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Under-Subjective Knowledge, Compatibility, and the Impact on Adoption and Implementation of Technology

Donghyun Kim
The University of Mississippi

Anthony Ammeter
The University of Mississippi

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ABSTRACT

The purpose of the current study is to explore the impact of compatibility on the relationship between *under-subjective knowledge,* a concept we develop here in the context of technology adopt and implementation research, and technology adoption and implementation. To do so, we develop two versions of mobile systems for a controlled experiment: 1) high compatible system and 2) low compatible system. The experiments are designed to test two hypotheses. Based on our hypotheses, we predict that compatibility may trigger a transformation from under-subjective knowledge to a condition of objective knowledge (and possibly, and less ideally, to a condition of over-subjective knowledge). Thus, the current study predicts that compatibility raise self-esteem or confidence and mitigates the negative effect of under-subjective knowledge on intention to adopt technology.

Keywords

Technology adoption and Implementation, Knowledge, Compatibility, Experiment

INTRODUCTION

Why do people resist using new technology? One of the answers of the questions is complexity. The more features and functions has technology, the more complex it is and the more knowledge people need to use it. Previous research, such as the technology acceptance model (TAM), suggests that ease of use is a critical factor influencing technology acceptance (Davis, 1989). Technologies in organizations as well as in daily personal life, such as a smart phone, are equipped with multiple powerful features and tasks with a variety of functions that are complex to perform. Efficiency and ease of use may be sacrificed for performance. The corollary to this is that to accomplish high performance with the cutting-edge technology, people require more knowledge to understand it. This study focuses on a specific type of knowledge condition, that of having under-subjective knowledge, and investigates the research question "What is the impact of under-subjective knowledge on technology adoption and what is the impact of compatibility on this relationship?"

Consumer knowledge has been considered to be one of the more critical factors influencing the new technology adoption process (Gatignon and Robertson, 1985; Mahajan, Muller and Bass, 1995; Moreau, Markman and Lehmann, 2001; Sheth, 1981). People with more knowledge about technology are more likely to adopt technology. However, are individuals accurate about their perceptions regarding the knowledge they have about a particular technology? Consumer prior product knowledge is defined as "the amount of accurate information held in memory about product alternatives as well as buyers' self-perceptions of this prior knowledge" (Rao and Monroe, 1988, p.255) This definition includes two dimensions of consumer knowledge; 1) objective knowledge and 2) subjective knowledge. While objective knowledge refers to what consumers actually know (as measured by an authoritative third party), subjective knowledge refers to what consumers perceive they know. Many previous studies assert that there are independent effects of these two knowledge types on consumer behavior (Brucks, 1985; Metcalfe, 1986; Park and Lessig, 1981; Punj and Staelin, 1983; Raju, Lonial and Mangold, 1995; Schater, 1983). Empirically, the distinct roles of these two knowledge types have been tested and demonstrated in information search and decision-making processes in the psychology and marketing disciplines (Bearden, Hardesty and Rose, 2001; Brucks, 1985; Moorman, Diehl, Brinberg and Kidwell, 2004; Radecki and Jaccard, 1995; Raju et al., 1995; Schacter, 1983). While subjective knowledge leads consumers to a small amount of attribute evaluation, objective knowledge enables consumers to evaluate large amount of attributes with low search cost and high efficiency (Brucks, 1985). In addition, objective knowledge facilitates deliberation and use of newly acquired information, while subjective knowledge increase the reliance on internal information (Rudell, 1979).

Despite this research, studies have overlooked another aspect of subjective knowledge: *under-subjective knowledge*, referring to the extent to which consumers feel they have little or no knowledge even though they actually do. Previous studies have considered *over-subjective knowledge,* referring to the extent to which consumers feel they have knowledge they actually don't, as subjective knowledge with limited perspective. In this paper, we develop the

concept of under-subjective knowledge and apply it to explain its impact on technology adoption and implementation. People with under-subjective knowledge may be likely to adopt new technology because they think they cannot use it, resulting in ineffective implementation because of the fear of technology derived from a lack of confidence. We also investigate how to reduce the negative effect of this under-subjective knowledge. As a possible remedy, we examine if compatibility can mitigate the negative effect of under-subjective knowledge on technology adoption. Compatibility refers to "the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters" (Moore and Benbasat, 1991, p. 195). This study proposes a controlled experiment that measures the impact of compatibility on the relationship between under-subjective knowledge and technology adoption and implementation. We propose that this experiment would help explain adoption of new technologies in terms of cognitive aspects and consumer knowledge aspects. This paper is organized as follows: first, we present relevant findings on over- and under-subjective knowledge. Second, we integrate this with diffusion theory and develop hypotheses. Third, we describe two experiments that may be used to test these hypotheses. Finally, implications are discussed.

OVER-SUBJECTIVE KNOWLEDGE AND UNDER-SUBJECTIVE KNOWLEDGE

Subjective knowledge is able to be divided into two different types: over-subjective knowledge and under-subjective knowledge. In most previous studies, over-subjective knowledge has been considered as subjective knowledge, and focusing on the limited effect of over-subjective knowledge on technology adoption behavior. We seek to study the negative effect of under-subjective knowledge (Brucks, 1985; Metcalfe, 1986; Park and Lessig, 1981; Punj and Staelin, 1983; Raju et al., 1995; Schater, 1983). Under-subjective knowledge is a state where a consumer does not accurately perceive how much s/he actually knows and under-evaluates his/her knowledge. While consumers with over-subjective knowledge know less than they feel they know, consumers with under-subjective knowledge know more than they feel they know (this is diagrammed in Figure 1).

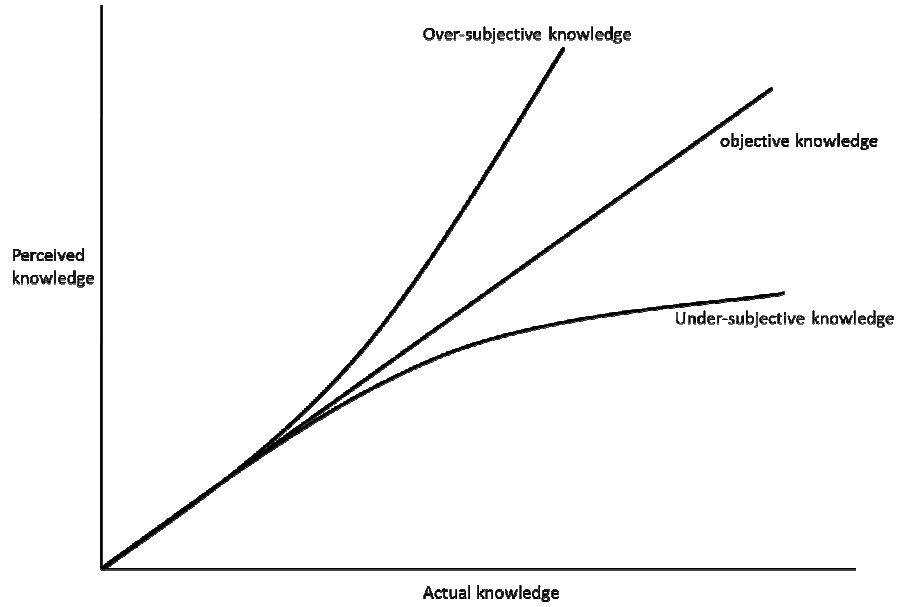


Figure 1. Relationship among objective knowledge, over-subjective knowledge, and under-subjective knowledge in terms of how much one feels they know and actually knows

The difference among objective knowledge, over-subjective knowledge and under-subjective knowledge can be explained by familiarity and knowledge. In the study of consumer knowledge, Alba and Hutchinson (1987) find two dimensions for consumer knowledge: 1) consumer expertise is defined as "the ability to perform product-related tasks successfully," (p. 411) and 2) familiarity refers to "the number of product-related experiences that have been accumulated by the consumer" (p. 411). The core of argument is that as familiarity increases, the ability to differentiate alternatives and to analyze information increases and cognitive effort decreases. Knowledgeable consumers have distinct purchasing behaviors. First, knowledgeable consumers tend to use more internal information than non-knowledgeable consumers during the purchasing decision making process. Park and Lessig

(1981) found that the impact of familiarity on the consumer decision biases and heuristics. In their study, consumers who had a high level of familiarity felt confident and exhibited more decision-making biases and heuristics than consumers who had low and moderate levels of familiarity.

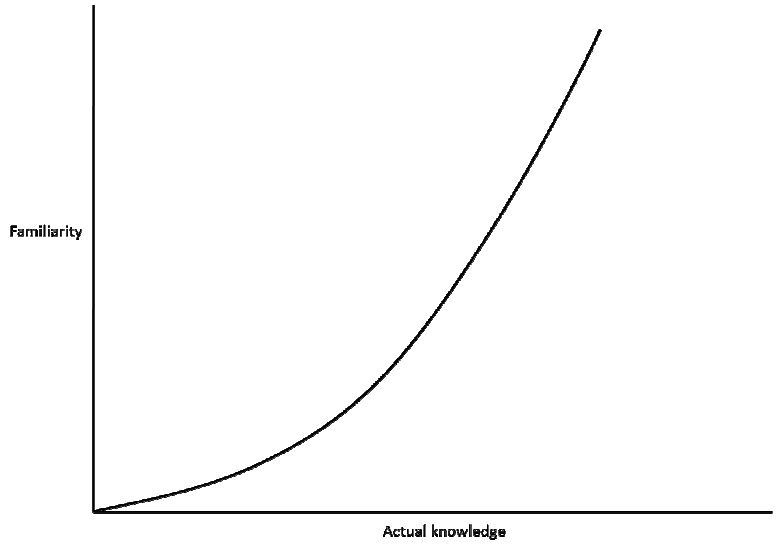


Figure 2. Relationship between familiarity and actual knowledge in terms of how much one is familiar with a product and actually knows about it

If we can assume that objective knowledge increases as familiarity increases, we propose that over-subjective knowledge also increases as familiarity increases. This is diagrammed in Figure 2. But a high level of familiarity does not necessarily mean a high level of actual knowledge. While consumers get familiar with a category of products, their perceived incremental knowledge about that product might not be increasing, as they might be using only a relatively few features of the product (familiarity increases but actual knowledge does not increase). Instead of the increment of actual knowledge, perceived knowledge increases, as consumers are getting familiar with a category of products (Figure 3). Putting this together with the processes of information search and decision making for conditions of objective knowledge, over-subjective knowledge, and under-subjective knowledge, we develop the following hypotheses to illustrate how these differences may be salient in the process of adopting new technologies.

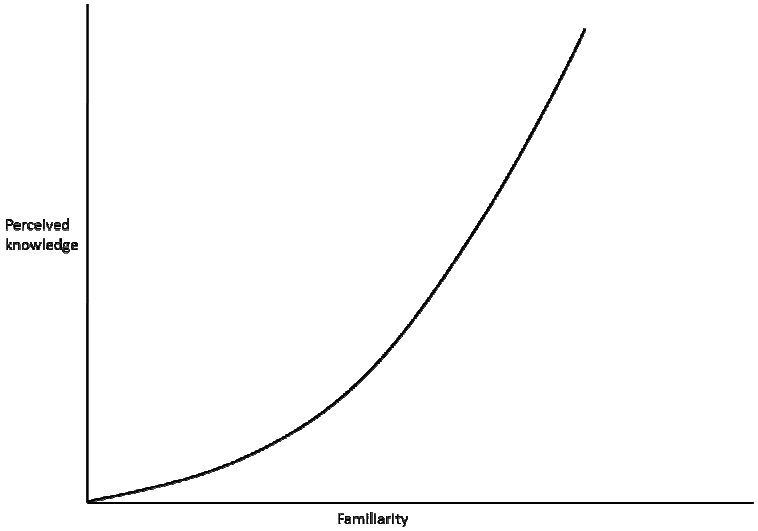


Figure 3. Relationship between perceived knowledge and familiarity in terms of how much one feels they know and is familiar

HYPOTHESES

The following hypotheses are developed to help assess the negative impact of under-subjective knowledge on technology adoption and implementation and the mitigating impact of compatibility on the negative relationships between under-subjective knowledge and technology adoption and implementation.

The Negative Impact of Under-Subjective Knowledge on Technology Adoption and Implementation

Confidence about using a product affects perceived knowledge of the product (Radecki and Jaccard, 1995). Thus, high levels of over-subjective knowledge from high consumer self-confidence has been associated with the active adoption of new technologies. On the other hand, consumers high in under-subjective knowledge are less likely to adopt new technologies due to their low level of confidence and self-esteem derived from their assumed low level of knowledge about the product. In addition, Brucks (1985) argues that objective knowledge facilitates information search with the number of attribute, variability of search, and reduces the degree of inappropriate search in the complex situation. Therefore, objective knowledge should be positively related to high task performance when using the new product. Objectively, consumers who are familiar with a product have actual knowledge (intrinsic information) that could be used to evaluate an innovation in that product family. However, consumers with high levels of over-subjective knowledge of a product will perceive a high level of familiarity and have a high level of confidence which is higher than their actual knowledge would produce. Their adoption decision will be based on familiarity with a product category and is dependent on intrinsic information (Park and Lessig, 1981; Rao and Monroe, 1988; Raju et al, 1995). Implementation by these individuals of new products in this product family may not be as successful as these over-subjective consumers had led themselves to believe should be the case (due to the lack of actual knowledge). Thus, their performance is lower than expected because their actual knowledge is lower that they had thought. At the other end of the adoption – subjective knowledge spectrum, consumers with high levels of under-subjective knowledge are afraid to adopt the new technologies because of their low perceived levels of familiarity and perceived knowledge about the product.

Further support for this is evidenced in the findings of innovation diffusion research that the adoption speed and success of an innovation depends on the adopter's characteristics as well as the characteristics of innovation (Gatignon and Robertson, 1985; Moore and Benbasat, 1991; Premkumar, Ramamurthy and Nilakanta, 1994; Roger, 2003; Tornatzky and Klein, 1982). Innovation diffusion is defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p. 5). Among innovation characteristics, complexity has negative effect on adoption. Under-subjective knowledge consumers' adoption decisions would be expected to be more intensively negative affected by of high complexity innovations because of their lack of confidence. However, perceptions of task performance using the innovation would likely be higher than expected due to the lower expectations these consumers had prior to adoption and due the objective knowledge that they were able to draw upon (but did not know they had). This leads to the following hypotheses:

Hypothesis 1:

H1a: Over-subjective knowledge is (i) positively related to intention to adopt technology and (ii) negatively related to perceived performance of the adopted technology.

H1b: Under-subjective knowledge is (i) negatively related to intention to adopt technology and (ii) positively related to perceived performance of the adopted technology.

The Effect of Compatibility on the Relationship between Under-subjective Knowledge and Technology Adoption and Implementation

Compatibility of prior user experiences with an innovation has a positive relationship with the speed and success of its adoption (Bransheau and Wetherbe, 1990; Drury and Farhoomand, 1999; Gatignon and Robertson, 1985; Moore and Benbasat, 1991; Premkumar et al, 1994; Roger, 2003; Rajagopal, 2002; Tornatzky and Klein, 1982). In addition, compatibility has an attenuating effect on the negative relationship between complexity and the adoption and implementation. In this study, compatibility focuses on how much knowledge for adopting an innovation comes from previous product categories. Even though complexity is high, if compatibility is high, the likelihood of a fast

and successful adoption increases. When compatibility is high, prior actual knowledge is highly transferrable for adopting the innovation (Monroe, 1976; Gregan-Paxton and John, 1997) and, in turn, the negative effect of complexity may be mitigated due to the potentially high level of knowledge for the new product. We expect compatibility to have a differentiating effect on the relationship between over- and under-subjective knowledge and adoption. The effect of compatibility may be low for consumers in the over-subjective knowledge condition because they are already motivated by familiarity. On the other hand, the effect of compatibility may be high for consumers in the under-subjective knowledge condition because these consumers might recognize cues that trigger them to use the latent knowledge about the product family, thus accelerating the speed of adoption and its subsequent task performance.

Hypothesis 2:

H2a: In conditions of under-subjective knowledge, high levels of compatibility will weaken the negative relationship between under-subjective knowledge and intention to adopt.

H2b: In conditions of under-subjective knowledge, high levels of compatibility will strengthen the positive relationship between under-subjective knowledge and perceived performance of the adopted technology.

H2c: In conditions of over-subjective knowledge, we do not expect this effect to obtain

PROPOSED STUDY DESIGN

Experiments Using a Simulated Wireless Handheld Device

The current study focuses on the adoption of wireless handheld devices because confidence / self-esteem will vary across product categories. A "wireless handheld device" is distinguished from a mobile device that doesn't have Internet access and GPS features; in effect, the wireless handheld device is equivalent to a smart phone. We describe below a set of experiments to test our hypotheses developed above.

Experiment 1: The Effect of Over- and Under-Subjective Knowledge on Technology Adoption and Implementation

The first goal of Experiment 1 is to see the distinctive roles of over- and under-subjective knowledge on adoption of new technologies and performance (to test H1). Objective knowledge is also included as a third, intermediate condition of accurate knowledge, that is, neither over-subjective nor under-subjective. This experiment examines the intention to adopt technology and task performance using a simulated smart phone. The tasks used in this study that are related to smart phone performance are adopted by extending Fang et al. (2006). In their study, they looked at the moderating effect of task on the intention to use a handheld device, categorizing the tasks in the perspective of users' objectives: (1) general tasks that do not involve transactions and gaming, (2) transactional tasks, and (3) gaming tasks. The present experiment applies the three categories and extends them for more detailed investigation based on Harris et al. (2005) to four categories: (1) communication tasks, (2) informational tasks, (3) transactional tasks, and (4) entertainment tasks. Table 1. Four categories of tasks details the tasks in each of these categories.

Communication task	Voice, SMS, MMS, video call, and email
Informational task	Entertainment news, sports news, headline news, traffic news, weather forecast, local map, local information and navigation
Transactional task	Mobile payment, mobile banking, and buy ticket
Entertainment task	Games, ring tone, wallpaper/screen paper, and browsing Internet

Harris et al. (2005)

Table 1. Four categories of tasks

Design. A 3-way (objective knowledge, over-subjective knowledge, and under-subjective knowledge) between-subject design testing the influence of knowledge type on the task performance with smart phone and intention to adopt is proposed. Before subjects are assigned into a cell, they fill out a survey to determine their familiarity and usage experience with smart phones. Based on these responses, participants who score high on this text are assigned

to the objective knowledge cell. The remainders of the subjects are randomly assigned into over- and under-subjective knowledge cells. To manipulate the effect of knowledge difference subjects are given an information booklet on the smart phone to be used in the experiment. For objective knowledge, to increase familiarity and actual knowledge, both text and graphical information are presented. For over-subjective knowledge, where the objective is to increase familiarity only, pictures of the smart phone and advertisements are presented without any usage information. For the under-subjective knowledge group, where the objective is to increase actual knowledge, usage information in text-only format is presented in the booklet.

Procedure. Subjects are recruited from a mid-size southern university for extra credit in an Information Systems course. Each subject in different knowledge cells will receive their specific information booklet and have 20 minutes to gain knowledge about the smart phone. After this, subjects fill out a questionnaire measuring their intention to adopt the technology, and then perform usage tasks to measure their performance on the simulated smart phone (the authors developed a software application to simulate smart phone usage). Each of the four tasks have two types of objectives (e.g., the information task includes sending email and finding information via Internet access).

Manipulation Check. Knowledge, familiarity, and confidence of subjects will be tested using a survey prior to the task performance tests.

Experiment 2: The Effect of Compatibility on the Relationship of Over- and Under-Subjective Knowledge on Technology Adoption and Implementation

Design. A 3 x 2 (objective knowledge, over-subjective knowledge and under-subjective knowledge) x (high and low compatibility) between-subject design tests the attenuating influence of compatibility on relationships between under-subjective knowledge and intention to adopt technology and task performance. The method of recruiting and assigning subjects and manipulating knowledge is identical to Experiment 1.

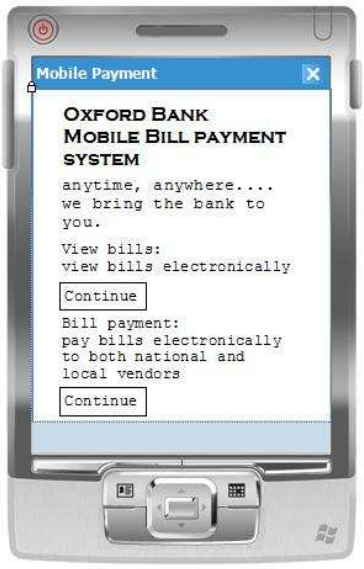
Procedure. To test the impact of compatibility on the relationships under-subjective knowledge and the task performance and intention to adopt technology, two different versions of systems are developed (Figure 3 and 4). In Figure 3, the main menu is manipulated: the first adopts the interface of the existing and popular smart phone (A. High compatibility, in Figure 3) and the second uses the first letter of function as the interface of buttons (e.g., E stands for e-mail), which is not compatible with current user's perception and experience (B. Low compatibility, in Figure 3).

A. High compatibilty B. Low compatibility

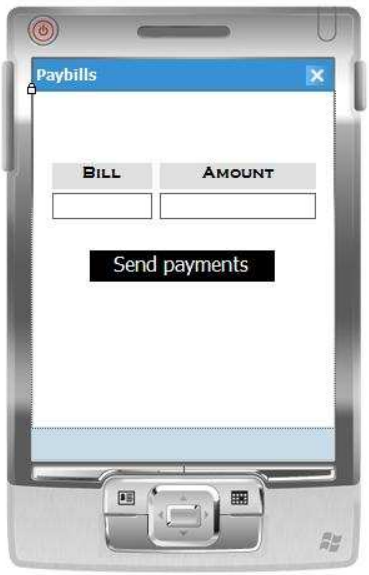
Figure 3. Compatibility Manipulation of Main Screen

In Figure 4, two different versions of mobile payment systems are designed: a high compatible system is more likely to be graphical user interface (GUI) and a low compatible system is more oriented to text-based interface. We believe that GUI is more likely to be compatible the current users.

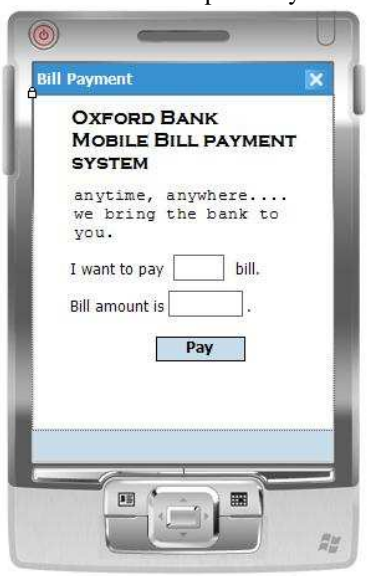
A. High compatibilty



B. Low compatibility



A. High compatibilty



B. Low compatibility

Figure 4. Compatibility Manipulation of Bill Payment Task

Task Performance is measured by the time and the number of clicks to do task. Intention is measured by the same questionnaire used in experiment 1.

DISCUSSION

The goal of this paper is to explore the effect of over- and under-subjective knowledge on the new technology adoption processes, in this case where the new technology is a wireless handheld device. In addition, we would like

to find a solution that would result in increased new technology adoption for those in the under-subjective knowledge condition. We believe that the unique characteristics of under-subjective knowledge may result in different effects on adoption decision making processes and that the study of under-subjective knowledge helps us better understand consumer behavior. Future research in looking at how to increase consumers' subjective knowledge could help increase opportunities for consumers to adopt more new technology products.

Based on our hypotheses, we predict that compatibility may trigger a transformation from under-subjective knowledge to a condition of objective knowledge (and possibly, and less ideally, to a condition of over-subjective knowledge). These three different knowledge types may have different relationships with self-esteem and actual knowledge (Figure 3). People in an under-subjective knowledge condition may have a lower level of confidence and self-esteem (area B in Figure 3), compared to people in an objective knowledge condition and those in an over-subjective knowledge condition (A+ B in figure 3). In other words, consumers (and marketers) may have lost the "B" or "A+B" chance for people in an under-subjective knowledge condition to take advantage of new technology. The current study predicts that compatibility raise self-esteem or confidence and mitigates the negative effect of under-subjective knowledge on intention to adopt technology.

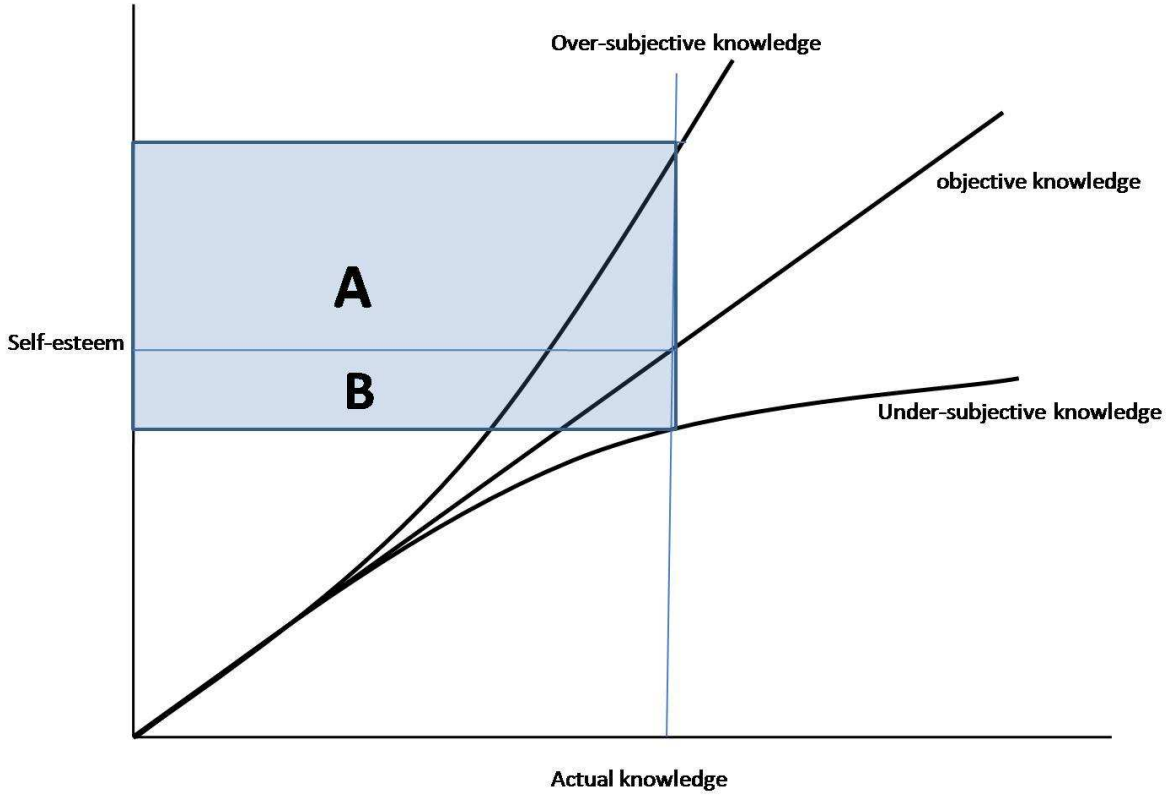


Figure 4. Relationship between Self-esteem and Actual Knowledge

Limitations

Perhaps the most significant limitation of the current study is that we are not able to measure an actual adoption processes. As well, we have a "virtual test of task performance" with the new technology. While this is a limitation, based on previous studies people who have high task performance are also more likely to adopt new technology (Roger, 1983; Gatignon and Robertson, 1985; Tornatzky and Klein, 1982; Moore and Benbasat, 1991; Premkumar et al, 1994), so we have some confidence in a relationship between task performance and adoption, at least for the under-subjective knowledge condition. While longitudinal experimental research is recommended to best observe virtual new technology adoption processes, our laboratory setting does allow us to measure adoption behavior under rigorously controlled conditions.

Another important limitation of the current study stems from selection of a specific category product. This study only focuses on wireless handheld devices and evaluates the effect of under-subjective knowledge on the technology adoption. To understand more fully the effect of under-subjective knowledge, the study of other new technology categories is necessary.

Conclusions and Future Study

To our knowledge, this is the first empirical study to propose under-subjective knowledge and test its effect on technology adoption intentions, thus providing a comparison with objective knowledge and over-subjective knowledge. The results will contribute to the understanding of the effect of knowledge on new technology adoption processes. It is also important to demonstrate how to transform under-subjective knowledge to objective knowledge and realize a positive effect of new technology adoption processes. This may help practitioners set up strategies to increase adoption of new products by consumers who have the knowledge to successfully use such products.

REFERENCES

Alba, J. W. and Hutchinson, J. W. (1987) Dimensions of consumer expertise, *Journal of Consumer Research*, 13 (March), 411-454.

Brancheau, J. C., & Wetherbe, J. C. (1990). The adoption of spreadsheet software: Testing innovation diffusion theory in the context of end-user computing. Information Systems Research , 1, 115-143.

Brucks, M. (1985) The effects of product class knowledge on information search behavior, *Journal of Consumer Research*, 12 (June), 1-15.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* , 13, 319-340

Drury, D. H., & Farhoomand, A. (1999) Innovation diffusion and implementation. *International Journal of Innovation Management ,* 3, 133-157.

Fang, X., Chan, S., Brzezinski, J., and Xu, S. (2005-6) Moderating effects of task type on wireless technology acceptance. *Journal of Management Information Systems* , 22, 123-157.

Gatignon, H. and Robertson, T. S. (1985) A propositional inventory for new diffusion research, *Journal of Consumer Research,* 11 (March), 849-867.

Gregan-Paxton, J. and John, D. R. (1997) Consumer learning by analogy: a model of internal knowledge transfer, *Journal of Consumer Research*, 24 (December), 266-284.

Harris, P., Rettie, R., & Kwan, C. C. (2005) Adoption and usage of m-commerce: a cross-cultural comparison of Hong Kong and The United Kingdom. *Journal of Electronic Commerce Research* , 6 (3), 210-224.

Mahajan, V., Muller, E. and Bass, F. M. (1995), "Diffusion of New Products: Empirical Generalizations and Managerial Uses," *Marketing Science,* 14, 3, 79-88.

Metcalfe, J. (1986) Feeling of knowing in memory and problem solving, *Journal of Experimental Psychology,* 12, 2, 288-294.

Monroe, K. B. (1976) The influence of price differences and brand familiarity on brand preferences, *Journal of Consumer Research,* 3 (June), 42-49.

Moore, G. C., & Benbasat, I. (1991). Developing of an instrument to measure the perceptions of adopting an information technology innovation. Information Systems Research , 2, 192-222.

Moorman, C, Diehl, K, Brinberg, D, and Kidwell, B. (2004) Subjective knowledge, search locations, and consumer choice, *Journal of Consumer Research,* 31 (December), 673-680.

Moreau, C. P., Lehmann, D. R. and Markman, A. B. (2001) Entrenched knowledge structures and consumer response to new products, *Journal of Marketing Research,* 38 (February), 14-29.

Moreau, C. P., Markman, A. B. and Lehmann, D. R (2001) What is it?" Categorization flexibility and consumers' responses to really new products, *Journal of Consumer Research,* 27 (March), 489-498.

Park, C. W. and Lessig, V. P. (1981) Familiarity and its impact on consumer decision biases and heuristics, *Journal of Consumer Research,* 8 (September), 223-230.

Punj, G., and Staelin R., (1983) A model of consumer information search behavior for new automobiles, *Journal of Consumer Research*, 9 (March), 366-380.

Premkumar, G., Ramamurthy, K. and Nilakanta, S. (1994) Implementation of electronic data interchange: An innovation diffusion perspective, *Journal of Management Information Systems,* 11, 1, 157-186

Radecki, C. M. and Jaccard, J. (1995), Perceptions of knowledge, actual knowledge, and information search behavior, *Journal of Experimental Social Psychology,* 31, 107-138.

Rajagopal, P. (2002) An innovation—diffusion view of implementation of enterprise resource planning (ERP) systems and development of a research model, *Information & Management*, 40, 87-114

Raju, P. S., Lonial, S. C., and Mangold, W. G. (1995) Differential effects of subjective knowledge, objective knowledge and usage experience on decision making: An exploratory investigation, *Journal of Consumer Psychology,* 4, 2, 153-180.

Rao, A. R. and Monroe, K. B. (1988), "The Moderating Effect of prior Knowledge in Cue Utilization in Product Evaluations," *Journal of Consumer Research,*15 (September), 253-264.

Rogers, E. M. (2003). Elements of diffusion. New York, NY: Free Press.

Rudell, F. (1979), Consumer Food Selection and Nutrition Information, New York: Praeger.

Schacter, D. L. (1983), Feeling of knowing in episodic memory, *Journal of Experimental Psychology,* 9 (1), 39-54.

Sheth, J. N. (1981), Psychology of innovation resistance: The less developed concept (LDC) in diffusion research, *Research in Marketing,* 4, 272-282.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management* , 29, 28-45.