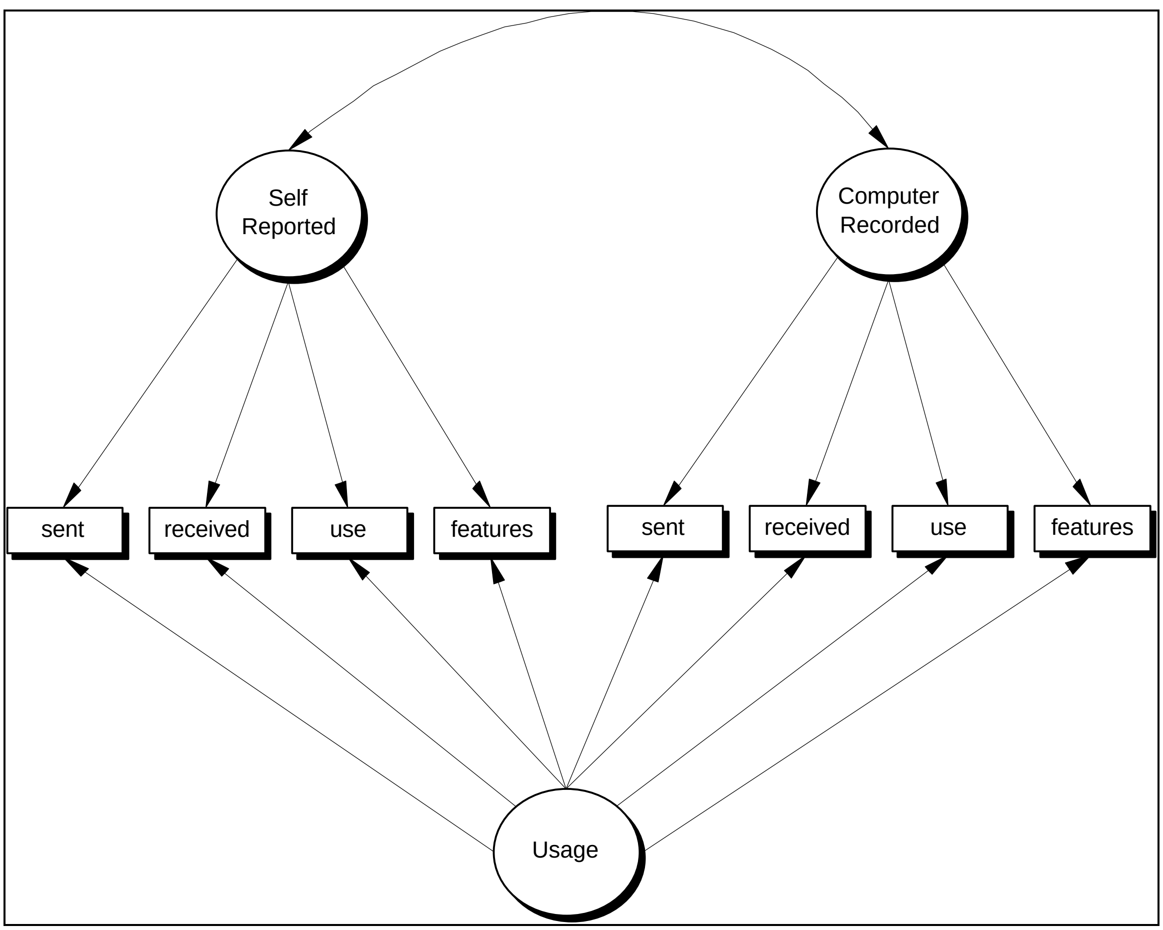


Figure 2. One Factor Model with Method Effects



One function which we can assign to IT usage embodies the value that sooner is better. As epitomized by sayings such as “Don’t put off doing what you can today” and “The early bird catches the worm”, this value considers that, all else being equal, it is better to use an IT sooner than later. Under the assumption that an IT is beneficial, this function would suggest the sooner an IT is first activated and the sooner an IT is integrated into an individual’s routine (e.g., Cooper and Zmud, 1990) the sooner the benefits to the individual and organization will accrue. Thus, we are not necessarily just concerned with the extent of usage, but also how soon it is used. The sooner it is used or the sooner it is put to regular usage are measures of the adoption/acceptance of the IT.

This adoption/acceptance function can also be argued to be inherent in the constructs which Straub et. al. applied to assess the usage measures. Specifically, Straub et. al. included measures for perceived ease of use (PEU) and perceived usefulness (PU) from the technology acceptance model (TAM) (Davis, 1986) to form a “nomological net.” In describing the TAM model, Davis, Bagozzi, and Warshaw (1989) stated that “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.” (p. 983). Davis et. al go on to say that “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.”

In so doing, there is a temporal function to the TAM measures. Intention and attitudes are assumed to be antecedent to the actual behavior. In turn, we can argue temporally, that length of time to usage is more immediate and functionally more consistent than amount of usage. For example, the intention question (“I intend to use_________.”) as suggested by Ajzen & Fishbein (1980, Appendix A) and used by Davis can be seen to be functionally connected to the temporal value of adoption (i.e., time to usage) than to predicting extent of usage. After all, what constitutes good or bad intentions? A good intention is one that is followed through, especially if done sooner.

The lack of a link between the TAM measures and the computer-recorded measures of usage discovered by Straub et. al. can now be explained. In addition to the lack of convergence of the usage measures discussed earlier, we see the measures are primarily assessing extent of IT interaction rather than adoption/acceptance. But probably more critical is the fact that the measures are not temporally consequent to the TAM measures. Instead, they are measures of past behavior. Thus, we might actually suggest that a different function be assigned to these measures; that these usage measures obtained the three previous weeks are more representative of an user’s habit or standardized ritual than adoption/acceptance.[3]

In terms of the linkage found between PU and the self-reported measures of usage, we might conjecture that the measures may indeed be measuring the more appropriate adoption/acceptance function of usage. While Straub et. al. did not provide the specific questions, we can conjecture that no recall cues were provided for measures such as the messages sent and received. Under these conditions, respondents may use their general world knowledge to infer reasonable answers. For example, Bradburn, Rips, and Shevell (1987, p. 160) suggest that when asked to report the frequency of dental visits, a respondent may refer to “normative expectation” (e.g., the expectation to have semi-annual checkups) and may adjust the resulting estimate to reflect individual deviations (e.g., “I don’t go as often as I should.”). Similarly, these IT usage questions may refer to an individual’s own normative expectations of future usage which is more consistent with the adoption/acceptance function.

---

[3] It should also be noted that the measures used by Straub et. al. for the TAM constructs are problematic in two ways. The first is that the measures can be construed as major modifications from the original TAM measures. For example, one of the PU measures asks whether “voice-mail is very important in performing my job.” This question misses out on the aspects of “an individual’s use” and assessment of whether the use will “increase the probability” of job performance. Instead the question refers to the IT only and not its use. Nor does the question specify to whom voice mail is important. Furthermore, the term “important” is not at the level of specificity as those developed by Davis (1989). The criterion “important” may be something other than increasing the probability of enhancing job performance. Only one of the questions used is taken directly from TAM. This is contrary to previous studies that used the TAM questions without changing the wording (Adams, Nelson, & Todd, 1992; Chin & Todd, 1995). The second issue is that the use of only two measure per construct leads to underidentification for each factor in a LISREL model. Ideally four measures should be used to provide a rigorous test of the measures used in a LISREL model.

Therefore, this paper is consistent with Straub et. al.'s belief that the two sets of measures may be measuring different phenomenon. But we believe that the computer-recorded measures are not necessarily anymore "objective" than the self-reported measures. Instead, they are likely more accurate. Furthermore, both sets of measures are problematic in their attempt to reflect "usage" as it is applied within the TAM context.

Results From A New Study On Computer-Recorded Usage

In order to further demonstrate the subjective/objective distinction used in explaining the discrepancies noted by Straub et. al, this paper present the results of a study examining the adoption/acceptance of secretaries to two software: a productivity tool and computer games. The results show that a link can indeed exist when computer-recorded measures of usage are embedded in the TAM model. Due to page limitations, this section will admittedly be brief.

Methodology

The site for the study is a midwestern University. The organizational members in this study consisted of 22 secretaries spatially dispersed among 7 floors of a building. The secretaries were relatively homogeneous in their knowledge of ITs. All were accustomed to using computers for word-processing, spreadsheet, and graphical applications. At the time of this study, the organization had switched over to a different computer operating system and the secretaries had been experimenting with the various available software for a period of 2 to 3 months.

Two software packages were used as the ITs in this study. Their selection were chosen to be different and reasonably independent of each other. The first IT, a productivity tool, is a software package that aids an individual in creating and manipulating files and directories on their computers. It represents a productivity tool useful in the everyday performance of ones job. The second IT, computer games, is a menu driven collection of 9 computer games. While not a productivity package, computer games have come to represent common software available in most organizations and thus a different type of software for examination.

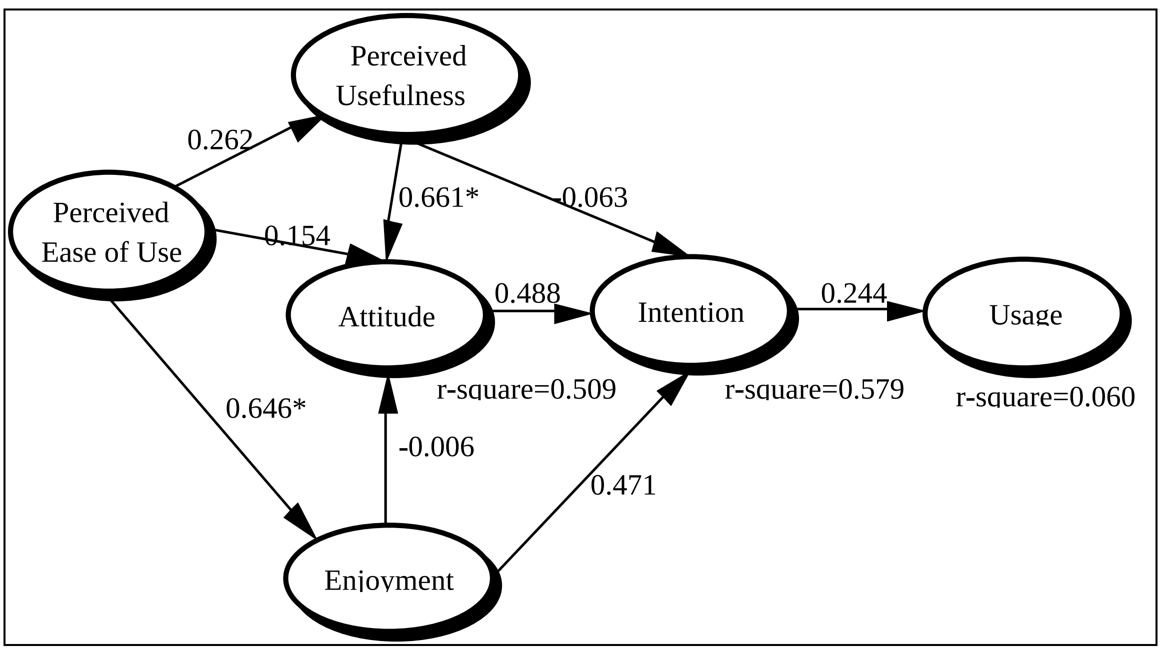
One month prior to the installation of both software packages, a questionnaire was distributed. A two page description of each software program was presented followed by questions identical to those used in the Davis et. al. (1989, 1992) studies. The only difference was to change the name of the software. Beyond the use of the PU and PEU constructs applied in the Straub et. al study, we opted to use the full TAM model which includes intention and attitude. Furthermore, we include a recent construct enjoyment (Davis et. al., 1992) which has been suggested as an extension to the TAM model. Software usage was unobtrusively recorded on each secretary's computer. Unbeknownst to each secretary, a time stamp was made each time they initiated either software. The usage measures tested here are time to initial usage and time to regular usage (defined as at least once a week). As discussed earlier, these measures of usage would be more consistent with the adoption/acceptance function inherent in the TAM constructs than those used by Straub et. al.

Partial Least Square via PLS-Graph (version 2.91.02) was used to analyze the data. This is primarily due to the small sample size. The stability of the estimates were tested via a bootstrap resampling procedure (500 samples) (Mooney & Duval, 1993).

Results

The results of the analyses for the productivity software are presented in Figure 3. All construct to indicator loadings, presented in Table 1, were significant ($p < 0.01$).The estimated linkage between intention and usage was 0.244. But partly due to the sample size, the only significant paths are the 0.66 link from PU to attitude and the 0.65 link from PEU to enjoyment. Another potential reason for the poor intention/usage linkage, that is not captured by the data, is the fact that it took approximately 3 months to move all the files from the old computer operating to the new system. Once the files were converted and stored in the new computers, the secretaries began to comment on the difficulty of finding, sorting, and managing files and directories. The intentions were measured under the assumption that the files were on the system, thus the conditions had changed. Furthermore, with the time gap between measures and usage, intentions may have changes. According to Fishbein and Ajzen (1975, p. 375) intentions measured immediately prior to the behavior tend to be better predictors than intentions measure some time in advance. Once the assumption of large number of files was met, it is not clear whether the intentions remain as they were 3 months earlier. For the games software (Figure 4), the linkage between intention and usage was significant ($p < 0.01$) with an estimate of 0.525. Again, likely due to sample size, only large effects were determined. Here the only other significant paths were from PU to intention, and attitude to intention.

Figure 3. Results from Productivity Tool software
* denote significant paths ($p < 0.01$)



It is important not to construe the PLS estimates in the new study as inferring from a population. Rather, it is purely meant to be descriptive of the population of secretaries studied. The bootstrap resampling, in turn, is used to determine to what extent the path numbers are influenced by noise. Thus, the results are not meant to be generalizable - but informative of what occurred in this particular context.

Figure 4. Results from Games software

* denote significant paths ($p < 0.01$)

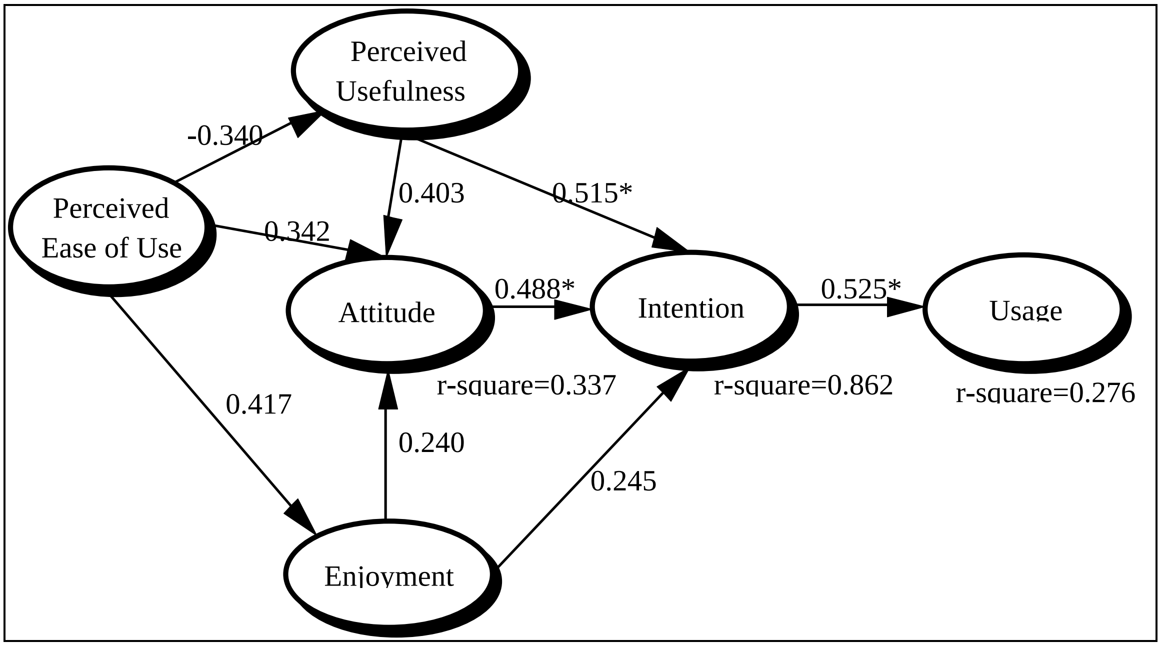


Table 1. Weights and Loadings of Measures for the Productivity and Games Analyses

	Productivity Tool		Computer Games	
	Weight	Loading	Weight	Loading
ease of use				
e1	0.3641	0.9649	0.3539	0.9095
e2	0.3533	0.9457	0.3482	0.8350
e3	0.1610	0.7641	0.1739	0.8929
e4	0.2240	0.8549	0.3099	0.8411
enjoyment				
ej1	0.2959	0.7834	0.3718	0.9336
ej2	0.4305	0.9189	0.4089	0.8085
ej3	0.4114	0.9059	0.3669	0.9038
usefulness				
u1	0.4044	0.9485	0.3127	0.8753
u2	0.4061	0.9059	0.3790	0.9267
u3	0.2849	0.8722	0.4442	0.8841
attitude				
a1	0.3633	0.6360	0.4283	0.9650
a2	0.4279	0.9162	0.3199	0.9045
a3	0.4075	0.9250	0.4023	0.9237
intention				
i1	0.3743	0.9390	0.3496	0.9597
i2	0.3571	0.9483	0.3514	0.9722
i3	0.3247	0.9543	0.3349	0.9640
usage				
usg1	0.3638	0.8695	0.1398	0.4349
usg2	0.7069	0.9672	0.9476	0.9911

Discussion & Conclusion

This paper builds upon the Straub et. al. study by attempting to reconcile the difference between computer-recorded and self-report measures as they are applied in the TAM context. Rather than according computer-recorded measures as having a closer connection to "reality" and thus being more "objective," we examined what constitutes objectivity from both an epistemological and ontological perspective. Furthermore, we brought forth the distinction that measures may be accorded both intrinsic features and observer-relative features. While the computer-recorded measures can be said to be more accurate, it can also be argued that self-reported measures have intrinsic features that are just as ontologically and epistemically objective.

To explain why the usage measures developed in the Straub et. al. study failed to be related within the TAM construct, we brought in the notion of observer-relative features. In particular, we discussed how the meaning of usage partly depends on what function we assign to it. We suggest that extent of usage may not be as appropriate as an adoption/acceptance function of usage when embedded in the TAM context. Furthermore, we highlighted some internal consistency and temporal problems in the measures used. Using the adoption/acceptance function, a new study demonstrated that computer recorded usage can be embedded successfully within the TAM context.

In summary, this paper argues that the concern that the TAM model may need substantial reformulation or that IT usage be split up between computer-recorded and self-reported may be premature. Instead, we suggest the meaning we attribute to usage must be assessed deeper than the mode of measurement

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, (June 1992), pp. 227-247.

Ajzen, I. & Fishbein, M., *Understanding attitudes and predicting social behavior*, Englewood Cliffs, NJ: Prentice Hall, (1980).

Burrell, G. & Morgan, G., *Sociological paradigms and organizational analysis*, Portsmouth, NH: Heinemann Educational Books, Inc., (1979).

Bradburn, N. M., Rips, L. J., & Shevell, S. K., "Answering autobiographical questions: The impact of memory and inference on surveys," *Science*, 236, (1987), pp. 157-161.

Chin, W. W. & Todd, P. A., "On the Use, Usefulness, and Ease of Use of Structural Equation Modeling in MIS Research: A Note of Caution." *MIS Quarterly*, 19:2, June 1995, pp. 237-246.

Cooper, R. B. & Zmud, R. W., "Information Technology Implementation Research: A Technological Diffusion Approach," *Management Science*, 36:2, pp. 123-139.

Davis, F.D., *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results*. Unpublished Ph.D. dissertation, Sloan School of Management, MIT, (1986).

Davis, F. D., "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* 13:3, (September 1989), pp. 319-340.

Davis, F.D., Bagozzi, R. and Warshaw, P., "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science*, 35:8, (August 1989), pp. 982-1003.

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, (1992), 1111-1132.

Jaccard, J. & Dittus, P., "Idiographic and nomothetic perspectives on research methods and data analysis." In C. Hendrick and M. S. Clark (Eds.) *Research Methods in Personality and Social Psychology*, Newbury Park, Ca: Sage Publications, (1990), 312-351.

Mooney, C. Z. & Duval, R. D., *Bootstrapping: A nonparametric approach to statistical inference*, (Sage University Paper series on Quantitative Applications in the Social Sciences, series no. 07-095). Newbury Park, Ca: Sage, (1993).

Orlikowski, W. J., & Robey, D., "Information technology and the structuring of organization," *Information Systems Research*, 2:2, (1991), 143-169.

Orlikowski, W. J., & Baroudi, J. J., "Studying information technology in organizations: Research approaches and assumptions," *Information Systems Research*, 2, 1, (1991), 1-28.

Searle, J. R., *The construction of social reality*, New York: The Free Press, (1995).

Straub, D., Limayem, M., & Karahanna-Evaristo, E., "Measuring system usage: Implications for IS Theory Testing," *Management Science*, 41:8, (1995), 1328-1342.