Rethink of Task-Technology Fit Theory: The Moderation Effect of Individual Characteristics on Technology Evaluation

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ABSTRACT

Task-Technology Fit (TTF) model has been examined widely on performance impact. However, utilization still cannot be explained accurately by existing literature. In this paper, we examine why TTF sometimes fails to predict utilization accurately through a comprehensive study. In other words, this study tries to provide a rational explanation about why individuals sometimes would not choose the technology with better fit for the tasks. A research model was developed drawing on the existing IS literature. To evaluate the research model empirically, a lab experiment was conducted, and the resulting data has been used to test both measurement and structural model. The paper concludes with theoretical and practical implications.

INTRODUCTION

Task-Technology Fit (TTF) model, after its introduction by Goodhue [12] and Goodhue and Thompson [15], has received much attention and been often used to predict individuals' task performance [10] [45]. However, utilization (or use), one of the important dependent variables (DV) of TTF model, cannot be fully supported yet [15]. In their paper, Goodhue and Thompson [15, p. 228] argued that one possible reason was that "TTF may not dominate the decision to utilize technology". They admitted that other factors, such as habit [30] and social norms, may also influence individuals' decision to utilize a technology. Later, several studies were conducted in order to understand how different individual characteristics, such as technology experience [14], with TTF, may better explain utilization[1]. However, these studies were done following a piecemeal approach and failed to acquire a bigger picture of utilization in TTF research stream. Thus, a comprehensive study on utilization is needed.

Technology Acceptance Model (TAM) study, one of dominated IS research streams, has established comprehensive models (e.g., UTAUT) to explain the importance of intention to use in people's ultimate decision of utilizing a new technology [7] [41] [42]. While TAM research has become mature, senior IS scholars made recommendations in terms of how IS community should further study information technology (IT) acceptance. For example, Schwarz and Chin [32] argued that our understanding of IT acceptance should be broadened, given that there are multiple meanings of acceptance. Consisting with their third acceptance dimension, we chose to focus the acceptance on the term "to access the worth". To be more specific, our focus is on "the overall valuation based on some form of assessment process" [32].

[1] Here we refer utilization to a broader definition, which include intention to use, actual use and user evaluation. We use this term in order to be consistent with this of Goodhue and Thompson [15]. In Goodhue et al. [14]'s study, they used the user evaluation.

In addition, given that IT is becoming more and more advanced, and many IT technologies have similar functions and can complete same tasks, individuals often confront the situation that they need to choose a better technology to complete their tasks. Thus, when an individual needs to work on a task, s/he faces a critical choice challenge. The individual's characteristics can play an important role in technology choice decision process. In the TTF context, different users may have different evaluations on the same technology because of their different individual characteristics (e.g., need of cognitive and computer self-efficacy). In other words, the users' individual characteristics could moderate the relationship between TTF and users' technology evaluation.

In this study, we try to examine how different individual characteristics influence their evaluation toward the level of technology fit. We use two criteria to select the individual characteristics: first, individual characteristics should relate to IT usage (e.g., technology experience); secondly, individual characteristics have been tested in the previous task performance literature (e.g., task experience). After careful evaluation and comparison, we select the following individual characteristics for our study: task experience, technology experience, need of cognitive, cognitive style and computer self-efficacy.

The major contribution of this study is that we try to offer a comprehensive picture to depict how individual characteristics (i.e., task experience, technology experience, need of cognitive, cognitive style and computer self-efficacy) influence their evaluation on technology in the context of TTF. In other words, TTF does not necessarily lead to better evaluation, and we try to understand why individuals sometimes choose a technology with low task-technology fit. Given that previous research on TTF mainly follows a piecemeal approach, a comprehensive study is needed and desired. From statistical perspective, examining all variables simultaneously in one model is always superior to a piecemeal approach statistically, because a comprehensive model is able to statistically control for and partial out the influence from other factors [18]. In the following sections, we first review previous literature, upon which the research model is built. Then, the method of study is presented. Finally, the implication and conclusion are discussed.

LITERATURE REVIEW

Fit is a wide-applied concept, which has been used in various disciplines, such as Management [31] [35] [43] and Information Systems (IS) [19] [33] [38]. One of the most popular fit theories in IS literature is Task-Technology Fit theory (TTF) [12] [15] [45]. TTF theory states that the characteristics of technology need to fit (match) with those of task, to receive higher user evaluation and enhance the performance.

Since then, IS researchers examine and apply TTF from different perspectives. The first stream of TTF research tries to clarify what the "right" characteristics of technology for specific tasks are [22] [23] [36] [45]. For example, Ferratt and Vlahos [10] identified the factors that are important for computer-based information systems (CBIS) to support managerial decision making. The second stream of TTF research works on combining TTF with other theories, which resulted in integrated models with more power [9] [24]. For example, Mathieson and Keil [24] confirmed that perceived easy ease of use (PEOU) is a function of TTF. The third stream of TTF research examines the outcome of TTF [6] [8]. For example, Dennis, Wixom and Vandenberg [8] tried to understand the inconsistent result of GSS with TTF.

While these streams of research enhance our understanding of TTF in IS discipline, the underlying reason that TTF cannot fully predict user evaluation is still not clear. Moreover, the piecemeal approach followed by previous research fails to offer a comprehensive picture to depict user evaluation. Therefore, this study tries to overcome the aforementioned limitations of previous TTF research.

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

In this section, we develop our research model and hypotheses based on the existing IS literature. From the literature review, we can see that individual characteristics have an interactive effect with TTF on technology evaluation. In other words, when holding TTF constant, different individual characteristics can lead to different level of technology evaluation. In this study, we examine five individual characteristics: technology experience, computer self-efficacy, task experience, need for cognition, and cognitive style.

Technology experience is an important factor to influence utilization [42] or performance [5]. For example, in the context of a prototyping project, individuals' experience is important on the process of the prototyping [5]. In another study, Goodhue, Klein and March [14] proved that individuals are able to evaluate TTF more correctly when they have had experience with that technology for a task. In other words, when individuals have related technology experience, TTF can predict their corresponding evaluations. On the contrary, if individuals do not have such related technology experience, they may not evaluate the TTF correctly and may choose the wrong technology with low technology fit on the task. Thus, we hypothesize that:

H1: Technology experience has an interactive effect with TTF to influence individuals' technology evaluation.

In the context of usage choice, Nance and Straub [28] used qualitative data to show that when individuals have *insufficient* IT knowledge and training, they would not use IT even if IT is a good fit for the task. In IS discipline, Compeau and Higgins [4, p.192] propose the concept of CSE and use it to refer to "a judgment of one's capability to use a computer". Therefore, CSE reflects one's knowledge about computer and IT-related IT topics, and we argue that when individuals' CSE is high, s/he can have a better knowledge of IT and make a better choice of technology that fit his/her working task. In such a situation, the likelihood that individuals make poor decision and choose the low-fit technology is low. Thus, we hypothesize that:

H2: Computer self-efficacy has an interactive effect with TTF to influence individual's technology evaluation.

Experience with task is another important individual characteristic in this study. Prior research shows that the outcome of decision making is impacted by individuals' experience with a specific type of task [16] [21] [25] [34] [37] [39]. The more familiar individuals are with the task, the more understanding they would have about the feature of technology needed to finish the task. Thus, they are more likely to select the technology with better fit. Therefore, we hypothesize that:

H3. Task experience has an interactive effect with TTF to influence individuals' usage choice.

Need for Cognition (NFC) represents "the amount of cognitive effort that the subjects are willing to exert in working on the problem" [26], and previous NFC research shows that NFC is related to the performance [2] [26]. For example, Cacioppo and Petty [2] argued that NFC is related to performance efficiency, and Mennecke et al. [26] found that NFC is marginally related to the accuracy of problem solving tasks. In another study, Nance and Straub [28] focused on learning effort and studied whether individuals would use IT to finish a task from the marginal training cost perspective. Their views are consistent with NFC studies in that the more amount of cognitive effort the individuals are willing to put in the task, the more learning effort they are willing to take to learn the technology if they have not used that technology before. Therefore, when the individuals' NFC is high, they are more likely to learn the new technology to finish a task if they think the new technology can help them better finish the task, in other words, the new technology fit the task better. On the other hand, individuals may stick to the old technology if their NFC is low, no matter how well the new technology fits the task. Thus, we hypothesize that:

H4: Need for cognition has an interactive effect with TTF to influence individuals' technology evaluation.

The final individual characteristic, cognitive style, is another important factor to performance [3]. As suggested by adaption-innovation theory [20], the preferred cognitive style of individuals ranges between highly adaptive to highly innovative. Individuals with different levels of preferred cognitive styles probably behave differently when they face new technology adaption. To be more specific, the highly adaptive individuals are reluctant to change their routines until they are certain that new means can offer them some benefits; on the other hand, highly innovative individuals are more likely to switch to new technologies when they are available to them [40]. Thus, in the context of TTF, individuals with high adaptive cognitive style probably keep using the old technology until they are sure that new one has a better fit with their tasks; individuals with high innovative cognitive style probably switch to the new technology no matter how fit it is with their task. According to Kirton [20], there are three subdimensions of cognitive style: originality, efficiency and group conforming. The third subdimension is not applied here since our study deals with TTF at individual level. Thus, we hypothesize that:

H5: Preferred cognitive style (originality and efficiency) will have an interactive effect with TTF to influence individuals' technology evaluation.

METHODOLOGY

The experimental methodology was used to test the proposed hypotheses. As we know, two considerations are important for experimental research methodology: 1) the availability of student subjects, and 2) the ability to manipulate different level of TTF. Keeping these two considerations in mind, we carefully designed the experiment. The participants are students from a college-wide entry level business class at a large North-West University in the United States. 176 students participated in the study. About 1% of their final score was awarded for this research study participation. 22 incomplete surveys were dropped, which resulted in 154 usable records. The average age of subjects was 20.02, with the range from 18 to 38 years old. The percentage of female subject was 29.22%.

The task of the research study for participants was to draw an organizational structure diagram for a large company with multiple departments (e.g., Marketing, Customer Service, Finance, and HR). The Microsoft (MS) PowerPoint (PPT) and MS Visio applications were used in the study. Both of these two applications can support the drawing task, but in different levels Thus, TTF can be manipulated by presenting two technologies with one drawing task: MS PPT is considered a relatively low fit with the task (TTF is low) since drawing feature of MS PPT is not that powerful; MS Visio is considered a relatively high fit (TTF is high) since MS Visio supports complex diagram drawing. The survey results regarding participants' knowledge about these two applications' drawing feature indicated that although many students had experience with the MS PPT, not many of them were familiar with its drawing feature. The first author created video tutorials of MS PPT and Visio in order to give participants a baseline idea towards these two applications.

The measurement scales were modified from prior research studies. Each item was measured using a 7-point Likert-type scale (i.e., 1=strongly disagree, 7=strongly agree). Specially, the scales for task and technology experience were from Goodhue et al. [14]. The scales for need for cognitive were from Cacioppo and Petty [2]. The scales for cognitive style were from Kirton [20]. We also measure the computer self-efficacy by modifying scales from Compeau and Higgins [4]. Finally, user evaluation of technology scales were from Dishaw and Strong [9].

The participants were randomly divided into two groups: the first group viewed MS Visio tutorial video, and the second group viewed the MS PPT tutorial video. After participants arrived at the laboratory, the first author briefly introduced the purpose of the study. Then participants were asked to complete a short survey regarding their individual characteristics (i.e., task experience, technology experience, need for cognition, cognition style, and computer self-efficacy). After they finished the survey, participants viewed the video tutorial for one of the applications on their own computer monitor. Finally, the post-survey was conducted to measure their technology evaluation. The descriptive data for two groups are shown in table 1. Based on the information shown in the table 1, participants in these two groups are quite similar.

	Group 1 (Visio)	Group 2 (PPT)
Number of Participants	80	74
Age	19.95 (18-38)	20.09 (18-27)
% of Female	26.25%	32.43%

TABLE 1 PARTICIPANTS DESCRIPTIVE INFORMATION

RESULTS

Mplus [27] was used to conduct the data analysis. We chose Mplus because it supports the interaction analysis between continuous and categorical variables. The procedure is quite simple when the categorical variable has only two values. Consistent with previous research [11], we analyzed our model in two stages: (1) assessment of the measurement model, which involved "the assessment of the reliability and the validity of the measurement model," (2) assessment of structure model [17, p.198].

The global fit was first assessed, and then the following fit indices were used: chi-square statistic ($\chi 2$), Comparative Fit Index (*CFI*), Root Mean Error of Approximation (*RMSEA*) and the Standardized Root Mean Squared Residual (*SRMR*). The chi-square test is significant when p value is less than 0.05. However, a significant chi-square alone cannot determine the model fit. A *CFI* value equals to or greater than .90 indicates a reasonable global fit [29]. The *RMSEA* less than .08 indicates the reasonable fit [29] as well. And the *SRMR* less than .05 indicates an acceptable fit [1].

After the data analysis with Mplus, the results showed that chi-square test is significant and the global fit of model is acceptable, given that (χ^2 (227) =336.032, p <0.001, *CFI* = 0.933, *RMSEA* is 0.063, *SRMR* is 0.050).

Assessment of the Measurement Model

Convergent validity was assessed with the following criterion [11]: First, the composite reliabilities of all constructs were over .70, to show these items are with high reliability (see Table 2); secondly, each item loaded significantly on their corresponding constructs, all of the loadings below met the cutoff value of .50. As shown in Table 2, we can see both reliabilities and loadings are above 0.700. Therefore, the good convergent validity is supported.

Item	Construct	Reliability	Loading	Item	Construct	Reliability	Loading
CSE1	CSE	.916	0.702	NOC1	NOC	.790	0.719
CSE2			0.828	NOC2			0.777
CSE3			0.897	NOC3			0.739
CSE4			0.769	AIO1	AIO	.785	0.745
CSE5			0.846	AIO2			0.758
CSE6			0.804	AIO3			0.722
TE1	TE	.926	0.874	AIE1	AIE	.848	0.837
TE2			0.837	AIE2			0.730
TE3			0.841	AIE3			0.743
TE4			0.882	AIE4			0.763
TE5			0.799				

TABLE 2 RELIABILITY AND LOADINGS OF ITEMS

Discriminant validity was established by examining the cross-loadings between a certain latent construct and items from other constructs, and requires that the items loaded much higher on their own construct than on any other constructs. We use M.I. (Modification Indices) together with StdYX E.P.C. (Completely Standardized Expect Parameter Change) to examine cross loadings. In Mplus, M.I. is the amount of chi-square value which would drop if the parameter is estimated as part of the model. 3.84 is the chi-square value which is significant at the .05 level for one degree of freedom. When the M.I. is significant, we also want to examine the size of completely standardized expected parameter change. Usually, values more than 0.300 are considered large and should be included in the model. Value less than 0.200 indicates a trivial change of parameter, and we may not include it into the model, even if M.I. is significant. Here we want StdYX E.P.C. much below 0.700 so that items' cross loadings are lower than their loadings. Based on the results of Mplus, only three M.I.s are significant, and their expected standardized parameters are much less than 0.700 (NOC by AIO1 with 0.427; NOC by AIO3 with 0.366; AIE By NOC29 with 0.414). Therefore, the results support acceptable discriminant validity.

Assessment of Structural Model

First, the path coefficient from TTF to technology evaluation was examined. The result showed the path coefficient is not significant (0.101, $p > 0.10$), which is inconsistent with previous TTF research. Next, a two group model was run to examine whether individual characteristics influence technology evaluation significantly and whether these individual characteristics have interactive effects with TTF to influence technology evaluation. At the first step, separate path coefficient was calculated to examine whether each variable influences technology evaluation significantly for each group, and chi-square value was recorded as the baseline value. Then, corresponding unstandardized path coefficients were constrained to be equal, and Chi-Square Difference test was conducted. If the result is significant, then the unstandardized path coefficient for a certain individual characteristic is different on different level of TTF. In other words, TTF will have an interactive effect with a certain individual characteristic on technology evaluation. The baseline chi-square value is χ^2 (454) =673.681 and the results are shown in table 3.

	Standardized Path Coefficient		Chi-Square Test when forcing path coefficient equal	Chi-Square Diff Test	Hypotheses Supported?
	Group 1 (VISIO)	Group 2 (PPT)			
H1: Technology Experience	0.153	0.149	χ^2 (455) = 673.736	p>0.10	No
H2: CSE	0.371***	0.311* *	χ^2 (455) = 673.708	p>0.10	Partially Supported
H3: Task Experience	-0.243**	-0.037	χ^2 (455) = 675.208	p>0.10	Partially Supported
H4: Need for Cognition	-0.106	0.151	χ^2 (455) = 674.152	p>0.10	No
H5: Cognitive Style (Originality)	0.302	-0.257	χ^2 (455) = 677.003	p<0.10*	Partially Supported
H5: Cognitive Style (Efficiency)	0.285*	0.258	χ^2 (455) = 673.681	p>0.10	Partially Supported
* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$					

TABLE 3 RESUTS OF HYPOTHESES TESTING

As shown in the second and third columns, CSE, task experience and Cognitive Style (Efficiency) significantly influenced participants' technology evaluation in one or two groups. Next, the unstandardized path coefficient for each variable was constrained to be equal across groups, and Chi-Square Difference test was conducted. The test for Cognitive Style (Originality) was marginally significant, which indicates that the path coefficients for Cognitive Style (Originality) across two groups are different.

Therefore, H2, 3, and 5 are partially supported. To be specific, CSE, task experience and Cognitive Style (Efficiency) significantly influence technology evaluation in one or two groups. However, TTF has no interaction effect with these variables to influence technology evaluation. One reason could be that TTF has no main effect on technology evaluation. In fact, the path coefficients for Cognitive Style (Originality) with different level of TTF do differ from each other. The interaction effects of TTF with CSE, task experience and Cognitive Style (Efficiency) are expected to be significant if the main effect of TTF is significant.

DISCUSSION

The purpose of this study is to advance the understanding of how individuals' characteristics (i.e., task experience, technology experience, need of cognitive, cognitive style and computer self-efficacy), together with TTF, can predict individuals' overall evaluation of technology. Based on the results of a lab experiment, we find that CSE, task experience and cognitive style influence individuals' evaluation on technology. This study sheds lights on the rare studied utilization aspect of the TTF model, and contributes to our understanding of the moderating effect of individuals' characteristics on their evaluation of a technology based on the fit of the task and technology characteristics.

The main contribution of this study is that we find that individual characteristics play an important role in influencing individuals' evaluation on technology, which is consistent with Goodhue and Thompson [15, p. 228]'s argument that "TTF may not dominate the decision to utilize technology". Based on existing literature, we conduct a comprehensive study and offer a bigger picture to show how different individual characteristics influence individuals' evaluation on technology. The results have both theoretical and practical implication.

From theoretical perspective, when TTF model is applied and tested, researchers may want to consider the potential impact from individual characteristics. For example, individuals with different CSE may perceive and evaluate the same technology differently for a certain task, which may lead them to behave differently. Researchers may want to control for these relevant, especially when they want to manipulate the effect of different technologies on TTF. This study also has important practical implications. The practitioners not only need to consider the characteristics of technology and task to see whether they are fit with each other, but also need to consider the characteristics of users in order to achieve a higher evaluation and the selection of technology. In this study, we find that CSE, task experience and cognitive style influence individuals' evaluation on technology. If individuals who have low CSE perceive a technology to be a low fit with their tasks, it is highly likely they will not use that technology, and organizations who invested in that technology may fail to receive the intended benefit from it. Therefore, practitioners may want to take these individual characteristics into consideration when they introduce a new technology [28]. Failing to consider these characteristics may result in the situation that individuals still doing tasks with the old tool or manually, without realizing the benefit and fit from new technology.

CONCLUSION

Previous TTF literature mainly focuses on the performance effect, and relatively little is known about how individuals adopt technologies with different level of TTF. This study contributes to TTF literature by comprehensively examining how different individual characteristics (task experience, technology experience, need of cognitive, cognitive style and computer self-efficacy) influence their evaluation on technologies with different levels of TTF. While the main effect of TTF is not significant, it may in fact indicate that perceived TTF is theoretically different from objective TTF, and some individual characteristics do significantly influence participants' technology evaluation. We hope our study can shed light on how to better predict individuals' technology evaluation in the future TTF study.

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