Is Usage Predictable Using Belief-Attitude-Intention Paradigm?

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Abstract

While much of the prior information system (IS) research has employed technology acceptance model (TAM) and theory of planned behavior (TPB) to explain user's technology acceptance behavior, most of them use self-reported use intention to develop their investigation. The purpose of this paper is to empirically examine the validity of behavioral intention's prediction on actual system usage under a voluntary context. By integrating constructs of the two closely related theoretical paradigm (TAM and TPB), we propose an integrated model to investigate the relationship. In doing so, we used questionnaire to gather the system usage perceptions of students who took an online management information system (MIS) course at a large Canadian university. At the same time, we also set up the e-learning system to record students' actual usage. Using partial least square (PLS) approach, data collected from 105 students are tested against the model showing a very good fit with 60% explanation of the behavioral intention. The relationship between the intention and actual system use however was found to be insignificant and weak. Our study questions the validity of using self-reported intention to represent system usage and provides insight into future research directions on technology acceptance behavior.

Keywords: TAM, Planned Behavior, Multimedia, Intentions, Usage

Introduction

The benefits of information technology (IT) on individuals (Bernard, 2004; Leidner & Elam., 1993-94), groups(Leidner & Fuller, 1997) and organizations usage (Devaraj & Kohli., 2003) have driven information systems (IS) research for more than two decades. Numerous studies and articles have been published each year about individual acceptance of IT in different contexts. This important stream of research examines factors related to, among others, adoption, use, adaptation, diffusion, and appropriation of information technologies.

Over the decades, various theories and paradigms have been proposed in order to get better understanding of individual acceptance behavior on IT. The technology acceptance model (TAM) one of the intention models, is perhaps the most widely applied theoretical model in IS research. The core formulation of TAM argues that an individual's system usage is determined by behavioral intention, which is, in turn, influenced by two be-

liefs: perceived ease of use and perceived usefulness.

Another dominant research model to understand user acceptance of technology is the theory of planned behavior (TPB). According to the TPB, behavioral intentions to perform a behavior are jointly determined by three factors: attitude toward the behavior, subjective norms (SN), and perceived behavioral control (PBC). Grounded in social psychology, TPB has been widely applied to diverse disciplines such as leisure behavior, marketing/consumer behavior and medicine (Ajzen, 1991). In the IS filed, researchers also found empirical support for predicting the intention on the adoption of new technologies by using TPB (e.g. Harrison, Mykytyn, & Riemenschneider, 1997; Taylor & Todd, 1995; Yi, Jackson, Park, & Probst, 2006).

As research mainstream, substantial empirical studies have been conducted using this beliefs-attitudes-intention paradigm of human behavior extended from Fishbein and Ajzen's (1975) the theory of reasoned action (TRA). Although TAM has been extensively used, very few studies (if any) have attempted to examine the model by using "actual system usage" rather than self-reported use. For instance, in the studies reported by Legris, Ingham, and Collerette (2003), only one study measures actual system usage (Taylor & Todd, 1995). The research of TPB also confronts a similar situation (e.g. Carswell & Venkatesh, 2002; Yi et al., 2006). Since most of the studies use self-reported usage, it can be argued that the power of TAM has yet to extend beyond the conceptual perceptions domain. In this study, we aim to explore the TAM with actual use as a construct. This is done within the context of e-learning. In order to get a holistic overview, we integrate the constructs of TAM and TPB, and include actual system usage records in our research model.

Research Model and Hypotheses

It is not surprising that a long list of theories and models that IS researchers have used to predict or explain factors influencing individual acceptance of information technologies. The TAM and the TPB are two of the most widely applied theoretical models in addressing concerns on individual decisions of IT adoption (Legris et al., 2003). Indeed, researchers also introduce effects of the holistic and positive user experience to expand the view on individual behavior towards learning activities (Choi, Kim, & Kim, 2006; Saadé & Bahli, 2005).

Figure 1 presents the research model for this study. Although several studies using TAM suggest that exclusion of attitude from the model (Venkatesh, 1999; Venkatesh & Davis, 2000; Yi et al., 2006), attitude towards the system has been identified as an essential determinant to behavioral intention, as described in the TPB. Indeed, in recent studies, attitude shows its effect on individual online acceptance behavior (Dinev & Hu, 2007; Heijden, 2003; Hsu & Lu, 2004; Lee, Cheung, & Chen, 2005; Moon & Kim, 2001; Saadé, Nebebe, & Tan, 2007). In this study, we keep the attitude construct to validate its importance in the original TAM. The proposed constructs and hypotheses are fully supported by prior studies in the IS literature. Drawing upon the literature and based on the present research context, we hypothesize the following:

H1: *Attitude has a significant positive effect on behavioral intention*

H2: *Perceived usefulness will have a strong positive effect on behavioral intention*.

H3: *Perceived ease of use has a significant positive effect on attitude.*

H4: *Perceived usefulness has a significant positive effect on attitude.*

H5: *Perceived ease of use has a positive effect on perceived usefulness*

H6: *Subjective norm has a positive effect on behavioral intention.*

H7: *Perceived behavioral control has a positive effect on behavioral intention*

H8: *Behavioral intention has a positive effect on system usage*

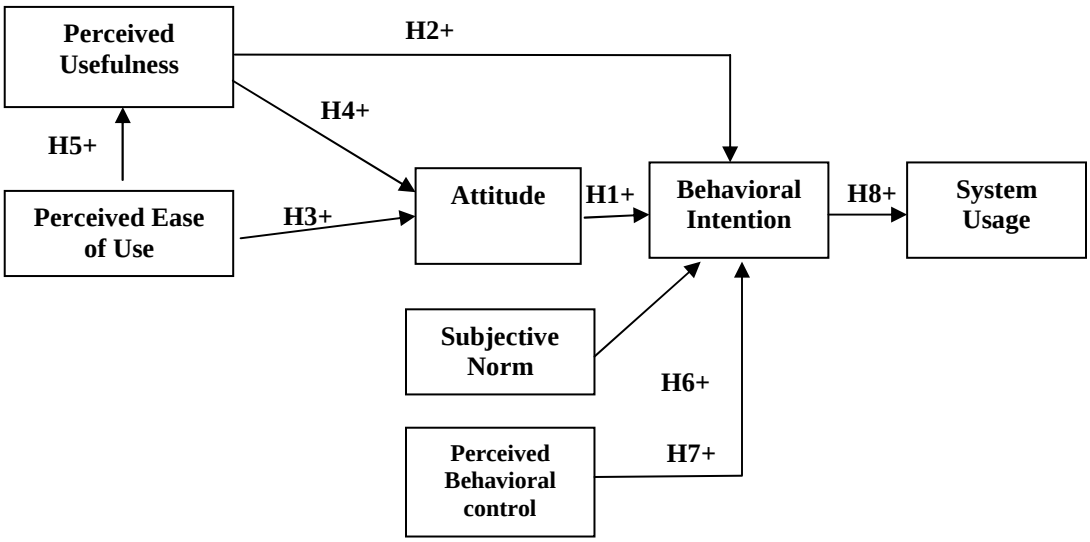

Figure. 1. Research model

Research Methodology

Target system

The target system used in this study is a Multimedia Entity Relationship Diagram (MMERD) learning tool. The MMERD presents instructional materials through the step-by-step method from basic definitions to problem tests. At each step, key words of displaying learning materials are emphasized visually by using a different color scheme. Each step is also accessible directly through the menu bar, thus allowing students to instantaneously retrieve information as they are confronted with assignments and problems. Students can also practice problem solving using the same tool (see Figure 2).

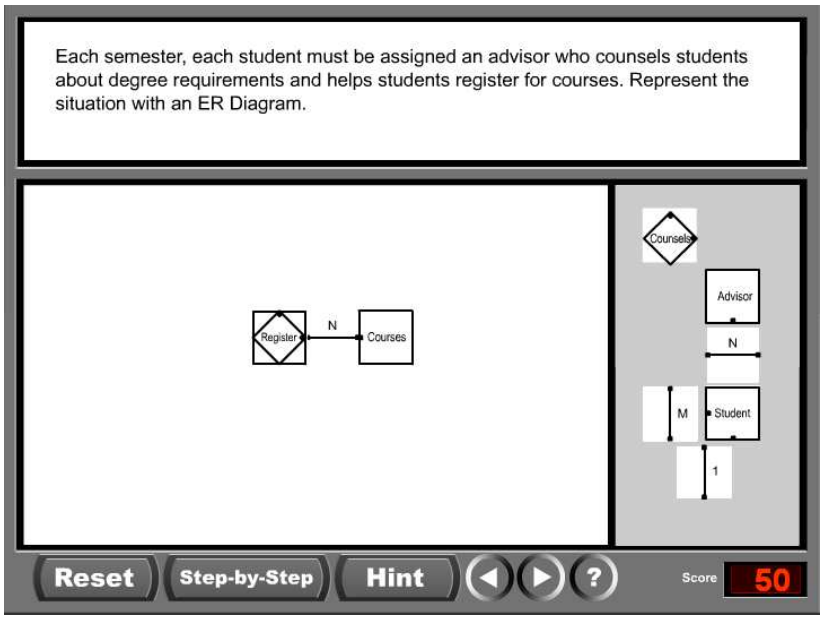

Figure 2. Screenshot of the practice component of MMERD

Study Context and Data Collection

A field study was conduced to test the model. Approximately 306 students registered in an online management information system course at a large Canadian university were given the choice to participate in the study in 2007. The students were asked to fill out a web-based questionnaire to describe their level of agreement with the research question statements after the use of the e-learning system. A total of 105 students responded to the survey completely. The response rate is 34%. The average age of the respondents was 22.8, ranging from 18 to 51. The system use experiment lasted one month in order to enable students have enough time to adjust to the environment and experience the features of the system thoroughly. After the student logged on, the system automatically assigned an access ID to this student, recorded her/his student ID, and triggered a timer to count the duration of the use.

Operationalization of Constructs

Items used in the questionnaire to operationalize the constructs in the model are from prior research with adaptation to fit the specific technology studies. Perceived ease of use and usefulness were assessed using a 4-item instruments respectively developed by Davis, Bagozzi, and Warshaw (1989). Based on Ajzen and Fishbein (1980), behavioral intention was measured using 2-items. Scales to measure attitude, subjective norm and perceived behavioral control were adapted to the context of the multimedia learning system from previous research (Ajzen, 1991; Davis et al., 1989; Taylor & Todd, 1995). Actual system usage is measured in terms of access times and access minutes.

Data Analysis of Results

Measure validation and structural model testing were conducted using Partial Least Squares (PLS) Graph Version 2.91.03.04 (Chin & Frye, 1998), a structural equation modeling tool that utilizes a component-based approach to estimation. PLS is a second-generation multivariate technique permitting the validation of the psychometric properties of the scales used to measure a variable, as well as the strength and direction of the relationships among variables.

Psychometric Properties of Measures

The measurement model was assessed by using PLS to examine internal consistency reliability and convergent and discriminant validity (Barclay, Higgins, & Thompson, 1995; Compeau, Higgins, & Huff, 1999). Internal consistencies of 0.70 or higher are considered adequate (Agarwal & Karahanna, 2000; Barclay et al., 1995; Fornell & Larcker, 1981). Two criterion are necessarily applied to establish convergent and discriminant validity in the measures: (1) The square root of the average variance extracted (AVE) by a construct from its indicators should be at least 0.707 (i.e., AVE > 0.50) and should be much larger than any correlation among any pair of latent constructs (Agarwal & Karahanna, 2000; Gefen & Straub, 2005) and (2) standardized item loadings (similar to loadings in principal components) should be at least 0.707, and items should load more highly on their own theoretically assigned constructs than on other constructs in the model. Cross-loadings were computed by calculating the correlations between latent variable component scores and the manifest indicators of other latent constructs. These criterion for reliability and convergent and discriminant validity should be applied only for latent constructs with reflective indicators, and are not appropriate for formative indicators (Chin, 1998; Gefen, Straub, & Boudreau, 2000).

The internal consistency reliabilities were all at least 0.76, exceeding minimal reliability criteria. As strong evidence of convergent and discriminant validity: (1) The square root of the average variance extracted for each construct was greater than 0.707 (i.e., AVE > 0.50) and greater than

the correlation between that construct and other constructs (without exception) (2) the factor structure matrix showed that all items load high on their respective constructs (0.70 or more) and lower on other constructs. Overall, these results exhibit sufficiently strong psychometric properties to support valid testing of the proposed structural model (see Table 1).

Table 1. Factor Structure Matrix of Loadings and Cross-Loadings

	ATT	PBC	BI	PU	PEU	SN
att1	**0.9169**	0.4779	0.6102	0.6174	0.4458	0.4243
att2	**0.9129**	0.4857	0.5379	0.6013	0.5050	0.3709
att3	**0.9192**	0.6685	0.6531	0.6120	0.5147	0.4543
pbc1	0.5040	**0.8437**	0.5647	0.5262	0.6732	0.2632
pbc2	0.5141	**0.8981**	0.5548	0.5238	0.6831	0.3687
pbc3	0.5476	**0.8834**	0.5845	0.5481	0.5950	0.3401
inte1	0.6300	0.6198	**0.9484**	0.6368	0.5566	0.4869
inte2	0.6173	0.6124	**0.9492**	0.5715	0.4770	0.5476
pu1	0.5730	0.5558	0.5568	**0.9214**	0.6593	0.5501
pu2	0.6103	0.5419	0.5848	**0.9402**	0.5974	0.5226
pu3	0.5892	0.5290	0.5652	**0.9542**	0.5916	0.5467
pu4	0.7000	0.6346	0.6582	**0.9165**	0.6809	0.4926
peu1	0.4159	0.6288	0.4650	0.5948	**0.8667**	0.2012
peu2	0.4145	0.6540	0.4311	0.5808	**0.8743**	0.2698
peu3	0.5064	0.6764	0.5683	0.6558	**0.8987**	0.3149
peu4	0.5329	0.6553	0.4445	0.5611	**0.8837**	0.2662
sn1	0.4346	0.3547	0.5131	0.5476	0.3176	**0.9543**
sn2	0.4370	0.3529	0.5289	0.5323	0.2575	**0.9570**

ATT: Attitude; PBC: Perceived behavioral control; BI: Behavioral intention;

PU: Perceived usefulness; PEU: Perceived ease of use; SN: Subjective norm

Test of Model and Hypotheses

The PLS structural model and hypotheses were assessed by examining path coefficients (similar to standardized beta weights in a regression analysis) and their significance levels. Firstly, we use the access times to represent system usage.

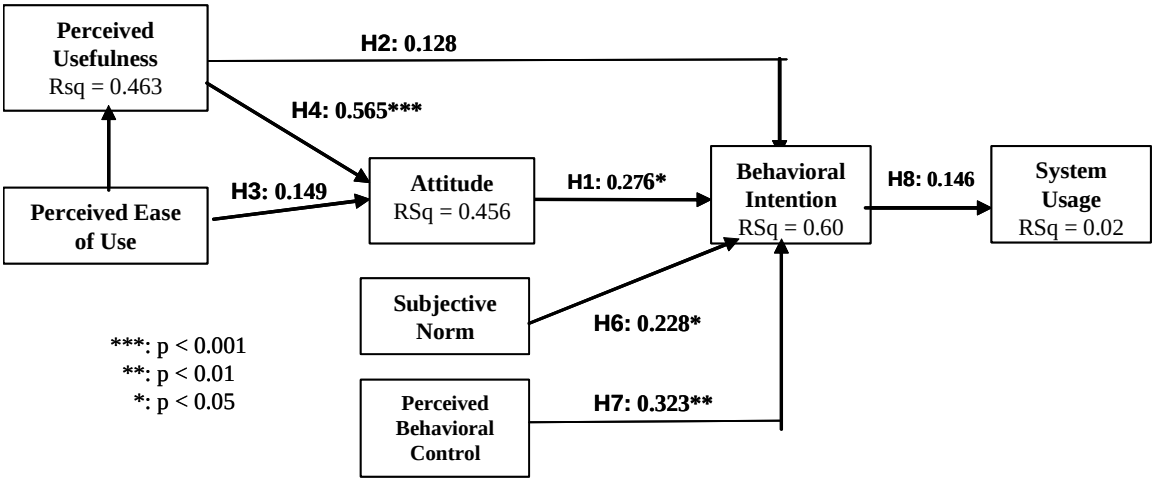

Figure 3. PLS test of model

Figure 3 summarizes model-testing results. The results provide strong support for hypotheses essentially drawn from the specification of the TAM except for H2 and H3. Supporting Hypothesis H6, SN had a significant effect on BI (β =0.228, p < 0.05). Supporting Hypothesis H7, PBC had a significant effect on BI (β = 0.323, p < 0.01). However, the link between BI and system usage (Access Times) is weak and not significant (β = 0.146, p = n.s). Secondly, we use the total minutes of each respondent spending on the system as the dependent variable. The result shows that there is no significant relationship between BI and system usage (Duration) either (β = 0.088, p = n.s).

Ease of use explains 46.3% of the variance in usefulness, while 45.6% of the variance in attitude is explained by usefulness alone. Moreover, 60% of the variance in behavioral intention toward technologies is jointly explained by attitude, subjective norm and perceived behavioral control. Finally, a small portion of actual system usage is explained by behavioral intention for access times as dependent variable (2.2%), and duration as dependent variable (1%), respectively.

Discussion and Conclusions

The objective of this study was to empirically investigate the relationship between behavioral intention and actual system usage under a voluntary context of e-learning tool usage. It provided insight into the mechanism of an integrated model based on the notion of the beliefs-attitude-behavior paradigm. It is important to test the validity of using self-reported measures as indicators of actual system usage in technology acceptance research, since most of the research findings and implications are based on those assumptions.

With respect to the present research work and consistent with the original formulation of TAM and TPB, we integrated these two models to conduct our study. The measurement model was confirmed with adequate convergent and discriminant validity. Of the eight hypothesized relationships, five were supported. At the conceptual domain of the integration model, the formulation of TPB provides insights into what influences individual behavior. Subjective norm, attitude, and perceived behavioral control are significantly and positively associated with behavioral intention. In consistent with prior studies, the usefulness beliefs were influenced by ease of use perceptions. In addition, individuals' assessments of instrumental outcomes would increase the positive level of attitude towards the system use.

While the empirical findings of the study provide some support for the overall structure posited in the research model, some relationships among constructs are opposite to what was hypothesized. There is no direct relationship between the usefulness belief and behavioral intention but attitude mediates their relationship. As one of the few attempts to investigate technology acceptance behavior using real system use data, we found that behavioral intention has insignificant and weak effect on actual system usage. This finding questions the validity of self-reported usage in IS research again (e. g. Lucas & Spitler, 1999; Straub, Limayem, & Karahanna-Evaristo, 1995). In Straub et al.'s (1995) study, they point out self-reported usage can not explain computer-record usage, although the relationship between self-reported usage and measures of cognitive constructs is strong. Therefore, research that relied on self-reported usage may be only describing an artificial 'truth'. It is possible that people intend to guess researchers' expectations and answer in that manner (Straub et al., 1995), or manipulate answers to follow social norms (Legris et al., 2003).

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