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Abstract

MIS researchers have taken a great deal of efforts to explain why a user adopts an information system. Intention theories, such as Theory of Reasoned Action, Theory of Planned Behavior, and Technology Acceptance Model, have been widely used as fundamental models to explain user's adoption. Although such intention theories allow MIS researchers to investigate factors that motivate users to adopt an information technology, they could not be used to explain why a user prefers one technology to another. Such a problem could be obviously seen when a user resists adopting a new technology since he/she prefers the one currently in use. This study proposes an idea of integrating preferential choice knowledge into existing intention theories to solve such problem. A new theory, namely Theory of Preferred Technology (TPT), is proposed and validated. The results of LISREL support this study's hypotheses and a new scale measuring user's preference is validated. The result of this study could be used as a guideline to investigate how likely a new technology could compete with one that is currently in use.

Introduction

Several of intention theories have been applied to various types of information systems. Few examples of such theories are Theory of Reasoned Action (Ajzen and Fishbein 1980a, 1980b; Fishbien and Ajzen 1975), Theory of Planned Behavior (Ajzen 1985), and Technology Acceptance Model (Davis 1986). Although these intention theories could be used to explain why an information system user would adopt a technology, they lack abilities to explain why a user selects one technology over another and why a user resists adopting a new innovation.

This weakness of current intention theories prohibits MIS researchers to investigate how much failure could happen to a new innovation of information technology. This weakness of intention theories was acknowledged in a remark meta-analysis study of Theory of Reasoned Action (TRA) (Sheppard et al. 1988). In that study, it was claimed that TRA could not be used to explain alternative behaviors. In other words, TRA could not be used to explain why an individual selects one behavior from a group of behaviors that could yield a similar outcome.

Since TRA was used as a fundamental model to develop Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM), this research argues that not only does TRA have such a weakness, TPB and TAM also hold similar drawback. This research therefore strives to mend this drawback by integrating preferential decision knowledge into intention theories, rendering a new model, namely Theory of Preferred Technology (TPT). The contribution of this study lies in a theoretical enhancement of current intention theories. In addition, this study provides an empirical result of TPT. With a rigorous literature review and circumspect integration of preferential choice knowledge to intention theories, the weakness of existing intention theories could be challenged.

Literature Review

Intention Theories

As early as 1862, psychologists began developing theories that examine how people behave by proposing that human's attitude drives human's behavior. In the 1950's, Fishbein and other social psychologists began to study human behaviors and factors that motivate an individual to take action. One of well-developed and widely applied models in social psychology is Theory of

Reasoned Action (TRA) (Ajzen and Fishbein, 1980a, 1980b; Fishbien and Ajzen 1975). TRA is "designed to explain virtually any human behavior" (Ajzen and Fishbein 1980a, 1980b).

TRA has extended the relationship between human's attitude (A) and behavior (B) by suggesting that human develops behavioral intention (BI) before an action is taken. In other words, TRA proposed that behavioral intention is a mediating construct in the relationship of attitude and behavior. In addition, it is articulated that attitude is a function of beliefs and evaluations. Also, TRA proposed that behavioral intention is driven not only by attitude but also by subjective norm and subjective norm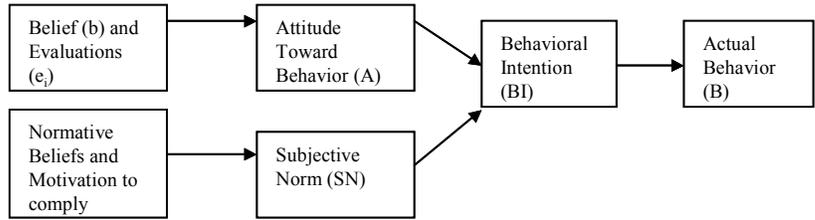 is driven by normative beliefs and motivation to comply. Figure 1 shows TRA model and relationships of its antecedents.

Figure 1. Theory of Reasoned Action (TRA)

TRA has long been employed to predict various types of behaviors. A meta-analysis of TRA by Sheppard et al. (1988) shows a large record of studies that employed TRA as the underlying model. TRA has also been utilized as a rudimentary foundation to develop a number of new intention models. One of which is the Technology Acceptance Model (TAM) (Davis 1986). TAM has received a significant attention from MIS researchers due to two major characteristics. First, it demonstrates a strong theoretical foundation. Second, it is parsimonious and could be used as a guideline to develop a successful information system (Taylor and Todd 1995).

The strong theoretical foundation is derived from the use of TRA, which has long been validated in several contexts, as an underlying model. The parsimonious characteristic is derived from the deployment of two meaningful and easily understandable constructs, Perceived Usefulness (U) and Perceived Ease of Use (EOU). U and EOU are decomposed version of belief in TRA. Figure 2 presents the relationships among factors in TAM.
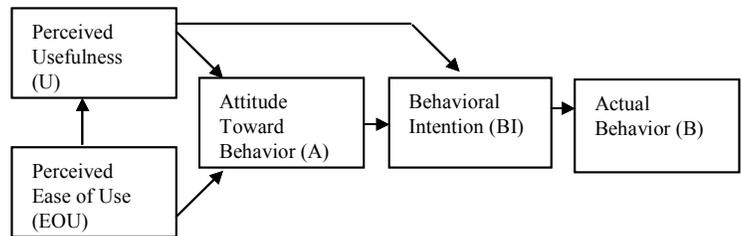
Figure 2. Technological Acceptance Model (TAM)

Although TAM was developed by using TRA as its fundamental model, there appear to be few differences between TAM and TRA. Firstly, in TAM, BI is not only driven by A but also by a salient belief namely Perceived Usefulness (U). In TRA, BI is driven by A and SN. Another difference between TRA and TAM is the omission of evaluation weight (e_i) to U and EOU. Fishbein and Ajzen (1975) signified the importance of evaluation (e_i) based on the ground of the individual's difference. In other words, it was argued that some people in a same sample might hold positive evaluations while others hold negative evaluations of a similar outcome. Nevertheless, Davis et al. (1989) argues that U and EOU possess a positive nature to most people. It is consequently acceptable to omit evaluation (e_i) without misleading the case. Other differences between TRA and TAM could be found in a number of studies (e.g. Davis 1986; Davis et al. 1989).

Despite their differences, TRA and TAM have a similar weakness. It is a lack of ability to explain alternative behaviors (Sheppard et al. 1988). The original TRA model focuses on determinants of single behavior. In that study, it is admitted that disregarding alternative behaviors demonstrated a drawback of TRA (Ajzen and Fishbein, 1980b). It has been recommended that TRA be extended by incorporating situations in which individuals are forced to choose alternative behaviors (Sheppard et al. 1988). Such an extension could also be a theoretical enhancement of TAM, since TAM was developed from TRA. This study consequently attempts to provide such a theoretical enhancement by integrating preferential choice knowledge to intention theories. TAM will be used as an example to demonstrate how to develop a new model that could be used to explain alternative behaviors.

Preferential Choice

Preferential choice is a well-developed research area in marketing discipline. There are several approaches in preferential choice studies. One of which is the multiattribute modeling approach. This approach has gained an increasing significance in the last three decades (Jacoby 1976; Kassarjian 1982). Within the domain of multiattribute modeling approach, two concepts of preference development have emerged. They are attribute-based preference and attitude-based preference. First approach suggests that

preference formation involves comparing specific attributes (attribute-based preference), while the second approach signifies the overall evaluation of alternatives (attitude-based preference) (Mantel and Kardes 1999).

When attribute-based preference is used, individuals compare their alternative in detail. For instance, a consumer, who is engaged in an automobile selection, might want to compare colors, transmission systems, number of seats, size, etc. When attitude-based preference is used, individuals employ their general feeling to develop their preference. Such general feeling might be derived from brand, past experience, etc (Wyer and Srull 1989).

Tversky (1969) proposed that alternatives are compared directly on each dimension (attribute), and the differences on those dimensions are summed together to reach a decision. In addition, it was proposed that human somehow combines all dimensional (attribute) value cognitively and comes to an overall evaluation (attitude) before making his or her decision (Einhorn 1971). In other words, these propositions asserted that attribute-based preference influences attitude-based preference or attitude-based preference is function of attribute-based preference. The relationship between attribute-based and attitude-based preferences is shown in figure 3.

Figure 3. Relationship between Attribute-based and Attitude-based Preferences

Development of Theory of Preferred Technology

This research is proposing a new intention theory, namely Theory of Preferred Technology (TPT), with an attempt to mend a weakness of currently available intention theories, such as TRA, TPB, and TAM. Figure 4 shows how to combine the concept of attribute-based and attitude-based preferences to TAM. Though figure 4 employs TAM as an example, the similar approach could also be used to improve TRA and TPB.

This research argues that employing U and EOU to investigate user's acceptance of information technology could be considered a study of user's acceptance at the absolute level, where only characteristics of a proposed technology is analyzed without considering characteristics of alternative technology. To have a comprehensive understanding in how a user would adopt a new technology, it is necessary to extend TAM to a comparative level where new technology is compared to the one currently in use. Figure 4 manifests how this study integrates TAM to attribute-based and attitude-based preferences.

Figure 4 shows that attribute-based and attitude-based preferences are added to TAM, rendering a new model, namely Theory of Preferred Technology (TPT). TPT is consisted of two levels including absolute and comparative levels. All relationships at the absolute level are drawn from TAM. Antecedents at the absolute level, such as U and EOU, belong to an information system that system developers are trying to propose to system users. Within the comparative level, this study argues that users would compare attributes of new and current systems (attribute-based preference), before developing his/her general preference (attitude-based preference).

This study further argues after users compare system alternatives, they would develop attitude toward using new technology (A) and intention to use a new technology (I). Theoretically, if a user believes that new system is <u>better</u> than the one currently in use (comparative level), he/she would have a <u>good</u> attitude and high intention to use such a new system (absolute level).

Another attempt of this study is to provide an empirical validation of TPT. This study selects email as system of interest and strives to prove that users make comparison between email and telephone before they adopt email. Selecting email to test TPT is based on a number of reasons. User's comparison between email and voice technology was claimed to be an important issue when a user considers adopting email (Adams et al. 1992). Also, TAM has been applied to validate email adoption in several studies (e.g. Gefen and Straub 1997; Hiltz and Johnson 1989). Therefore, the result of this study could be compared to those studies to find the consistency of relationships among antecedents.

This study further argues that it is important to find what attribute that a user uses to compare new and current systems. Since different group of information technologies have different objectives, a poll from the group of relevant subjects should be performed in order to elicit such attributes. Defining attributes in TPT could be considered a similar approach of decomposing belief in TRA into U and EOU in TAM. Like beliefs in TRA, attribute-based preference could be decomposed into antecedents that provide practical meaning to system developers.

In TRA, belief was accompanied by its evaluation weight. This evaluation weight was omitted in TAM based on the assumption that U and EOU hold a positive nature to most people. However, to develop a comprehensive model for TPT, this study argues that each attribute should be accompanied by its evaluation weight. For instance, if a system developer selects to use "timeliness" as an attribute to evaluate user's preference between new and current systems, it is important to find how much users give value
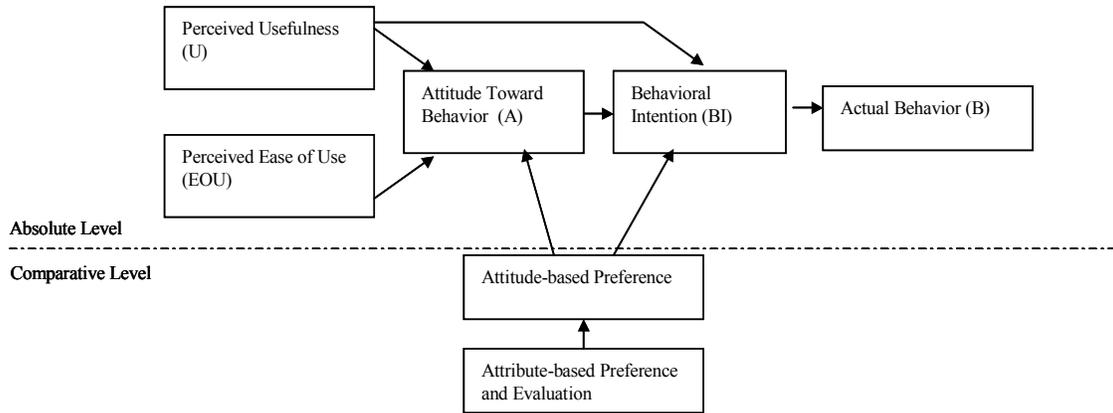
Figure 4. Theory of Preferred Technology

(evaluation weight) to their time resource. Some users might believe that completing their task in time is important, while others might be more flexible in terms of meeting their time constraint. However, due to a limited number of respondents in this study, evaluation weight would not be included in model testing.

Model Testing

Hypothesis and Scale Development

To test this study's proposed model, measurement scales of U, EOU, A, BI, and B were drawn from past studies (e.g. Venkatesh and Davis 2000; Taylor and Todd 1995). Most of those scales are seven-point Likert scales, expressing how much a respondent agrees or disagrees with each statement. Such scales are however inappropriate to measure user's preference at the comparative level. Therefore, a new scale is developed in this study. Figure 5 shows a scale measuring two alternatives, email and telephone. This scale would be employed to evaluate user's preferences at both attribute-based and attitude-based preferences.

1	2	3	4	5	6	7
Telephone is Highly Superior	Telephone is Superior	Telephone is Somewhat Superior	Neutral	Email is Somewhat Superior	Email is Superior	Email is Highly Superior

Figure 5. Scale Measuring User's Preference between Two Technologies

Communication cost is used as an attribute to evaluate user's preference between email and telephone. This study argues that such an attribute is appropriate since it is claimed that email is a breakthrough communication media due to its low communication cost (Kraut et al. 1999). The scale in Figure 5 is further adjusted to accommodate to this attribute. To avoid confusion, the word "less expensive" is used instead of using the word "superior", when a respondent is asked to evaluate preference regarding communication cost. There are three items used to measure communication cost preference. They are cost of sending each message (X_1), cost of receiving each message (X_2), and cost of forwarding each message (X_3). To measure attitude-based preference, three items are employed. They are Overall Preference (Y_1), Attitude (Y_2), and Overall Feeling (Y_3). The scale in figure 5 is used without adjustment to measure user's attitude-based preference between the two alternatives.

To simplify the idea of hypothesis setting, a comprehension of nature of scale development is required. It is worth noting that our scale inherently implies positive relationships from communication cost to attitude-based preference and from attitude-based preference to A and BI. The best way to explain the relationships among constructs is to use an example.

If Mr. A finds that it is less expensive to communicate by using email (Attribute-based Preference), then he is supposed to prefer email to telephone (attitude-based preference). This inherent relationship is also applied to the relationship from attitude-based preference to attitude toward using email (A) and behavioral mutention to use email (BI). If a consumer scores 7 to Attitude-Based

Preference construct, he/she is likely to have a good attitude toward using email and have high intention to use it. Relationships among U, EOU, A, and BI hold the positive nature, which is drawn from past studies of TAM. Consequently, all research hypotheses represent positive relationships. The following are list of hypotheses tested in this study.

> H_1: Attitude-based Preference is a positive function of Communication Cost.
> H_2: Perceived Usefulness (U) is a positive function of Perceived Ease of Use (E).
> H_3: Attitude toward Using Email (A/Email) is a positive function of Perceived Usefulness of Email (U).
> H_4: Attitude toward Using Email (A/Email) is a positive function of Perceived Ease of Use (EOU).
> H_5: Attitude toward Using Email (A/Email) is a positive function of Attitude-based Preference.
> H_6: Behavioral Intention to Use Email (BI) is a positive function of Perceived Usefulness of Email (U).
> H_7: Behavioral Intention to Use Email (BI) is a positive function of Attitude toward Using Email (A/Email).
> H_8: Behavioral Intention to Use Email (BI) is a positive function of Attitude-based Preference.

Methodology and Data Analysis

Survey method is used for this study. Student subjects are employed. The student subjects intensively clusters among the group of graduate and senior students. With the student characteristic taken into consideration, the study attempts to enhance the generalizability by carefully selecting types of classes. The variety of classes is selected including management, accounting, finance, and computer related classes. Such a selection allows us to have a various levels of computer literacy among subjects. Data was gathered by handling the survey to instructors. A sample of 109 students was collected. Only 100 respondents completed the questionnaires and their data were used to conduct the analysis.

The sample group contains 48 males and 52 females. Descriptive statistics show that respondents generally find that communication cost of using email is much less expensive than that of telephone, due to high value of means for X_1, X_2, and X_3. They are 6.11. 6.02, and 5.98 with standard deviations of 1.45, 1.50, and 1.56 for X_1, X_2, and X_3 respectively.

Maximum likelihood estimation (Joreskog and Sorbom 1984) was used in the measurement and structural models. This analysis provides a simultaneous test of model relationship as well as estimates of measurement error in the constructs. LISREL 8.3 was used to conduct such an analysis.

Due to a limited number of sample size, some of items measuring U, EOU, A, BI are dropped according to modification matrices for Theta-Delta and according to a guideline provided by Oliver and Swan (1989). Using a correlation matrix as the input, a test of the measurement model generated a strong measure of fitness between the data and the proposed measurement model (Chi-square=211.64, d.f. = 75). Additionally, Normed Fit Index (NFI) demonstrates relatively high values of 0.87. The t-value of each items is greater than 2.0 as well. The modification matrices for Theta-Delta were all relatively low. These evidences indicated that there is little room to improve the proposed measurement model. The results also show that the model possesses a relatively low root mean square residuals (RMR = 0.044) comparing to the suggested cut off of 0.5 by Bentler (1985). Table 1 shows estimates for exogenous and endogenous measurement model.

Table 2 shows result for structural model. H_1, H_3, H_4, H_6, H_7, and H_8 are supported while H_2, H_5, and H_6 are not supported. However, this study focuses on the relationships within the comparative level and the relationships from across absolute and comparative levels. It is because those hypotheses represent the extension of TAM to TPT. Such hypotheses include H_1, H_5, and H_8. From these three hypotheses, two of them are supported. Those include the relationship from Communication Cost to Attitude-based Preference (H_1) and relationship from Attitude-based Preference to Intention to Use Email (H_8). The relationship from attitude-based preference to A/Using email (H_5) is not supported in this study.

Discussion

This study has validated a new intention theory, TPT. In addition, the result indicates that users adopt email not only because they find email useful and easy to use, but also because they find the cost of using email is less expensive than that of telephone. This approach could be employed to investigate how likely a new system could compete with the one currently in use. It is worth noting that relationship from Attitude-based Preference to Attitude toward using email is not supported, while the relationship from Attitude-based Preference to Behavioral Intention is supported. The logical explanation is users might have used telephone for a long period of time and already considered telephone a good communication medium. Therefore, after they compare communication cost between email and telephone and found that email is much less expensive, they could automatically have a propensity to use email technology.
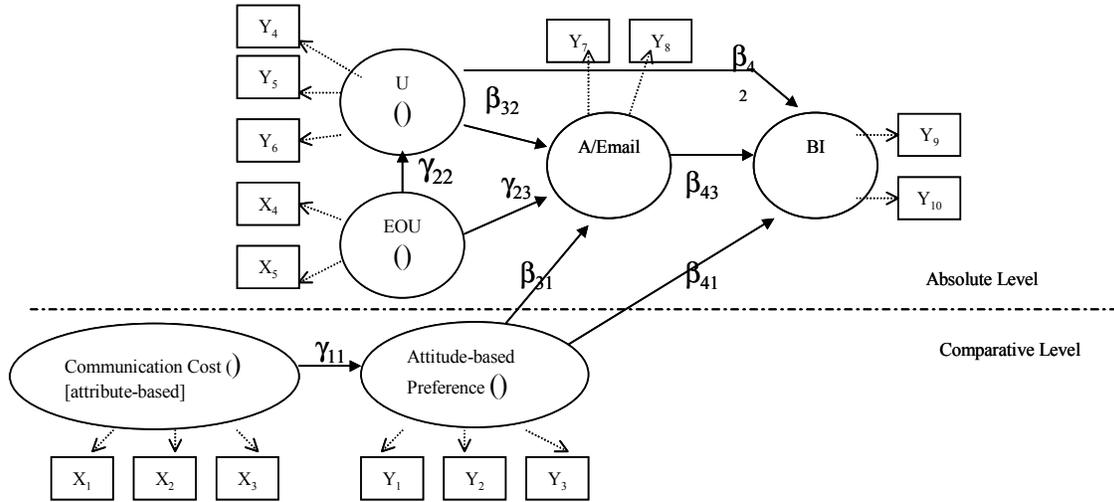
Figure 6. Relationship Among Antecedents

Table 1. Estimate for the Exogenous and Endogenous Measurement Model

		Standardized Loading	t-value
Exogenous Variables			
Communication Cost	(X_1)	0.96	12.84
	(X_2)	0.99	13.84
	(X_3)	0.84	10.39
Perceive Ease of Use	(X_4)	0.79	11.96
	(X_5)	0.93	10.36
Endogenous Variables			
Attitude-based Preference	(Y_1)	0.86	10.84
	(Y_2)	0.98	13.44
	(Y_3)	0.99	13.74
Perceived Usefulness	(Y_4)	0.96	12.95
	(Y_5)	0.97	13.13
	(Y_6)	0.94	12.45
Attitude/ Using Email	(Y_7)	0.95	11.96
	(Y_8)	0.86	10.36
Behavioral Intention	(Y_9)	0.90	10.99
	(Y_{10})	0.89	10.76

Table 2. Parameter Estimates for Proposed Model

		Standardized Loading	t-value
Relationship from Exogenous to Endogenous Variables			
H$_1$:	γ_{11}	0.31	3.10
H$_2$:	γ_{22}	*0.22*	*1.95*
H$_4$:	γ_{23}	0.67	5.25
Relationship among Endogenous Variables			
H$_3$:	β_{32}	0.32	3.63
H$_5$:	β_{31}	*0.02*	*0.22*
H$_6$:	β_{42}	*0.16*	*1.66*
H$_7$:	β_{43}	0.73	5.02
H$_8$:	β_{41}	0.32	3.59

Nonetheless, this research argues that the insignificant relationship from attitude-based preference to A could be found when alternative technologies are not mutually exclusive. In this case, a user could use email without sacrificing telephone, rendering an insignificant relationship from attitude-based preference to A. This research speculates that relationship from attitude-based preference to attitude toward using a new technology (A) could be significant when users have to select only one system; for instance installing either Window 98 or Window 2000 on their personal computer.

Conclusion

A new intention theory, namely Theory of Preferred Technology (TPT), is developed and validated. From the result of this study, TPT could be used to explain alternative behaviors which has long been a limitation of past intention theories. This study employs TAM as an example to show how to incorporate preferential choice knowledge to intention theories. The similar approach of improving TAM could be applied to TRA and TPB as well.

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