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Deciding to Update Mobile Applications: Reasons and Consequences of Inertia

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ABSTRACT

While most of studies have paid attention to the initial adoption of a specific application, research on applications has not focused on an individual's update decision process. This study draws upon both dual information processing and status quo bias perspectives as a comprehensive theoretical lens to explain why individuals do not update their applications. This study assumes that individuals' inertia could be the main reason for their reluctance to update the applications. Based on a survey of 186 smartphone users, this study demonstrated that both habit as an affective trigger of system 1 thinking and sunk cost as a cognitive trigger of system 2 thinking promoted the two types of inertia (i.e., affective and cognitive based inertia) in individuals, which have a negative effect on their willingness to update their applications. By grounding the research model in a theoretical view, such as dual information processing and status quo bias, this study provides a unique theoretical lens from which to view individuals' behaviors, thereby gaining a better understanding of their decision not to update to the current version of applications. This study also investigates the moderating effect of the types of applications on the relationships between affective/cognitive-based inertia and willingness to update. Results show that both habit and sunk cost decrease the willingness to update because they increase both affective and cognitive-based inertia. This study also found that the effects of affective/cognitive based inertia differed depending on the type of applications.

Keywords: Habit, Sunk Cost, Affective-Based Inertia, Cognitive-Based Inertia, Willingness to Update

Ⅰ. Introduction

In general, updates on incumbent applications in smartphones are critical to individuals' usage surroundings. Once a specific application is downloaded in a certain smartphone, updates to subsequent version appear to be required. While new version of the applications can fix important technological bugs, individuals are not always comfortable with them for various reasons such as changed user interface, incompatibility with other applications, or privacy invasiveness. Apparently, it is a non-trivial

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task for individuals to make their update decision (Tian et al., 2014).

According to the prior research, one of the most neglected issues related to applications was the decision to update from one version to another (e.g., Khoo and Robey, 2007). In the case of packaged software, the new version of the software may affect other installed software as well as may render conflicts with other existing software, thus further complicating the installation issues. In addition, unlike the more general case of new technology adoption, upgrading packaged software could be a kind of decision to continue using software that has already been adopted, implemented and used (Khoo and Robey, 2007). Updating mobile applications should be considered in the same vein as the case of upgrading packaged software, given that individuals decide whether and when to upgrade from the current version requires an ongoing process of evaluation. Thus, it is reasonable to expect individuals to update applications for the purpose of achieving benefits such as greater efficiency or better features (e.g., Beatty and Williams, 2006).

Although there are some possibilities which the updating causes positive impact on performance improvement, a majority of users might feel hesitant because of possible negative consequences (i.e., inferior interface). Therefore, in order to understand user's behavior and attitude on application updates, this study attempts to examine why individuals cannot easily adopt their willingness to update in their applications. More specifically, this study tries to find major reasons and consequences of individuals' inertia, which could be sailent inhibiting effects on making update decisions in the mobile application context. To do this, this study has employed two theoretical perspectives such as dual information processing theory and status quo bias for the following two research questions in order to identify theoretical mechanisms as determinants of update decision and relationships that influence update-decision. The research questions are:

1. *What factors influence the decision to update mobile applications?*
2. *How are the factors that influence updating decisions related?*

This study approaches these above questions from the two theoretical perspectives. The first, outlined above, argues that main triggers of influencing updating decision (i.e., willingness to update) might be triggers from both automatic and reflective thinking systems. To design effective interventions aimed at counteracting both automatic thinking and reflective thinking toward update, it is first necessary to understand the exact mechanisms by which these factors impact update decisions. In this study, there are two triggers of individual's motives such as habit and sunk cost.

The second, this study tries to divide inertia as two parallel constructs such as affective-based inertia and cognitive-based inertia. This study conceptualizes inertia as having affective and cognitive components (see Barnes et al., 2004; Ergün et al., 1999; Oliver, 1999; Oreg, 2003; Piderit, 2000) given the mobile applications usage surroundings. Such conceptualization on inertia implies that individuals have conceived the inertia as parallel processors of information who operate along diffuse associative links (i.e., affective base) or as analysts (i.e., cognitive base) who operate by deliberate manipulation of internal representation.

Based on the above, this study believes there is obviously a need to develop and test a model that can help explain users' upgrading behavior. This research could be provided as a starting point for under-

standing IT upgrading behavior by incorporating the dual information processing into status quo bias theory.

The reminder of this study is organized as follows. This study begins with a review of areas of the information systems literature related to decision to update. This study then presents the research model and hypotheses. The paper concludes with a discussion of the theoretical and practical implications of our findings.

Ⅱ. Background and Literature Review

2.1. Previous Research on Updating Software

Some of literature which is closely related to software upgrade is software maintenance since upgrading software means that software has already been adopted and implemented (e.g., Khoo and Robey, 2007). Kim and Westin (1988) have defined software maintenance as 'the activities performed on software after programs have been installed.' Considering Kim and Westin's definition, the maintenance and updates serve a similar functional purpose except that updates replace the previous version of software with a new version, whereas maintenance targets specific functions that need to be corrected or perfected (Swanson and Beath, 1989).

Meanwhile, there are some of benefits and drawbacks on software update (Ali, 2011). In the case of benefits of update, Ali has presented new features, enhanced speed and enhanced image. The potential benefits from software updates are numerous but at the same time there are different drawbacks associated with upgrading existing software (Mukherji et al., 2006). Basically, updates may lead to the new features. These may include simple changes to the current features or add new features that allow for a wider range of the existing software. In addition, the updates can bring improvement of performance in software such as speed or image. Enhanced speed and image could be benefits in terms of functionality and performance. Namely, the update of a specific application means having two things: 1) it means that updates lead to having features of the old version available and 2) it also means the updates was given to additional features are available as well. However, there are some of drawbacks on updates even though updates have several benefits for users. In psychological perspective, both sunk cost and transition cost might be one of major drawbacks. Updating applications may require learning how to use the software or it may retrain existing users of the same software of the new features provided by the upgrade. Furthermore, updating applications may influence other installed applications as well as may render conflicts with other existing applications due to the incompatibilities with other applications.

Based upon the above, prior studies have just presented some of benefits or cost when specific software is updated. Although updating could be helpful for users to make sure that their operating at peak performance, nearly half of individuals don't update their own applications (http://www.theregister.co.uk/2012/07/23/skype_software_update_survey/). According to a survey commissioned by Skype, 40 percent of individuals don't update their applications when prompted to do so, and that 25 percent of individuals skip applications updates sine they think updating offers no real benefits. In addition, there are various reasons for avoiding updates messages. Some said they expected new versions of software would have lots of bugs or would crash too often, while others said they thought the updates would slow down their smartphones.

Taking all consideration of above issues, examining the factors of affecting updating decision would be necessary for us. Despite having such necessities, there is not much understanding the updating applications phenomenon in the relevant research. In this study, what leads individuals to make updating decision represents important theoretical gap in the relevant literature that this study seeks to address. Therefore, this study has presented major factors of affecting individuals' updating decision from both dual information processing and status quo bias theoretical view in order to understand a mechanism of an individual's updating decision.

2.2. System 1 and System 2 from the Dual Information Processing Theory

The dual information processing approach is a useful framework that provides characteristics of perception, memory, decision, and attention. Generally, individual's brain has dual information processing such as system 1 and system 2. Recent research has identified two distinct modes of thought, one associative and feeling based, the other deliberate and rule-based (Chaiken and Trope, 1999; Choi, 2000; Epstein, 1994; Stanovich and West, 2002). For instance, Kahneman and Frederick (2002) contrast what they call system 1 as automatic, rapid, associative, and affective and system 2 as controlled, slow, deliberative, and deductive. Moreover, they view system 2 as an effortful check on the more reflex-like system 1. They write: "System 1 quickly proposes intuitive answers……systems 2 monitors the quality of these proposal, which it may endorse, correct, or override (Kahneman and Frederick, 2002, p. 51). Thus, Systems 1 and 2 in dual information processing are conceptualized as distinct modes of thought, the former automatic and affective, the latter controlled and deliberate (Rottenstreich et al., 2007).

In line with both system1 and system 2 thinking from dual information processing, Schneider and Shiffrin (1977) asserted that human performance is the consequence of two different processes: automatic and controlled processing. These qualitatively different processes are reviewed with emphasis on applications to research attention. For example, automatic processing is a rapid and parallel process, which is not limited by short-term memory. Furthermore, it requires little subject effort, and permits little direct subject control, but requires extensive and consistent training to develop. On the other hand, controlled processing is a comparatively glacial and serial process, which is limited by short-term memory and also requires subject effort and permits a large degree of subject control, although it requires little training to develop. That is, automatic processes are assumed to be involuntary, to require no attention, and to be relatively rapid, whereas controlled processes are assumed to be voluntary, to require attention, and to be relatively slow.

Moors and De Houwer (2006) also reviewed the characteristics that distinguish automatic processes from controlled processes, as follows: First, one of the most outstanding distinctions between automatic and controlled processes is the degree to which actions are subject to conscious control. Control involves the ability or propensity to monitor, alter, change, or discontinue engaging in a specific behavior. It can reduce the degree to which a task can be automatically performed. The second difference is the degree to which conscious intention is present. When peoples' activities are automatic, they tend to be more likely to occur autonomously－in that they appear to occur on their own in the absence of central control--as they are not actually consciously intending to engage in those activities. A third charac-

teristic of the automatic process is its inherent attentional efficiency. Generally speaking, activities associated with automatic processes occur with a minimum of attentional capacity, which leaves more capacity for the performance of other tasks. Another major distinction between automatic and controlled processes is a sort of increased speed approach (Schneider and Shiffrin, 1977). As the performance of a task may involve automatic processes, people just learn to carry out their tasks with increasing rapidity. According to the instance-based view of Logan (1998), the way that a task is performed tends to change fundamentally as the performers of those tasks become increasingly practiced. The performance of a task in the initial stage tends to be conscious and deliberate, involving effortful memory and information search. After sufficient practice, the performance of the task changes from the deliberate mode to the quick and simple mode. Therefore, people perform the tasks by quickly retrieving information, because of a great deal of practice. On the other hand, automatic process can be quite difficult to stop or modify, owing partly to the fact that they involve relatively little in the way of conscious monitoring. Therefore, people frequently make absentminded mistakes when they are engaged in automatic processing.

In comparison system 1 (i.e., automatic thinking) and system 2 thinking(i.e., reflective thinking), Rottenstreich et al. (2007) have named both system 1 and system 2 dichotomy as contrast memory-based and stimulus-based choice in marketing area. Rottenstreich et al. have found that memory-based choices favor immediately compelling, affect-rich system 1 options, whereas stimulus-based choices favor affect-poor options whose attractiveness emerges from deliberative system 2 thought.

After all, this study could apply this dual decision process, which includes automatic and controlled processes, to an individual's update decision behavior such as willingness to update. Within the context of mobile application surroundings, individuals tend to make update decisions when they are engaged in automatic or controlled decision processes. Meanwhile, as users under the controlled decision process, their behavior tends to be shown in both conscious and deliberate, involving arduous memory and information searches. Thus, they generally attempt to take into consideration whether or not the update decision will prove useful for them. This study attempts to explain individuals' updating behavior via the application of the above two thinking systems. As for the automatic thinking process (i.e., system 1), this study has identified the habit; as for the controlled thinking process (i.e., system 2), sunk cost.

2.3. Inertia from Status Quo Bias Theory

Status quo bias (hereafter, SQB) theory would be useful to predict as well as explain an individual's update decision (e.g., Abdul-Gader and Kozar, 1995; Polites and Karahanna, 2012).

The aim of SQB theory is to explain that individuals tend to maintain their current behavior status or situations (Kim and Kankanhali, 2009). The SQB theory presents that an individual is biased toward "doing nothing or maintaining one's current or previous decision" (Samuelson and Zeckhauser, 1988, p. 7). Polites and Karahanna (2012) have mentioned that the SQB does not present in a specific context even though this perspective represents a comprehensive set of theoretical explanations that explain status quo bias. Samuelson and Zeckhauser (1988) also suggested that a set if theoretical mechanism through status quo bias could be operated in a specific context.

The SQB is often shown as inertia, which was defined as "*attachment to, and persistence of, existing behavioral patterns (some of which are habituated) even if there were better alternatives and incentives to change*" (Polites and Karahanna, 2012, p. 22). Only one IS research have used the SQB to account for the inhibiting effect of switching cost on resistance toward a new system (Kim and Kankanhalli, 2009). Instead of resistance, from the viewpoint of automatic process, Polites and Karahanna (2012) have suggested habit leads to status quo inertia. They also argued that habit and inertia are clearly distinct while habit leads to the inertia. The reason that two constructs are different is that habit is a learned response automatically triggered by stimulus cues, whereas inertia is a conscious choice to stay with the status quo even though there is a better alternative (Polites and Karahanna, 2012). Based upon the above, inertia can represent a rigid continuance of the status quo.

Inertia, derived from the SQB, can be conceptualized by behavioral, cognitive and affective components (e.g., Barnes et al., 2004; Ergün et al., 1999; Oliver, 1999; Oreg, 2003; Piderit, 2000), Polites and Karahanna (2012) conceptualized it in IT switching context as the follows: First, behavioral-based inertia means that individuals have always continue to using a system simply without any thought. Second, cognitive-based inertia implies that individuals consciously continue to use a system, although they already know that the system might not be the best. Finally, affective-based inertia implies individuals unconsciously continue using a system because changing toward a new system would be stressful for them, because they have strong emotional attachment to the current way of doing things (Barnes et al., 2004), or because they just enjoy or feel comfortable doing so.

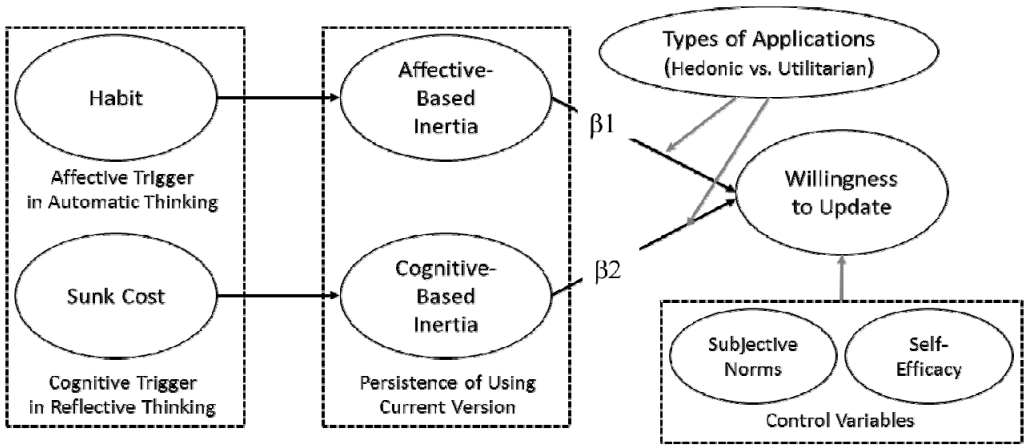
In this study context, individuals may express their intention to continue using the current version of applications because (1) this is what they have always done (i.e., behavioral-based inertia), (2) they still believe the current version has advantages despite being aware of better alternatives (i.e., cognitive-based inertia), or (3) they enjoy or feel comfortable using the current version of applications (i.e., affective-based inertia). This study believes that two types of inertia such as cognitive and affective-based inertia may prevent individuals from updating decisions from perspective of giving the practical implications to IT developers.

Therefore, both cognitive and affective-based inertia from the SQB theory in this study can offer valuable theoretical explanations for understanding the impact of an individual's update decision on his/her application. More specifically, two types of inertia (e.g., affective and cognitive based inertia) could be mediating the relationships between cognitive/affective trigger (e.g., sunk cost and habit) and an individual' willingness to update his/her application in parallel.

Ⅲ. Researh Model and Hypotheses

3.1. Research Model

Drawing on the meta-theoretical perspective of both automatic thinking (i.e., System 1) and reflective thinking (i.e., System 2), this study explore habit as an affective trigger from the automatic thinking and sunk cost as a cognitive trigger from the reflective thinking that influence to both affective-based inertia and cognitive-based inertia, which can lead to willingness to update. <Figure 1> illustrates the proposed research model in this study. As shown in the model, both habit and sunk cost are posited to have indirect effects on willingness to update by mediating both



- H1 : Habit → Affective-Based Inertia → Willingness to Update
- H2 : Switching Cost → Cognitive-Based Inertia → Willingness to Update
- H3 : β1 > β2 if a downloaded app was for hedonic value
- H4 : β2 > β1 if a downloaded app was for utilitarian value

<Figure 1> Research Model

affective-based inertia and cognitive-based inertia in parallel. Further, relationships among affective-based inertia/ cognitive-based inertia and willingness to update are posited to be moderated by types of using application (e.g., utilitarian vs. hedonic purpose).

3.2. Research Hypotheses

In prior research, habit has been commonly defined as "learned sequences of acts that become automatic responses to specific situations, which may be functional in obtaining certain goals or end states" (Verplanken et al., 1997, p. 540). According to Limayem et al. (2007), once habit is established, an individual's behavior is performed automatically. It implies that s/he behave with little conscious attention as well as minimal mental effort (Wood et al., 2002). In this study, habit, which could be an affective trigger from the automatic thinking perspective, is defined as the extent to which individuals tend to behave (i.e., use a current version of application) automatically. In the update context, individuals tend to use current version of application because of a consequence of repeated experience with the current version. Prior studies have found that incumbent system habit enables the user to automatically defer to the status quo, and save related costs (e.g., time and effort) to follow a particular course of usage action (e.g., Polites and Karahanna, 2012; Samuelson and Zeckhauser, 1988). Thus, it is reasonable to assume that affective-based inertia occurs due to the habit. This study further posits that the relationship between habit and willingness to update will be mediated by an individual's status quo bias as evidenced by his/her affective-based inertia. In this study, as an individual makes updating decision, his/her habit is likely to grow stronger because they enjoy or feel comfortable using the current version of applications, the update may be too stressful or emotionally taxing to change (i.e., affective-based inertia). Drawing on SQB theory, the influence of the habit on willingness to update is likely to be mediated by affective-based

inertia. Namely, when the habit is strong, this should increase an individual's affective-based inertia, which in turn should lead to a decrease in willingness to update. Therefore, this leads to the first hypotheses:

H1: The relationship between habit and willingness to update is mediated by affective-based inertia. Specifically, the habit demotes willingness to update because it increases an individual's affective-based inertia.

In this study, sunk cost can involve a cognitive trigger from the reflective thinking perspective. It is defined as the amount of time or effort already invested in the current version of applications. In this study, it is also reasonable to presume that individuals tend to persist in using an existing application even if there are other options or reasons to change. This study posits that as an individual make updating decision, they will tend to persist in using the current version of applications because of their investment of time and effort was high. In other words, both time and effort already invested in learning about the current version of applications, which might be lost as a result of replacing to a new version. Thus, the presence of sunk cost can lead to the status quo bias in an individual's decision making. Further, this study has considered that sunk cost lead to cognitive-based inertia, which implies that an individual consciously continues to use a system although they already knew that it might not be the best way of doing things (Polites and Karahanna, 2012). One prior study has also presented that sunk cost caused users unwilling to switch to a new product or service provider (Kim and Kankanhalli, 2009). Therefore, as an individual incurs a higher level of sunk cost related to replacing the current version to the new one, this will encourage a greater cognitive-based inertia. Based on the above, the influence of sunk cost on willingness to updates is likely to be mediated by cognitive-based inertia. In other words, when sunk cost is high, this should increase an individual's cognitive-based inertia, which in turn should lead to decrease in willingness to update. Therefore, this study can propose the following hypothesis:

H2: The relationship between sunk cost and willingness to update is mediated by cognitive- based inertia. Specifically, the sunk cost demotes willingness to update because it increases an individual's cognitive-based inertia.

In marketing area, for consumers who are strongly influenced by hedonic value, the value of a product is not in its use but in the emotional arousal experience (Spangenberg et al., 1997). For one of marking research, hedonic value in shopping context has been defined as "an overall assessment of experiential benefits and sacrifices, such as entertainment and escapism" (Overby and Lee, 2006, p. 1161). In this case, shopping is not primary utilitarian or task-oriented any more. On the other hand, utilitarian value is defined as "an overall assessment of functional benefits and sacrifices" (Overby and Lee, 2006, p. 1161). In the field of consumer behavior research, Batra and Ahtola (1990) have also mentioned that consumer attitude is consisting of two value dimensions such as hedonic value and utilitarian value. Hedonic value refers to an individual's feeling of enjoyment, whereas utilitarian value refers to an individual's pursuit of expected outcomes, which is rational and task-oriented (e.g., Batra and Ahtola, 1990; Engel et al., 1995). Considering the definitions of both hedonic and utilitarian value, this study argues that type of applications actually serves to moderate the relationship between affective/cognitive-based inertia and willingness to update. Previous studies on

both hedonic and utilitarian value have highlighted the importance of individuals' decision making such as behavioral intention (e.g., Batra and Ahtola, 1990). On the basis of the results of prior studies, it is reasonable to assume that an individual's willingness to update can be influenced by types of applications. From the marketing research, this study believes that the impact of affective/cognitive based inertia can be different by depending on the type of applications. Thus, this study states the following hypotheses:

H3: The type of applications will moderate the relationship between habit and willingness to update such that the strength of the relationship will be greater if a downloaded application is for hedonic purpose.

H4: The type of applications will moderate the relationship between switching cost and willingness to update such that the strength of the relationship will be greater if a downloaded application is for utilitarian purpose.

3.3. Control Variables

Subjective norms and self-efficacy could be control variables in this study. First, subjective norms refers to "the perceived social pressure to perform or not to perform the behavior" (Ajzen 1991, p. 188). In the IT adoption literature, subjective norms, or the normative influence of key referent groups such as peers may influence an individuals' behavioral choice if the referent groups have already made updating decision or plan to do so in the near future (Bhattacherjee and Park, 2014). Likewise, perceived behavioral control (hereafter, PBC) may also be related to update an application context. PBC has been defined as an individual's perception of the degree of control over a target behavior (Ajzen, 1991). It has two types of control: internal control such as personal ability and external control such as financial resources or technical support. In this study context, internal control could be adopted. Internal control has been tapped into self-efficacy, which was defined as individuals' judgment of their personal ability to perform a particular behavior (Compeau and Higgins, 1995). Unlike internal control, external control is excluded because it was less relevant to updating decision because technical or financial supports are related to IT developers, not to end-users. Therefore, subjective norms and self-efficacy in this study are included in the research model as control variables. Further, this study pursues to propose a preliminary and parsimonious model. It integrates predictors from different theoretical perspectives; nonetheless, there may be additional predictors of an individual's updating decision, which are left open for future research.

3.4. Construct Operationalization

This study employed a survey approach to test a proposed research model (see <Appendix A> for the measures which were all based on self-reports). Habit was operationalized using a 3-item scale (HBT1- HBT3), modified from Limayem et al. (2007) and Bhattacherjee et al. (2012). Sunk cost was operationalized using a 3-item scale (SCT1-SCT3) adapted and slightly modified from Polites and Karahanna (2012). Both affective and cognitive based inertia were also operationalized using each 3-item scale (AER1-AER3 and CER1-CER3) adapted and modified from Polites and Karahanna (2012). The final dependent variable, willingness to update, was assessed using a 2-item measure (WTU1-WTU2) adapted and modified from Ajzen (1991). In addition, subjective norms and self-efficacy as control variables were measured using Hsieh et al. (2008)' measurement items.

Ⅳ. Data Analysis and Results

4.1. Survey Items, Data Collection and Research Methodology

The questionnaire was developed with the idea that each subject would be asked to respond based upon his or her most recent experience on updating a specific application. Two bilingual domain experts in experience with survey design provided feedback to refine the questionnaire. Original survey items were developed in English and translated into Korean. After that, two experts who were fluent in both English and Korea performed a back translation to ensure consistency between Korean version and English version as well as to eliminate any translation related differences.

Subsequent to the adjustments of survey items, this study adopted a survey method that targeted individuals who had prior experiences on updating applications in their smartphones. A total of 200 responses were obtained, but some had to be dropped since there some of missing values in some cases, leaving us with 186 completed surveys.

All survey items for each construct were measured on a 7 point-Likert scale, which ranged from 'strongly disagree' (1) to 'strongly agree (7). This study also adopted partial least squares using Smart PLS 2.0 to analyse the research hypotheses. This study used PLS for the analysis as it: 1) it is enabled to estimate the measurement model and the structural model simultaneously, 2) is suitable for exploratory models, and 3) has fewer distributional assumptions (Gefen et al., 2005). Therefore, this study chose PLS over CB-SEM since the emphasis in this research is on prediction rather than model fit.

4.2. Descriptive Analysis

<Table 1> shows the demographic profile of our respondents. 48.39% of our respondents were male and 5.61% were female. Most of respondents (72%) were in the 21-40 age group. Most respondents (52.69%) are company staffs in the sample.

4.3. Measurement Model

Based on Fornell and Larcker (1981)'s criterion, the measurement model in this study was tested by examining both convergent and discriminant validity.

<Table 1> Descriptive Analysis

Items	Category	Frequency	Percentage (%)
Gender	Male	90	48.39%
	Female	96	51.61%
Age	20- 29	74	39.78%
	30-39	60	32.26%
	40-49	28	15.05%
	Over 50	24	12.90%
Job	Company staffs	98	52.69%
	Individual proprietors	7	5.38%
	Students	22	11.83%
	Public servants	56	30.11%

<Table 2> Results of Testing Reliabilities

	Constructs	Mean	STD	Cronbach's Alpha	Composite Reliability	AVE
Total sample group (n = 186)	Habit	4.91	1.67	0.91	0.95	0.85
	Affective-based inertia	4.37	1.8	0.87	0.92	0.80
	Cognitive-based inertia	3.82	1.57	0.96	0.97	0.93
	Self-efficacy	4.68	1.36	0.89	0.95	0.90
	Subjective norms	4.47	1.37	0.92	0.96	0.92
	Sunk cost	3.67	1.52	0.98	0.98	0.87
	Willingness to update	3.96	1.85	0.94	0.97	0.95
Hedonic value group (n = 103)	Constructs	Mean	STD	Cronbach's Alpha	Composite Reliability	AVE
	Habit	4.97	1.7	0.92	0.95	0.87
	Affective-based inertia	4.23	1.92	0.87	0.92	0.80
	Cognitive-based inertia	3.81	1.61	0.97	0.98	0.95
	Self-efficacy	4.58	1.43	0.89	0.95	0.90
	Subjective norms	4.19	1.32	0.89	0.95	0.90
	Sunk cost	3.47	1.54	0.97	0.98	0.87
	Willingness to update	3.99	1.81	0.88	0.94	0.89
Utilitarian value group (n = 83)	Constructs	Mean	STD	Cronbach's Alpha	Composite Reliability	AVE
	Habit	4.85	1.61	0.91	0.94	0.85
	Affective-based inertia	4.5	1.63	0.86	0.92	0.79
	Cognitive-based inertia	3.93	1.47	0.94	0.96	0.90
	Self-efficacy	4.59	1.31	0.89	0.95	0.90
	Subjective norms	4.59	1.35	0.94	0.96	0.92
	Sunk cost	3.9	1.51	0.98	0.98	0.87
	Willingness to update	3.99	1.84	0.98	0.99	0.98

In testing convergent validity, this study assesses two different approaches: (1) individual item reliability and (2) construct reliability. This study examined the item to construct loadings for each construct which was measured with multiple indicators to check the individual item reliability. In order for the shared variance between each item and its related construct to exceed the error variance, the standardized loadings should be greater than 0.70. As can be shown in <Appendix B>, all item-to-construct loadings in this study have exceeded the desired threshold. In the next step, this study has examined the construct reliability to see whether there is internal consistency on each construct. This was done by examining the Cronbach's alpha, composite reliability and the AVE (average variance extracted) for each block of measures. Although the absolute threshold values for both composite reliability and Cronbach' alpha are not existed, but measures in this study appear to be more than acceptable by the established criterion (e.g., Bearden et al., 1993). As shown in <Table 2>, all of constructs in this study exhibited Cronbach's alpha of 0.86 or higher, and they all exhibited composite reliabilities of 0.92 or higher. Furthermore, the

<Table 3> Construct Correlations and Square Root of AVEs (on Diagonal)

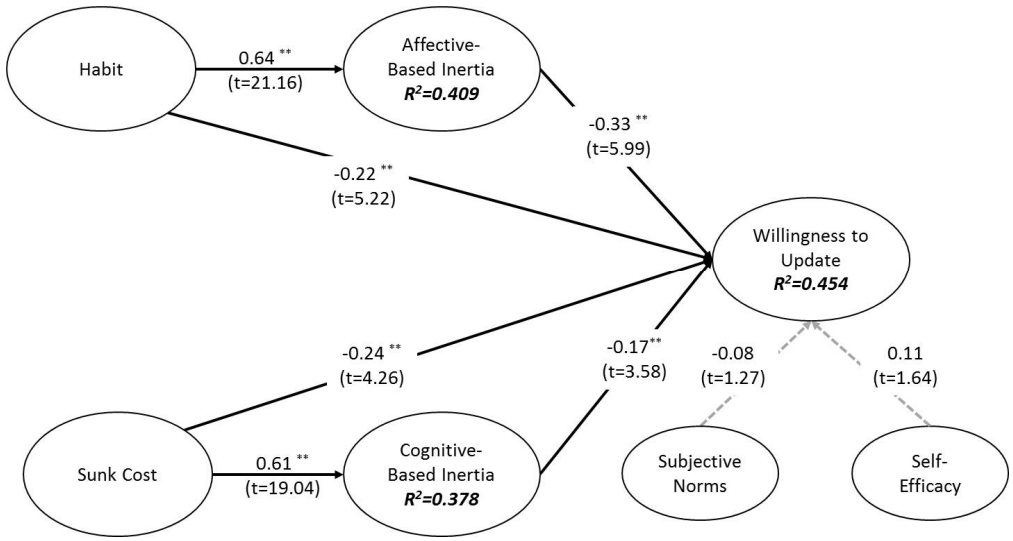
	Constructs	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Total Sample group (n = 186)	Habit (A)	**0.92**						
	Affective-based inertia (B)	0.64	**0.89**					
	Cognitive-based inertia (C)	0.38	0.63	**0.96**				
	Self-efficacy (D)	-0.12	-0.22	-0.32	**0.95**			
	Subjective norms (E)	0.03	-0.03	-0.09	0.56	**0.96**		
	Sunk cost (F)	0.45	0.61	0.61	-0.18	-0.05	**0.93**	
	Willingness to update (G)	-0.51	-0.57	-0.35	0.16	0.10	-0.51	**0.97**
Hedonic value group (n = 103)	Constructs	(A)	(B)	(C)	(D)	(E)	(F)	(G)
	Habit (A)	**0.93**						
	Affective-based inertia (B)	0.63	**0.90**					
	Cognitive-based inertia (C)	0.49	0.73	**0.97**				
	Self-efficacy (D)	-0.12	-0.24	-0.31	**0.95**			
	Subjective norms (E)	-0.08	-0.12	-0.21	0.69	**0.95**		
	Sunk cost (F)	0.37	0.62	0.66	-0.18	-0.13	**0.93**	
	Willingness to update (G)	-0.52	-0.54	-0.39	0.13	0.14	-0.46	**0.94**
Utilitarian value group (n = 83)	Constructs	(A)	(B)	(C)	(D)	(E)	(F)	(G)
	Habit (A)	**0.92**						
	Affective-based inertia (B)	0.67	**0.89**					
	Cognitive-based inertia (C)	0.22	0.48	**0.95**				
	Self-efficacy (D)	-0.15	-0.26	-0.29	**0.95**			
	Subjective norms (E)	0.10	-0.04	0.01	0.50	**0.96**		
	Sunk cost (F)	0.55	0.60	0.54	-0.17	-0.02	**0.93**	
	Willingness to update (G)	-0.48	-0.60	-0.25	0.19	0.09	-0.46	**0.99**

* Diagonal elements are square roots of AVE.

guideline threshold for AVE is 0.5, meaning that 50% or more variance of the indicators is accounted for Chin (1998). As <Table 2> indicates, all of the constructs in our measurement model exceed the established threshold value for AVE.

For the discriminant validity, this study adopted the method to see whether the square root of the AVEs of the latent constructs were greater than the correlations among the constructs. When this is true, more variance is shared between the construct and its block of indicators than with another construct.

As can be seen by reading across the rows of <Table 3>, all measures passed this test, thus providing evidence of discriminant validity. Additionally, this study calculated each indicator's loading on its own construct as well as its cross-loading on all other constructs for other construct indicators. Each indicator has a higher loading with its construct than a cross-loading with any other construct. This provides good evidences of discriminant validity.



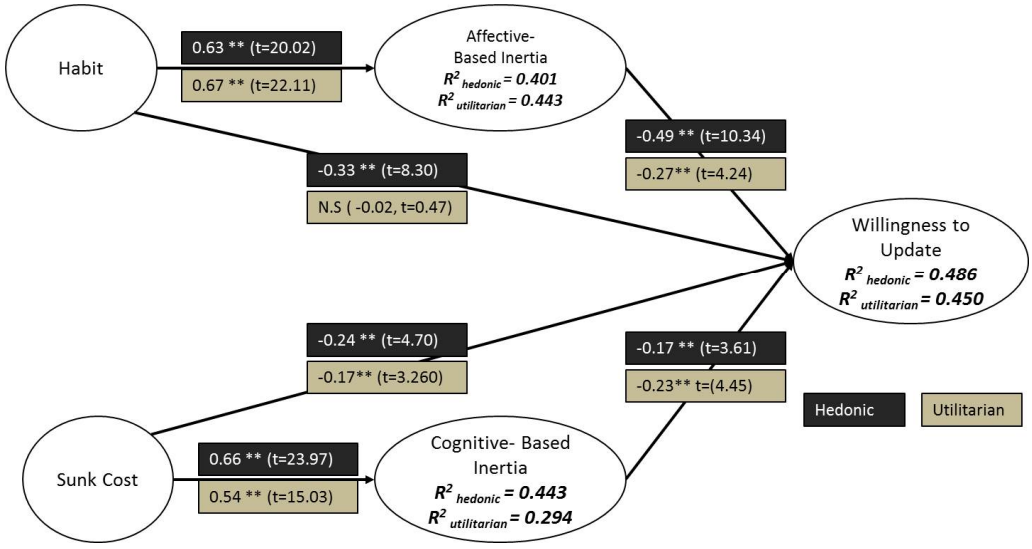
<Figure 2> Path Analysis Results

4.4. Structural Model

For testing the proposed hypotheses in this study, the structural model was assessed by examining both the path significance and the explanatory power of the proposed research model. First, the exploratory power of the model can be evaluated by looking at R^2 value (variance accounted for) of the dependent construct. As shown in <Figure 2>, the final dependent construct in this study (willingness to update) has an R^2 value of 0.454, meaning that the model explain 45.4% of variance in the dependent variable. Furthermore,. Both R^2 values for the intermediate variables (affective based inertia and cognitive based inertia) are 0.409 and 0.378, respectively. Based on the above, these R^2 values were high enough for a meaningful interpretation of the path coefficients.

Second, as shown in <Figure 2>, the path between habit and affective based inertia (β = 0.64, t = 21.16), the path between affective based inertia and willingness to update (β = -0.33, t = 5.99), the path between habit and willingness to update (β = -0.22, t = 5.22), the path between sunk cost and cognitive based inertia (β = 0.61, t = 19.04), the path between cognitive based inertia and willingness to update (β = -0.17, t = 3.58), and the path between sunk cost and willingness to update (β = -0.24, t = 4.26) were all significant at p < 0.01, indicating that both affective based inertia and cognitive based inertia mediated the relationship between each variable (i.e., habit and sunk cost) and willingness to update. The subjective norms and self-efficacy, as the control variables in this study, have no significant influence on willingness to update.

Next, in order to test hypothesis H3 to H4, this study conduct a subgroup analysis to test moderating effect of the purpose of application usage (i.e., hedonic vs. utilitarian). Thus, to perform this analysis, this study splits the entire sample into two groups, such as hedonic and utilitarian purpose, after which this study also tested both the validity and reliability by each subgroup. Referring back to <Appendix B> and <Table 2>, all items in the hedonic purpose group (n = 103) demonstrate an acceptable range having acceptable loadings (0.76 to 0.99), as do all items



<Figure 3> Comparisons between Hedonic and Utilitarian Purpose

in utilitarian purpose group (n = 83) (0.76 to 0.99). Furthermore, the reliability indicators are all well above the accepted thresholds, and the AVEs are greater than 0.5. According to Carte and Russell's (2003) suggestion, this study also assessed whether the constructs were perceived in a similar fashion between the both groups. In <Appendix B>, the loading patterns are the same and the factor loadings are very similar, thus permitting a between-group path comparison. This study examined the moderating effect of hedonic vs. utilitarian purpose by looking at the differences in the magnitude of the path coefficient from two types of inertia (i.e., affective based inertia and cognitive based inertia) to willingness to update across groups using the approach suggested by Chin et al. (2003). This involved computing a t-statistic[1] as follows:

$$S_{pooled} = \sqrt{\{[(N-1)/(N_1+N_2-2)] \times [(N_2-1)/(N_1+N_2-2)] \times SE_2^2\}}$$

$$t = (PC_1 - PC_2)/[S_{pooled} \times \sqrt{(1/N_1 + 1/N_2)}]$$

The resulting models for both groups explained a significant amount of the variance in the dependent and mediating variables. <Figures 3> illustrates the results of the analysis.

As shown in <Table 4>, comparison of the path coefficient from affective based inertia to willingness is larger for the hedonic purpose group (β = -0.49) than for the utilitarian purpose group (β = -0.27), whereas the path coefficient from cognitive based inertia to willingness to update is larger for the utilitarian purpose group (β = -0.23) than for the hedonic purpose group (β = -0.17).

In other words, affective based inertia has a greater impact on willingness to update when there is an application for hedonic purpose, thus supporting H3, whereas cognitive based inertia has a greater impact on willingness to update when there is an application for utilitarian purpose, thus supporting H4. After

1) where, S_{pooled}: the pooled estimator of the variance; PC_i : path coefficient in structural model of hedonic purpose group i; N_j : sample size of dataset for hedonic purpose group i; SE_i : standard error of path in structural model of hedonic purpose group i; andt_{ij} : t-statistic with N_1 + N_2 - 2 degrees of freedom.

<Table 4> Comparisons of Paths in Each Group

From → To	Hedonic (n = 103)		Utilitarian (n = 83)		R^2	t-statistic
	Path coefficient	S.E.	Path coefficient	S.E.		
Affective based Inertia → Willingness to update	-0.49	0.06	-0.27	0.05	0.486	26.75***
Cognitive based Inertia → Willingness to update	-0.17	0.06	-0.23	0.06	0.450	7.82***

<Table 5> Summary of Hypotheses Testing Results

#	Hypotheses	Results
1	The relationship between habit and willingness to update is mediated by affective based inertia. Specifically, the habit demotes willingness to update because it increases an individual's affective-based inertia.	Supported
2	The relationship between sunk cost and willingness to update is mediated by cognitive- based inertia. Specifically, the sunk cost demotes willingness to update because it increases an individual's cognitive-based inertia.	Supported
3	The type of applications will moderate the relationship between habit and willingness to update such that the strength of the relationship will be greater if a downloaded application is for hedonic purpose.	Supported
4	The type of applications will moderate the relationship between switching cost and willingness to update such that the strength of the relationship will be greater if a downloaded application is for utilitarian purpose.	Supported

all, these findings imply that the impact of affective based inertia and cognitive based inertia on willingness to update differs depending on the types of applications. As indicated in <Table 5>, all of hypotheses were supported.

Ⅴ. Conclusion and Implications

This study applied the dual information process thinking perspective as a meta-theoretic lens to explain why individuals are likely to stay in current version of their downloaded applications. This perspective provides many of researchers to generate insights into one possible theoretical mechanism underlying individuals' willingness to update, by focusing the attention on both an affective trigger of system 1 thinking (i.e., habit) and a cognitive trigger (i.e., sunk cost) of system 2 thinking. This study also attempted to divide inertia into two types such as affective based inertia and cognitive based inertia as well as considered as a moderator (i.e., types of applications) to retain further richness of the proposed research model.

The results show that both habit and sunk cost can promote inertia (i.e., affective based and cognitive based inertia) and such inertia mediates the relationship between major triggers of both system 1 and 2 thinking and willingness to update. Furthermore, the impact of each inertia on willingness to update is moderated by the types of applications. Specifically, this study found that type of application usage (i.e., hedonic or utilitarian purpose) strengthens the relationship between affective (cognitive) based inertia and willingness to update.

5.1. Implications for Research and Practice

This research makes several important contributions to both research and practice.

Given the growing importance of mobile applications, and the apparent inevitability of upgrades (Light, 2005), it is necessary to understand the decision processes for application updates. In line with

this, this research is one of few empirical studies focusing on updating mobile applications and drawing upon the dual information thinking perspective and status quo bias theory to better understand an individual's decision to update his/her own specific application. In particular, this study has considered habit as affective trigger of system 1 thinking as well as sunk cost as cognitive trigger of system 2 thinking and then predicted these triggers influence inertia as persistence of using current version, which in turn leads to an individual's willingness to update. This study provides empirical evidence that both habit and sunk cost influence affective based inertia and cognitive based inertia, respectively, which in turn, leading to an individual's willingness to update. Further, this study shows that the types of application usage have a moderating effect on the relationship between two types of inertia and willingness to update. Specifically, affective based inertia has a greater impact on willingness to update when the application is for hedonic purpose, whereas cognitive based inertia has a greater impact on willingness to update when the application is for utilitarian purpose. These findings, thus, indicate that the impact of affective as well as cognitive based inertia on willingness to update differs depending on the types of applications.

This study can also offer modest practical implications.

In this study, it is important for IT managers or developers to know why mobile users hesitate to update their applications. The view of this study would expected that outdated applications should be updated when new version with improved functionality including fixing the technical bugs are released by IT developers. IT developers will need to convince users that an update is safe and will help their system are important. Therefore, the findings in this study could guide them why users deny or ignore a well-intended message suggesting an update of mobile applications which could facilitate the use the applications.

Paradoxically, the findings create the possibility of predicting which individuals will be more likely to adhere to the current version of the applications due to the inertia. For mobile users, it is also important to be aware that better performance of a specific performance takes place when users should pay attention to the update. This suggests that application updates, from the user's standpoint, should be aimed at minimizing their inertia. One way to minimize the inertia, users should especially make a regular habit of updating immediately when they faced the updating messages from the developers.

Although there are meaningful findings in this research, there are some limitations in this study. First, this study relied on a survey-based approach. This means that the measurement items are subjective and open to potential recall bias. In the future research, it may be conducted by a qualitative based study for studying applications update decision in their natural surroundings to minimize the risk of recall bias (Yin, 1984).

Second, this study also adopted cross-sectional survey approach. Additional research such as longitudinal aspect of the research model is needed in order to take more a process view of an individual's decision making. For instance, tracking the entire usage cycle of a downloaded application, from adoption (e.g., downloaded apps in smartphones) to replacement by an updated version of that application, can give greater insight into the dynamics of the decision process (Khoo and Robey, 2007). In spite of the aforementioned limitations, this study believes that the work has important implications for both research and practice.

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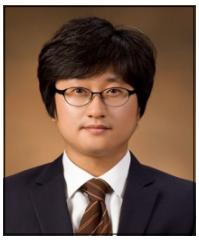
<Appendix A> Measurement Items

Constructs		Items	Sources that inform the construct
Willingness to update (A)	1	I would update my application.	Ajzen (1991)
	2	I am inclined to update my application	
Habit (B)	1	I use my current version of application as a matter of habit	Limayem et al. (2007), Bhattacherjee et al. (2012).
	2	Using my current version of application has become automatic to me.	
	3	Using my current version of application is natural to me.	
Affective-based inertia (C)	1	I (will) continue using my current version of application because it would be stressful to change.	Polites and Karahanna (2012).
	2	I (will) continue using my current version of application because I am comfortable doing so.	
	3	I (will) continue using my current version of application because I enjoy doing so.	
Cognitive-based inertia (D)	1	I (will) continue using my current version of application even though I know it is not the best way of doing things.	Polites and Karahanna (2012).
	2	I (will) continue using my current version of application even though I know it is not the most efficient way of doing things.	
	3	I (will) continue using my current version of application even though I know it is not the most effective way to do things.	
Sunk cost (E)	1	I have already invested a lot of time in learning to use my current version of application.	Polites and Karahanna (2012).
	2	I have already invested a lot of effort in learning to use my current version of application.	
	3	Overall, I have already invested a lot of time and effort in perfecting my skills at using my current version of application.	
Self-efficacy (F)	1	I can easily operate updating applications on my own.	Hsieh et al.(2008)
	2	I feel comfortable updating applications even if there is no one around me to tell me how to use them.	
Subjective norms (G)	1	People who influence me think that I should update my application.	Hsieh et al.(2008)
	2	People who are important to me think that I should update my application.	

<Appendix B> Item-Factor Loading and Cross-Loading for Full Sample And Item-Factor Loading for Subgroups

Total sample									Subgroup (1)	Subgroup (2)
Constructs	Items	(A)	(B)	(C)	(D)	(E)	(F)	(G)	Cross loadings in hedonic value	Cross loadings in utilitarian value
Willingness to update (A)	WTU1	0.98	-0.50	-0.59	-0.37	-0.52	0.34	0.10	0.95	0.99
	WTU2	0.97	-0.50	-0.52	-0.32	-0.47	0.35	0.10	0.94	0.99
Habit (B)	HBT1	-0.50	0.93	0.62	0.44	0.48	-0.15	0.07	0.90	0.94
	HBT2	-0.50	0.94	0.64	0.33	0.40	-0.11	-0.04	0.96	0.93
	HBT3	-0.39	0.90	0.49	0.26	0.36	-0.05	0.06	0.76	0.89
Affective-based inertia (C)	AER1	-0.51	0.45	0.77	0.74	0.68	-0.26	0.04	0.96	0.76
	AER2	-0.52	0.64	0.95	0.51	0.50	-0.16	-0.03	0.95	0.94
	AER3	-0.50	0.61	0.95	0.47	0.48	-0.18	-0.07	0.96	0.95
Cognitive-based inertia (D)	CER1	-0.32	0.41	0.62	0.94	0.58	-0.32	-0.08	0.97	0.91
	CER2	-0.35	0.35	0.60	0.97	0.59	-0.30	-0.07	0.98	0.97
	CER3	-0.35	0.34	0.60	0.98	0.61	-0.31	-0.10	0.97	0.96
Sunk cost (E)	SCT1	-0.52	0.47	0.60	0.57	0.97	-0.30	-0.04	0.99	0.98
	SCT2	-0.50	0.45	0.61	0.61	0.98	-0.27	-0.04	0.98	0.98
	SCT3	-0.47	0.40	0.59	0.62	0.98	-0.27	-0.07	0.96	0.97
Self-efficacy (F)	SEF1	0.35	-0.08	-0.18	-0.27	-0.29	0.95	0.51	0.94	0.96
	SEF2	0.32	-0.14	-0.24	-0.35	-0.25	0.95	0.56	0.94	0.95
Subjective norms (G)	SN1	0.10	-0.01	-0.03	-0.11	-0.07	0.53	0.97	0.94	0.92
	SN2	0.09	0.08	-0.02	-0.06	-0.02	0.56	0.95	0.96	0.99

◆ About the Authors ◆



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