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Examining explorative and exploitative uses of smartphones: a user competence perspective

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Abstract

Purpose – The purpose of this paper is to investigate the effects of user competence on two different usage variables related to information systems (IS) infusion: explorative use and exploitative use.
Design/methodology/approach – Structural equation modeling is used to construct a predictive model of user competence toward IS infusion. Individuals' responses to questions about attitude and intention to use smartphone were collected and analyzed.
Findings – The results showed that all first-order factors of user competence were significantly linked to the second-order factor. User competence is then significantly related to IS infusion, both explorative use and exploitative use.
Research limitations/implications – This study discusses individual usage behavior related to IS infusion usage. The authors conceptualized that exploitative use is different from explorative use. The findings in this study suggest that user competence must be included in IS usage models, especially IS infusion model.
Practical implications – The results associated with exploitation are more certain and closer in time, while those associated with exploration are more variable. That is, users are likely to innovate through their smart devices related to IS infusion. Smartphone developers and the relevant service providers should decide which factors are more important along the stages of the information technology implementation process. As indicated in this study, knowledge-based user competence together with perceived usefulness influences the usage behavior of smartphone users. Industry players need to consider user competence when they promote their smartphone services.
Originality/value – The proposed model brings together extant research on IS use and technology acceptance.

Keywords Behaviour, Adoption, Human computer interaction (HCI), IT/IS management
Paper type Research paper

1. Introduction

The diffusion of mobile computing technologies has accelerated during the last century (Ladd *et al.*, 2010), as has mobile phone research (e.g. Butt and Phillips, 2008; Coursaris *et al.*, 2012; Chung *et al.*, 2012; Hong *et al.*, 2012; Koo *et al.*, 2013; Sun and Teng, 2012). Because of its unique combination of technologies, mobile computing has the potential to significantly alter the interactions of individuals, groups, organizations, and societies (Ladd *et al.*, 2010). Smartphones are one of the latest developments in mobile computing technology. Smartphones are an emerging phenomenon for personal and business voice, data, e-mail, and social networking communications, as well as having applications

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through internet access (Oulasvirta *et al.*, 2011). Smartphones offer a combination of technologies, including location tracking, digital cameras, and digital content, including music, apps, and podcasts. A Smartphone provides a myriad of different functions. Some people use Smartphones for a range of tasks from simply making and receiving phone calls to a variety of applications for in-depth use. Clearly, not everyone uses Smartphones in the same way or to the same degree. With usage increasing in the last several years, Smartphones accounted for around 70 percent of all US mobile devices in 2013 (Hardawar, 2012). In case of Korea, the number of Smartphone users reached to 40 million in 2013, which equates to roughly eight out of every ten people (62 percent) in Korea (Strategy Analytics, 2013). The number of active Smartphones worldwide is expected to total around 1.4 billion in 2014 (digitaltrends.com). Smartphone market share also explains the worldwide usage of Smartphones: Asia/Pacific (52.3 percent), Europe (18.0 percent), North America (15.0 percent), Latin America (9.0 percent), and Middle East and Africa (5.7 percent)[1]. Due to the complex characteristics of Smartphone platforms and the broad range of functionality, Smartphone usage behaviors are not easily generalized into usage types along the lines of general information systems (IS). Despite the rapid market growth in recent years, limited research has been conducted in this area. Since the first appearance of the devices on the market, Smartphone usage has extended significantly and limitlessly.

Korean carriers and electronic manufacturers eagerly introduced new Smartphones in late 2009, including the iPhone and Android phones (Kim *et al.*, 2010). According to the Korean Communications Commission, Smartphone subscriptions in South Korea saw staggering growth between late 2011 and early 2012 (Walter, 2014). South Korea is an important Smartphone market for several reasons. First, it is the first connected-device market in the world. Second, it is the home market of Samsung, the Korean manufacturer of devices that are widely used throughout the entire world. Finally, South Korea is home to more early and fast adopters of technology than anywhere else (Walter, 2014). Nearly the first market in the world to reach saturation, 60 percent of Korean residents now own a Smartphone device (Martin, 2012). In addition, mobile application (App) games are the most popular category of games in South Korea in comparison to the rest of the world, and they occupy the most time of users and generate the most revenue ($5.27 in Korea vs $2.92 in the USA per user per month). Social networking accounts for a significant share of App activity in South Korea in comparison to other countries (Martin, 2012). Given the rapid growth in South Korea's Smartphone market, this study investigates Smartphone use in South Korea with a focus on the significant role of user competence (Marcolin *et al.*, 2000; Munro *et al.*, 1997) related to IS infusion (i.e. using the system to its full potential and in innovative ways) (Ahuja and Thatcher, 2005; Saga and Zmud, 1994; Saeed and Abdinnour, 2013; Thatcher *et al.*, 2011).

This study is motivated by two issues. First, previous studies have investigated either personal innovativeness (Ahuja and Thatcher, 2005), ability to explore (i.e. user's perceived competence) (Nambisan *et al.*, 1999), perceptions of internal control (i.e. self-efficacy) (Venkatesh and Morris, 2000), self-efficacy (Venkatesh *et al.*, 2003), and cultural capital (i.e. user self-efficacy and knowledge) (Hsieh *et al.*, 2011a), together with the relationships of users with their intentions to use IS or their actual usage of IS. While most previous research has examined user competence as a single-dimensional construct, the work of Blili *et al.* (1998) suggests that end-user computing competence should be conceptualized in three dimensions, including user characteristics, usage characteristics, and application characteristics. Munro *et al.* (1997) also argued that individual users need differing competencies such as breadth, depth, and finesse to fulfill a variety of different tools, skills, and knowledge to the extent of mastery and creative capability.

Unlike the usage of typical IS, the limitless possibilities of Smartphone usage should be explored to understand user differences, including attitude and learning (as well as user competence). March (1991) provided a theory of exploitation and exploration innovation in an overall theory of organization (March, 1991). The theory of exploration and exploitation innovation can be adapted for Smartphone usage in IS infusion. In the context of Smartphones, the concept of exploration is analogous to "search, discovery, and innovation," whereas, the concept of exploitation includes such things as "production, efficiency, implementation, and execution." Thus exploration and exploitation are distinctive and clearly different concepts.

A recent study in IS by Saeed and Abdinnour (2013) examines enhanced usage (i.e. exploitation) and exploratory usage. Some IS researchers have investigated the usage of IS systems (Saeed and Abdinnour, 2013) in an infusion context, while others have examined adoption behaviors of households (e.g. PC users) in an office context (Venkatesh and Brown, 2001) and internet shopping behaviors in a consumer use context (Venkatesh *et al.*, 2012). A study by Ghose *et al.* (2013) explores how internet browsing behavior is somewhat different between users of mobile phone and PC platforms. Despite the growth of Smartphone usage since 2007, however, there is a scarcity of IS research investigating the relationship of Smartphone usage with its perceived usefulness and IS user competence and its sub-dimensions (Eschenbrenner, 2010; Munro *et al.*, 1997) for different types of usage. Moreover, while competence has been widely measured in organizational settings (e.g. Gravill *et al.*, 2006; Marcolin *et al.*, 2000), research on competence at the individual level is incomplete (Basselieer *et al.*, 2001). Certain IS adoption models that deal with concepts of perceived ease of use and self-efficacy (Venkatesh and Morris, 2000), particularly the unified theory of acceptance of use of technology (UTAUT) (Venkatesh *et al.*, 2003), do consider user competence (i.e. self-efficacy) as a determinant of IS usage. The relatively limited amount of research on this topic in the context of the stages of IS usage, however, warrants studying IS user competence to provide important insights into the use of Smartphones (Eschenbrenner, 2010).

As for the second motivation, existing IS usage models have focussed on early adoption decisions or usage amounts (e.g. intention to use, frequency of use) (Davis, 1989; Chin and Marcolin, 2001; Taylor and Todd, 1995). Only a few models have gone beyond this topic to explore the infusion stage (Jasperson *et al.*, 2005). Existing theories have made a few attempts to explain extended usage behavior during IS infusion. Theoretically, the usage behavior of IS infusion is distinct from the usage behavior of adoption. To understand how innovation is incorporated in usage, it is necessary to examine the nature and extent of infusion of an innovation (Jasperson *et al.*, 2005; Saga and Zmud, 1994; Saeed and Abdinnour, 2013; Thatcher *et al.*, 2011; Zmud and Apple, 1992). This topic involves the use of a wider range of technology features and innovations, such as is expected to occur during the post-acceptance stage of usage (Jasperson *et al.*, 2005; Hsieh and Wang, 2007; Hsieh *et al.*, 2011a; Saga and Zmud, 1994). A more sophisticated usage concept, which elaborates on usage behavior related to IS infusion may provide valuable explanations of IS usage patterns.

The objective of this study is two-fold. Conceptually, we recognize the need for a comprehensive study of technology usage patterns from the perspective of IS user competence (e.g. innovativeness, ability, and self-efficacy). The main goal of this study is therefore to investigate the effects of user competence on two different usage variables related to IS infusion, namely, exploitative and explorative use. The second goal of this study is to provide a better understanding of the two main determinants of IS continuance (i.e. perceived usefulness and satisfaction) (Bhattacherjee, 2001; Limayem *et al.*, 2007) and their relationships with different types of IS infusion in the context of Smartphones. To accomplish the research objectives, we develop a research model based on the integration of user competence and IS continuance model, which is tested through a survey of Smartphone users in South Korea. Theoretically, we suggest exploitative and explorative use theory in the context of Smartphones. Practically, this study provides a range of recommendations to Smartphone developers and service providers. In particular, it lends insights on how to promote Smartphone use by individual users.

2. Conceptual background

2.1 Smartphone characteristics

A cellular device combining telephony, internet access, and built-in applications is the advanced application programming interface (API) on Smartphones for running their-party applications (*PC Magazine*, 2011). In 2008, Apple introduced third party native applications (both free and paid), in which users can choose Apps from the App Store to download directly via iTunes – as often and as many as they want – among many different billions of applications. Apple's specific Smartphone device provides built-in multi-functions, including Maps, Calendar, Gmail, a full HTML web browser, the capability to interact with a multi-touch interface by direct finger input, an improved camera with both back-facing and front-facing photo functionality, a camera for video conferencing, wireless third generation connectivity, and synchronizing backup, along with additional features such as iCloud (wikipedia.org). Users can search/browse for information, communicate (via e-mail, telephony, or chat), shop online, manage their tasks, and much more. Of course, not everyone uses Smartphones as broadly or to the same degree in depth.

Some users limit themselves to simple using, while others fully engage to maximum capacity in a variety of different using activities. Some competent users are likely to develop more extensive Smartphone use. In other words, users with a certain degree of overall Smartphone functionality do not restrict IS usage to a couple of specific purposes only. Given the rapid evolution in the Smartphone market, Smartphones account for around 70 percent of all US mobile devices as of 2013 (Hardawar, 2012). Due to the unique characteristics of the platform and the broad range of functionality, the characteristics of Smartphones – unlike general IS and household technology – are not easily generalized into types of usage that are either exploitative or explorative. Theoretically, much IS research examined specific systems in the context of adoption and post-adoption usage behavior. In spite of the various findings of existing research, we argue that Smartphones have totally different aspects in terms of the integration of hardware and software, commerce and computing, among a wide range of additional functionality.

2.2 Usage behavior in the infusion stage

Cooper and Zmud (1990) explicitly recognized a variety of post-adoption behaviors beyond the initial decision to adopt or reject IS. They posited that the stage model is not only applicable to organizational-level phenomena, but also to individual-level analysis. Thus, IS use among individual users might also be viewed as progressing through six stages (Agarwal, 2000). Drawn from Cooper and Zmud (1990), the work of Saga and Zmud (1994) suggests four different stages of the information technology (IT) diffusion process, as follows:

(1) adaptation, in which IS is modified to foster a better fit between individuals, organizations, and IT applications;

(2) acceptance, in which efforts focus on encouraging employees to commit to using an application;

(3) routinization, in which alterations to the system ensure that IT is no longer perceived as new or out of the ordinary; and

(4) infusion, in which IT applications become deeply embedded within an organization's work processes (Ahuja and Thatcher, 2005).

Post-adoption corresponds to the last two stages of this process (i.e. routinization and infusion), after the acceptance stage, while IS continuance (Bhattacherjee, 2001) corresponds to the routinization stage. During the initial stage of the IT diffusion process, users learn new technologies and become familiar with ways to use them. During the infusion stage, users are likely to attempt IT innovations to meet existing (but unmet) needs and apply them to emerging job demands (Ahuja and Thatcher, 2005). Through direct experience with IS and associated learning processes, individuals gain the capability to use IS to its full potential in ways that are innovative, ad-hoc, and noble (i.e. IS infusion).

The work of Saga and Zmud (1994) indicates that the infusion stage can be measured in three different ways, namely, extended use, emergent use, and integrative use. The concept of extended use refers to the ways in which users apply more of a technology's features to accommodate a more comprehensive set of work tasks. Schwarz (2003) proposed the concept of deep usage, which describes the extent of use of different features of technology. Both of these concepts emphasize more complex usage to support tasks. Saga and Zmud (1994) also conceptualized emergent use, which refers to using technology in ways that were not recognized prior to implementation of the technology. Jasperson *et al.* (2005) proposed a similar concept, feature extension, in which users discover ways to apply the features of a technology beyond the uses defined by the technicians of an application. Ahuja and Thatcher (2005) introduced the concept of innovating through IT to describe post-adoptive IS behavior.

Exploitative use and explorative use are types of IS usage in the IS infusion stage. At the individual level, Burton-Jones and Straub (2006) conceptualized exploitative system usage as usage related to short-run task performance, while explorative system usage is linked to long-run task performance. In this case, exploitative usage refers to usage that implements and executes a user's knowledge of the system and task. A conceptualization of the stages of technology use is illustrated in Figure 1.

2.3 Two types of IS use: exploitative use and explorative use

Based on the theory of exploitation and exploration innovation borrowed from the work of March (1991), we focus on exploration and exploitation innovation theory in order to formulate a theory for the two types of use in the IS infusion phase. March explained that the concept of exploration is analogous to "search, discovery, and innovation," whereas the concept of exploitation refers to concepts such as "production, efficiency, implementation, and execution." Exploration and exploitation are distinctive concepts that are clearly different from one another. Exploration focusses on sensing, searching, and scanning slowly for answers to any questions, while exploitation is

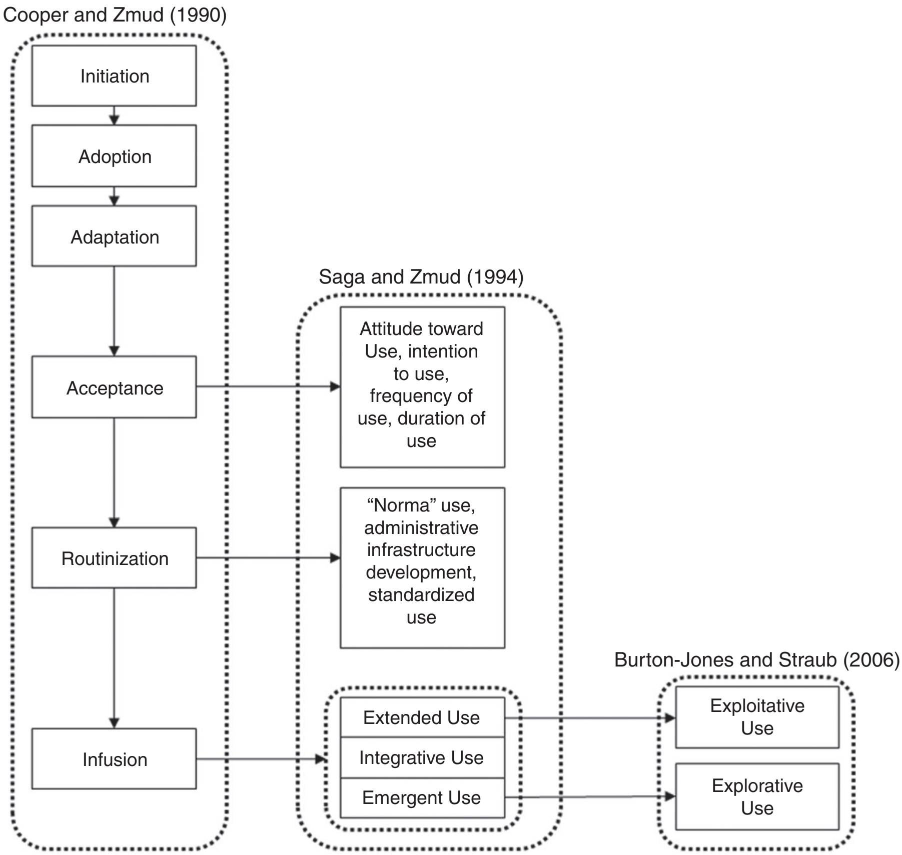


Figure 1.
The stages of technology use

for executing, conducting, and realizing with speed. Thus March argued that the sure and fast routine of exploitation activities bolster explorative activities such as experimentation, change, and innovation. In the context of IS, two behavior types are adopted to discuss usage behaviors in the infusion stage at the individual level, which are exploitative use and explorative use, as suggested by Burton-Jones and Straub (2006). As these authors noted "exploitation refers to routine execution of knowledge, whereas exploration refers to the search for novel or innovative ways of doing things (p. 236)." Therefore, drawing on the general behaviors of exploitation and exploration, we propose two types of usage, which we describe as exploitative use and explorative use, to inform our investigation of Smartphones. Table I summarizes the key characteristics and differences between explorative use and exploitative use.

We conceptualize the two types of IS use, exploitative use and explorative use, based on established concepts of exploration and exploitation in other contexts. Exploration and exploitation have long been recognized as critical organizational activities (Durcikova *et al.*, 2011). In the context of organizational learning, March (1991) defined exploration as a learning mechanism, the goal of which is experimentation with new alternatives. Thus exploration is the pursuit of new possibilities, which includes a class of activities whose goal is to learn about the environment and discover novel ways of

	Exploitative use	Explorative use
Definition	Using more system features to complete tasks	Using the system in an innovative manner to support tasks
Relevant general behavior (Exploitation vs Exploration)	Exploitation is chiefly interested in refining and extending existing skills and capabilities	Exploration is concerned with challenging existing ideas with innovative and entrepreneurial concepts
	IS for exploitation refers to using the system to perform structured, repetitive tasks to improve efficiency	IS for exploration refers to using the system to perform unstructured tasks or existing tasks in innovative ways
Characteristics	The class of activities whose goal is to improve operational efficiencies	The pursuit of new possibilities, which includes a class of activities whose goal is to learn about the environment and discover novel ways of creating value or solving old problems
	Activities such as refinement, production, efficiency, selection, implementation, and execution	Activities such as exploring new skills and resources, and testing definitions of customer needs that might deliver breakthrough ideas
	Exploitation leverages existing knowledge through the application of pre-established procedures, technologies, and solutions	
	Leads to better outcomes such as efficiency	Leads to novel outcomes and innovative solutions to problems

Table I. Comparison between explorative use and exploitative use

creating value or solving old problems (Subramani, 2004). Exploration includes activities such as exploring new skills and resources, testing definitions of customer needs rather than accepting customer needs as given, and engaging in activities that might deliver breakthrough ideas (Auh and Mengue, 2005; March, 1991). In other words, exploration is characterized by search, discovery, experimentation, risk taking, and innovation (He and Wong, 2004; Subramani, 2004). Exploration can therefore lead to novel outcomes and innovative solutions to problems (Durcikova *et al.*, 2011).

While exploration is concerned with challenging existing ideas with innovative and entrepreneurial concepts, exploitation is chiefly interested in refining and extending existing skills and capabilities. Exploitation is thus the extension or elaboration of old certainties (Subramani, 2004), which describes a class of activities whose goal is to improve operational efficiencies (e.g. by way of increased standardization, tighter process controls, and reduced manual intervention). That is, exploitation leverages existing knowledge through the application of pre-established procedures, technologies, and solutions (Durcikova *et al.*, 2011). Exploitation includes activities such as refinement, production, efficiency, selection, implementation, and execution (March, 1991). The distinction between exploitation and exploration is succinctly summarized by March (1991) as the difference between the "exploration of new possibilities" and the "exploitation of old certainties." Indeed, the exploitation of existing capabilities often leads to the exploration of new capabilities (He and Wong, 2004).

Because exploration and exploitation refer to general behavior in the context of organizational learning or knowledge management, we extend the previous research (Auh and Mengue, 2005; Burton-Jones and Straub, 2006; Durcikova *et al.*, 2011; He and Wong, 2004; March, 1991; Subramani, 2004) on exploration and exploitation to propose two terms, explorative use and exploitative use, specific to the context of IS use. In the IS usage context, exploitation refers to using the system to perform structured, repetitive tasks to improve efficiency (Subramani, 2004). In contrast, exploration refers to using the system to perform unstructured tasks or existing tasks in innovative ways

(Subramani, 2004). We define the concept of exploitative use as using more of the available system features to complete tasks. We further define the concept of explorative use as using the system in an innovative manner to support tasks. The extended use and emergent use concepts of Saga and Zmud (1994) can be mapped to exploitative use and exploratory use, respectively, as in Figure 1.

In the context of Smartphone usage, exploitative use means using more Smartphone features in automatic, substantial, technical, or productive ways, while explorative use means using Smartphone features in an innovative and new ways. IS infusion (i.e. using the system to its full potential) requires a high level of user competence in using the IS (Saga and Zmud, 1994). For this reason, the next section discusses user competence.

2.4 User competence and IS usage

Previous research has discussed the importance of user competence in IS usage. Existing IS literature describes different conceptualizations of competence, ranging from task-oriented concepts to broader requirements attached to specific professions (Bassellier and Benbasat, 2004). Previous studies of IS competence are investigated with similar types of variables, such as personal innovativeness (Ahuja and Thatcher, 2005), ability to explore (Nambisan *et al.*, 1999), perceptions of internal control (Venkatesh and Morris, 2000), self-efficacy (Venkatesh *et al.*, 2003), and self-efficacy and knowledge for cultural capital (Hsieh *et al.*, 2011a), which we summarize in Table II. A study by Marcolin *et al.* (2000), however, asserts that "understanding how to assess the competence of users is critical in maximizing the effectiveness of IT use. Yet the user competence construct is largely absent from prominent technology acceptance and fit models, poorly conceptualized, and inconsistently measured (p. 37)."

A study by Blili *et al.* (1998) emphasizes that the importance users attach to a particular system, including user, usage, and applications characteristics, is closely related to user tasks. Another notion is cognitive knowledge as an IS user competence dimension. Competence is dependent on the knowledge and skill level of an individual in a particular domain. Thus, expertise in an IS domain is dependent on an individual's IS knowledge and IS capability (Bonner and Lewis, 1990). From this concept, it can be inferred that a prerequisite for being an expert is having adequate knowledge about a specific domain. A study by Munro *et al.* (1997), however, conceptualizes user competence in end-user computing environments, and suggests three independent dimensions, including breadth, depth, and finesse.

Breadth refers to the extent or variety of different end-user tools, skills, and knowledge that an individual possesses and can bring to bear on his or her job. Depth refers to the completeness of the user's current knowledge of a particular technology sub-domain. This includes the degree to which the user has mastered the full features of a specific technology package and to which they are able to apply the package's toolset to support their tasks. Finesse is defined as the ability to creatively apply a specific technology. Competent user behavior with Smartphones requires not only proficient control of computing hardware/software usage skills, but also needs to generate self-realization about the newness of Apps. Along these lines, we embody these three dimensions for user competence in Smartphone usage.

Individual competence refers to using the systems based on ability or skill, computer literacy, and expertise and proficiency (Marcolin *et al.*, 2000). However, there are still limits to the terms of exploitative use and explorative use. Current concepts of competency with any targeted application and systems have already been researched. However, unlike the typical IS aspects of usage, the limitless and endless content of

Table II. Previous research on user competence

Research	Dimension	User competence measures	Findings
Hsieh *et al.* (2011a)	Single dimension	Belief in one's own capabilities to use ICT	Self-efficacy for cultural capital influences initial intentions to use ICT
Wang and Haggerty (2008)	Multi-dimensional	Virtual self-efficacy, virtual media skills, virtual social skills	Virtual competence influences knowledge transfer in an organization; individuals who have previously engaged in more virtual work activities and related virtual communication activities will develop greater virtual self-efficacy over time, which improves their virtual competence
Bassellier and Benbasat (2004)	Multi-dimensional	Organization-specific knowledge, interpersonal and management skills	Organization-specific and interpersonal and management skills influence business competence positively, and in turn, business competence significantly influences the intentions of IT professionals to develop partnerships with business clients
Venkatesh *et al.* (2003)	Single dimension	Belief in one's own capabilities to use IT	Self-efficacy does not have any direct effect on user intention
Bassellier *et al.* (2003)	Multi-dimensional	IT knowledge and IT experience	IT knowledge and IT experience have a positive impact on managerial intentions to champion IT
Basselieer *et al.* (2001)	Multi-dimensional	Explicit IT knowledge, Tacit IT knowledge (experience and cognition)	IT competence influences Theory of Planned Behavior variables (attitude toward line technology leadership, subjective norm, and perceived behavior control), and in turn, these variables are the predictors of intentions toward line technology leadership
Venkatesh and Morris (2000)	Single dimension	Belief in one's own capabilities to use IT	Self-efficacy determines early perceptions about the ease of use of a new system
Marcolin *et al.* (2000)	Multi-dimensional	Knowledge and self-efficacy	User competence is a multifaceted phenomenon that is assessed differently by different measurement methods
Blili *et al.* (1998)	Multi-dimensional	User ability, usage intensity, and application customization	The level of task complexity and perceived importance that users attribute to end-user computing influences both EUC competence and success
Munro *et al.* (1997)	Multi-dimensional	Breadth and depth of knowledge, and the ability to creatively apply user knowledge	Dimensions of competence relate differently to individual factors, such as gender, education, self-efficacy, and specific software-syntax skills

Smartphones should be explores to understand the differences of Smartphone users, including user attitude and learning (including user capability) according to dimensions of breadth, depth, and finesse (Munro *et al.*, 1997). IS capability (i.e. competence) is an important factor to engage in a more comprehensive manner regarding high-level features of emerging technology (Saeed and Abdinnour, 2013).

The stage of IS infusion involves a user's full potential and the ongoing challenging to maximize the system's possibility, which affects users differently depending on the level of user competence. The IS infusion stage has become a routinized aspect of the nature of IS, and only reinforces the least habitual user behaviors (Jasperson *et al.*, 2005; Limayem *et al.*, 2007). Indeed, IS infusion explores a system in innovative and new ways (Ahuja and Thatcher, 2005; Burton-Jones and Straub, 2006). Accordingly, the IS infusion model needs to add an aspect of user competence to explore exploitative and explorative use in the context of Smartphone model formation.

2.5 *Antecedents: perceived usefulness, satisfaction, and user competence*

Theories on IS use in post-adoption stages have garnered attention in important research (Jasperson *et al.*, 2005; Saga and Zmud, 1994; Saeed and Abdinnour, 2013). IS researchers have focussed on what factors will help individual users achieve the performance of his/her tasks with more of the available IS features in post-adoption stages. Prior research has explored many antecedents and moderating effects of both initial acceptance and post-adoption. Consequently, previous research has found several antecedents of IS continuance (Bhattacherjee, 2001; Limayem *et al.*, 2007) and IS infusion (Hsieh and Wang, 2007; Saeed and Abdinnour, 2013; Thatcher *et al.*, 2011). Especially, studies by Venkatesh and Brown (2001) and Venkatesh *et al.* (2012) focus on utilitarian and hedonic factors, together with social influences on household and consumer usage behavior, from an end-user perspective. We assert that the major antecedents of technology usage are perceived usefulness and satisfaction, as conceptualized in the IS continuance model (Bhattacherjee, 2001; Limayem *et al.*, 2007). The work of Limayem *et al.* (2007) reconfirms these two major determinants on IS continuance.

However, IS infusion (i.e. using the system to its full potential) is different from IS continuance (i.e. routine use). IS infusion requires an individual engage more in the motivations and his or her competence in voluntarily exploring the potential of IS beyond the simple performance of individual user tasks. On the other hand, the key to maximizing the potential of IS is competence, which enables users to translate ideas into highly-valued productivity in the workplace. A high level of competence ensures that users are able to fully utilize not only IS features, but also to change and improve the routines of IS use.

Competence is important in shaping how an individual develops their potential ability (Marcolin *et al.*, 2000). Users who are competent with a target system tend to be more proactive and affirmative in using the system, and tend to demonstrate alternative ways of finding more efficient and effective methods, or furthering creative and novel ideas. Therefore, the importance of user competence as an explanatory factor in IS infusion, including explorative and explorative use, is significant even though previous IS continuance studies have not included user competence (Bhattacherjee, 2001; Limayem *et al.*, 2007). The impact of the usefulness of Smartphones has become enormous, both for individual consumers and industry wide. In the context of Smartphones, user competence is largely related to the level of experience, ability, and learning, which Smartphone users engage for different types of multifeatured functions, as well as diverse Apps, for increasing performance of specific tasks. Accordingly, we take into account perceived usefulness, satisfaction, and user competence in exploring the dynamics of usage in the context of Smartphones.

The three key antecedents (perceived usefulness, satisfaction, user competence) need to be investigated in terms of exploitative and explorative use of IS by users. However, the handful of IS infusion studies that deal with the notion of exploitative use and explorative use employ models and factors that are typically applied to IS continuance models (Hsieh and Wang, 2007), or examine the motivations that cause users to pursue personal interests with uncertain payoff in the context of mandatory organizational settings. Indeed, while previous research has examined extrinsic (e.g. perceived usefulness) and intrinsic (e.g. satisfaction) motivations as high predictors for the continued use of IS, this study suggests that these motivations are not strong enough for the infusion stage of IS because they lack a differentiating factor (i.e. competence), which induces the characterization and development of high-level individual user abilities. Therefore, constructs for exploitive and explorative use are needed to stabilize the extrinsic and intrinsic motivations of users, and to explore user competence as a key factor in the context of Smartphone use.

3. Research model and hypotheses

This study adopts an IS continuance model (Bhattacherjee, 2001) as its main overarching theory, because the IS continuance model has been commonly used for explaining the post-adoption stage of IS. However, IS infusion requires high-level skills and knowledge among users when it comes to using the system. For this reason, we add a factor of user competence to the IS continuance model by conceptualizing it as a second-order formative construct with its three dimensions (finesse, breadth of knowledge, and depth of knowledge). Munro *et al.* (1997) explained the three dimensions of user competence. Petter *et al.* (2007) provided decision rules in modeling second-order constructs for formative models and reflective models. In conceptualizing user competence for our purposes herein, there are three issues to consider, as follows: the three dimensions of user competence are not interchangeable, the dimensions do not necessarily covary with each other, and the three dimensions are defining characteristics of user competence. For these reasons, we model user competence as a second-order formative model based on the decision rules of Petter *et al.* (2007).

Our proposed research model is shown in Figure 2. This model was developed based on a theoretical combination of user competence (Marcolin *et al.*, 2000; Munro *et al.*, 1997) and the IS continuance model (Bhattacherjee, 2001; Limayem *et al.*, 2007), which explains post-adoption usage (Jasperson *et al.*, 2005; Hsieh and Wang, 2007; Saeed and Abdinnour, 2013) in terms of perceived usefulness and user satisfaction. The current research model treats perceived ease of use as a control variable because prior literature has indicated that perceived ease of use becomes less important in the post-adoption stage of IS (e.g. Bhattacherjee, 2001). Perceived ease of use is expected to have a significant effect, mainly as a near-term consequence (initial adoption). On the other hand, perceived usefulness is predicted to have both near-term and long-term consequences. For these reasons, perceived ease of use was excluded from the main model, while its effect on both exploitative and explorative use was controlled for in our analysis.

Perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). In other words, perceived usefulness may represent a user's subjective belief that certain technology systems contribute to improvements in his or her performance.

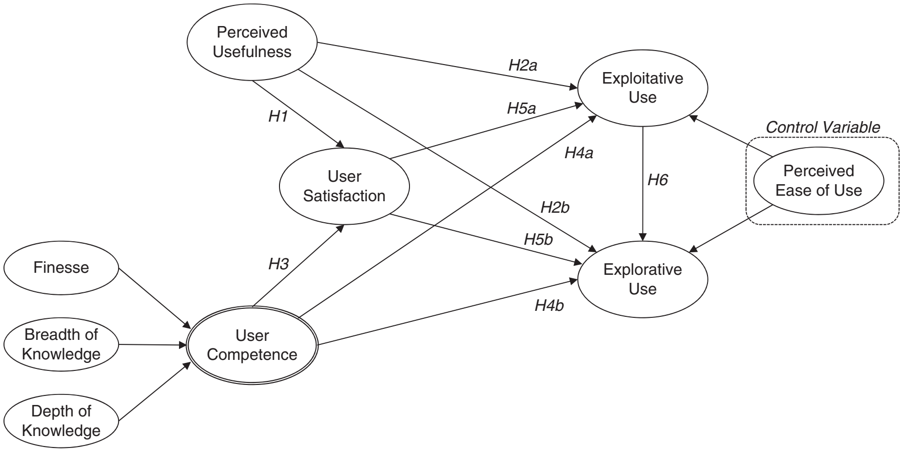


Figure 2.
Research model

Note: User competence is modeled as a second-order formative construct based on its three dimensions

In the broad context of Smartphone settings, manufacturers provide built-in multifunctions, including map and calendar functions, e-mail, and web browsers, which provide users with the opportunity to work effectively. What is more, users download many different Apps directly from the App Store and are thereby able to fulfill and manage their personal and official tasks at any time and any place. Thus we define perceived usefulness as the degree to which a user believes that using a Smartphone enhances his or her performance in doing what he or she wants, as a result of the diverse functions, Apps, and content.

The IS continuance model explain usage behavior after the initial adoption of a technology, and argue that after initial use, cognitive beliefs such as individual perceptions of system usefulness may change, leading to repeated behaviors or discontinued usage (Bhattacherjee, 2001; Limayem *et al.*, 2007). In the context of Smartphones, satisfaction will emerge and become an instant behavioral determinant (*New York Times*, 2013). This model posits that the intent to continue usage is determined primarily by a user's satisfaction with prior use of Smartphone features (e.g. platform system, App, and podcasts). Satisfaction refers to an individual's evaluation and affective response to the overall experience of a Smartphone's functions, Apps, and podcasts. The IS continuance model explains that the perceived usefulness of a technology increases user satisfaction with the technology. Therefore, perceived usefulness should increase user satisfaction in the context of Smartphone use:

H1. Perceived usefulness has a positive effect on user satisfaction in the context of Smartphones.

A study by Fang *et al.* (2005) indicates that perceived usefulness influences user intentions to perform general tasks in the context of wireless PDA. Perceived usefulness reflects perceptions of performance-use contingency, and has been closely linked to outcome expectations (Venkatesh and Morris, 2000). The robustness of the technology acceptance model (TAM) has shown that perceived usefulness is a strong determinant of user acceptance, adoption, and usage behavior (e.g. Davis, 1989; Taylor and Todd, 1995; Venkatesh and Morris, 2000). Users who have better insight into system functionalities are likely to both exploit the system to accommodate tasks and to explore the system to organize related tasks. Interestingly, not everyone uses Smartphones in the same way or to the same degree. We believe that, depending on the extent of perceived usefulness, users may use Smartphones either extensively, or use them for exploratory purposes, in ways that are limitless and boundless. If users at first employ a small number of system features, over time they will find additional useful features (Robey *et al.*, 2002) (i.e. exploitative use). As users become familiar with a system, they may not be content with the current use scenario, and they may find more useful functionalities (i.e. explorative use) to support their endeavors (Hsieh and Wang, 2007).

Saeed and Abdinnour (2013) found that perceived IS usefulness is a good predictor of extended usage and exploratory usage, particularly impacting exploratory usage. The reason for the strong effect of perceived usefulness on exploratory usage may be associated with the aptitude of individuals to learn and improve in their capability to manage devices (Jasperson *et al.*, 2005). In terms of Smartphone devices, people use a range of built-in multifunctions, starting from a foundation of maps, calendars, Gmail, and cameras for video conferencing, up to synchronizing backup, along with additional features such as iCloud. Users can search/browse for information, communicate, download a variety of Apps and content, shop online instantly, manage their personal and official tasks, and much more. Therefore, perceived usefulness should affect the two types of IS infusion usage, exploitative use and explorative use, in the context of Smartphone use:

H2a. Perceived usefulness has a positive effect on exploitative use of Smartphones.

H2b. Perceived usefulness has a positive effect on explorative use of Smartphones.

User satisfaction is determined by a user's beliefs concerning the consequences or outcomes of that behavior. The belief of users about one's own technological ability (including effort and performance) enables users to fully utilize not only IS functions, but also to achieve satisfaction with use (Bhattacherjee, 2001; Chung and Lee, 2011; Limayem *et al.*, 2007). User competence is largely related to levels of experience, ability, and learning, which are rapidly engaged in various types of multifeatured functions and information in Smartphones, to provide users with higher levels of satisfaction. Users first install IT applications, and subsequently extend features as sets are frequently made available (Jasperson *et al.*, 2005) to enhance innovative usage of a system (Ahuja and Thatcher, 2005; Burton-Jones and Straub, 2006). These activities and the associated feelings of increasing competence intensify the levels of user satisfaction (Limayem *et al.*, 2007). We argue that user competence will induce high-level abilities among individuals to integrate hardware platforms and software apps, and to successfully perform his or her intended objectives. Eventually, this competence provides users with added value and instant gratification. As the subjective nature of knowledge represents personal beliefs that are associated with individual IT competence, individual knowledge about IT reflects individual beliefs about IT (Basselieer *et al.*, 2001). An individual with a high level of competence will anticipate and seize satisfactory opportunities to obtain useful Apps and implement habitual practices that add value. Therefore, a user with a high level of competence tends to be more satisfied with Smartphone use:

H3. User competence has a positive effect on user satisfaction in Smartphone use.

A study by Jasperson *et al.* (2005) posits that users generally employ a narrow space of technology, operate at low levels of feature functionality, and rarely initiate technology- or task-related extensions of the available features. Less competent users may not be able to adapt IS to novel situations, or they may have limited capabilities to utilize IS to address problems that arise. In addition, they are less likely to be able to apply subject matter knowledge if they lack IS skills (Eschenbrenner, 2010). A study by Marcolin *et al.* (2000) suggests that IS use models must include the concept of user competence. In its modified task-technology fit model, the Marcolin *et al.* study (2000) proposes that IS use and user competence are related to each other. Using various features of a technology and engaging in active thinking are typically associated with exploring a system to learn how to accomplish new tasks (Thatcher *et al.*, 2011). We discuss the effects of user competence on the types of IS infusion. Accordingly, user competence should affect the two types of IS infusion usage (i.e. exploitative use and explorative use). Specifically, some competent users are likely to use the features of Smartphones in ways that are extensive and comprehensive, regarding a broad range of functionalities. Others are likely to be more exploratory in their use, while remaining restricted to only a certain domain of Apps (e.g. medical, arts, sports expertise Apps) in the context of Smartphone use:

H4a. User competence has a positive effect on exploitative use of Smartphones.

H4b. User competence has a positive effect on explorative use of Smartphones.

The relationship between user satisfaction and system usage has been empirically tested in IS environments (Bhattacherjee, 2001; DeLone and McLean, 1992, 2003). Bhattacherjee (2001) developed an IS continuance model and posited that the intentions of users for IS continuance are influenced by their satisfaction with prior system use. Positive experiences will increase user satisfaction. Limayem *et al.* (2007) argued that beginners tend to rely on ease of use when it comes to IS continuance, while experienced users are inclined to consider ongoing usage on the utilitarian value of technology, and eventually "get into the habit" of continued use. Thus to a certain degree, a satisfactory experience with any single IS system is a key factor for continued use of various applications (Limayem *et al.*, 2007).

In contrast, when it comes to perceived business-related benefits (i.e. satisfaction), the capability of organizations to fully leverage their current IT stimulates organizational members to explore the technology in order to discover the features that meet their work needs (Thatcher *et al.*, 2011). In the long term, increased user satisfaction will lead to increased intention to use, and thus will lead to increased use reciprocally (DeLone and McLean, 2003). A TAM-based study also predicts that attitude toward technology is an important antecedent of technology use. That study by Coursaris *et al.* (2012) finds the impacts of distractions on efficiency and effectiveness, and on the satisfaction and behavioral intentions of users to use a mobile device for wireless data services. Recently developed diverse features of Smartphones allow customers a range of options, from simply scanning bar codes for the provision of home delivery (e.g. peapod.com) to instantly buying items described in an article by tapping a shopping cart icon on the page (e.g. Vogue Magazine) (*New York Times*,2013). Therefore, user satisfaction should affect the two types of IS infusion usage, exploitative use and explorative use, in the context of Smartphone use:

H5a. User satisfaction has a positive effect on exploitative use of Smartphones.

H5b. User satisfaction has a positive effect on explorative use of Smartphones.

The work of Wang and Hsieh (2006) integrates the symbolic adoption construct with the IS continuance model in order to deal with the use of a system in mandatory settings, such as the work place. When a user encounters a system in a voluntary context, he or she has two decisions to make: to accept or not to accept the idea, and to use or not to use the system. In a mandatory setting, however, a user is likely compelled to use the system before he or she accepts the system. The Wang and Hsieh(2006) study also argues that extended use is positively associated with emergent use. By using more of a technology's features (i.e. exploitative use), users are motivated to acquire more experience and knowledge about the system. Higher levels of experience and knowledge will enhance user capacities for utilizing the system more creatively (Limayem *et al.*, 2007). If, in the case of Smartphones, users exploit multifeatured IS for many different purposes (i.e. comprehensiveness of usage) at their own pace and on their own time, then we assume that users will be more able to engage in activities that are more exploratory in nature. Therefore, exploitative use should affect explorative use in the context of Smartphone use:

H6. Exploitative use has a positive effect on explorative use in the context of Smartphones.

4. Research methodology

Data were collected through a field survey of Smartphone users in South Korea to empirically validate the research model in Figure 2. As voice call-oriented businesses transformed to fixed-mobile convergent businesses in recent years, the three major South Korean players, Korea Telecom, LG U+, and SK Telecom, competed to offer the best Smartphone services to the largest number of users. There were more than 20 million people (out of a population of 45 million people) using Smartphones in South Korea as of 2012. For this reason, South Korea is a good setting for this study.

4.1 Data collection

We conducted our survey with the assistance of a leading internet research firm in Korea. The internet research firm electronically distributed the questionnaire to randomly selected potential Smartphone users from November 20 to November 25, 2013. A screening question was used to select those who had experienced at least two years of Smartphone use including the preceding year, which is appropriate for the context of our research (i.e. the use of IS at the infusion stage). Based on the screening question, 322 respondents were collected. Table III summarizes the demographic information of respondents.

As shown in Table III, 48.8 percent of respondents were male, and 51.2 percent were female, thus evenly distributing the gender of respondents. In terms of marital status, 31.7 percent of the sample was single, and 68.3 percent of respondents were married. Respondents who were attending university or who had university degrees comprised a majority of the sample (60.9 percent). Almost one-third of the respondents (30.1 percent) had monthly incomes over US $4,000 (US $1 = approximately 1,000 Korean won). In terms of occupations, office workers comprised the largest proportion (37.3 percent) of the sample, and homemakers comprised the second largest proportion (17.7 percent) of the sample. With regard to Smartphone usage experience, over half of the sample (54.0 percent) had been using Smartphones for over three years. More users (54.7 percent) named Samsung Galaxy as their favorite Smartphone than any other type of model.

4.2 Instrument development

The measurement items used in this research were adapted from previous studies. To measure the three dimensions of user competence, we followed the method developed

Table III.
Descriptive statistics of respondents

Demographic variable		Frequency	%
Gender	Male	157	48.8
	Female	165	51.2
Marital status	Single	102	31.7
	Married	220	68.3
Education	High school	51	15.8
	2-year College	46	14.3
	University	196	60.9
	Graduate School	29	9.0
Monthly personal income	Less than US$1,000	36	11.2
	$1,000-$1,999	45	14.0
	$2,000-$2,999	80	24.8
	$3,000-$3,999	64	19.9
	$4,000-$4,999	36	11.2
	More than $5,000	61	18.9
Occupation	Student	34	10.6
	Office worker	120	37.3
	Sales and service	12	3.7
	Technician	20	6.2
	Professional	26	8.1
	Business person	33	10.2
	Civil servant	7	2.2
	Homemaker	57	17.7
	Other	13	4.0
Smartphone usage experience (years)	Under 3	148	46.0
	3-4	112	34.8
	4-5	40	12.4
	Over 5	22	6.8
Smartphone type	iPhone Apple	47	14.6
	Samsung Galaxy	176	54.7
	LG Optimus	51	15.8
	Other	48	14.9
Total		322	100.0

and tested by Munro *et al.* (1997). Specifically, measures of breadth and depth were taken for three different knowledge areas (hardware, software, and concepts and practices). Prior literature records several features that are necessary for the optimal Smartphone, including a multitasking operating system, a powerful processor, a real QWERTY keyboard, high screen resolution, internet access, tools for business productivity, e-mail, MMS and IM services, personal information management functionality, host synchronization, voice communication and voice mail, WiFi for VoIP, and Bluetooth for cable replacement (Chang *et al.*, 2009). Therefore, we designed our questionnaire by elaborating on these specific Smartphone features. In measuring the breadth of knowledge of respondents, respondents were asked to indicate (per each Smartphone feature) whether or not they had ever used the feature. The final breadth of knowledge score was calculated by summing up the number of items that respondents had previously used or been aware of. To measure the depth of knowledge of respondents, we asked the respondents to rate their level of knowledge for each of the same Smartphone features they considered in the breadth of knowledge portion of the questionnaire. The ratings were measured on a seven-point Likert-type scale ranging from (1) very limited knowledge to (7) complete knowledge.

The dimension of finesse was also measured by three items adapted from the work of Munro *et al.* (1997) on the seven-point Likert scale.

Items for perceived usefulness and perceived ease of use were adapted from the work of Gefen *et al.* (2003). We use the term "task" to describe activities related to the use of Smartphones in the context of voluntary usage for personal purposes, such as reading and sending emails, using social network services, and posting messages on web sites. Previous research also uses the term "task" as a measurement item in measuring the usefulness of mobile internet service. In the context of voluntary usage by individual users, Kim *et al.* (2007) articulated an item for the measurement of perceived usefulness as "using mobile Internet enables me to accomplish tasks more quickly." In line with previous research, we use the term "task" in measuring perceived usefulness in the context of voluntary usage of Smartphones for personal purpose by individual users. Items for user satisfaction were adapted from the work of Bhattacherjee (2001). To measure exploitative use and explorative use, we adapted items from Kim and Gupta (2014). Some items were rephrased to reflect the context of Smartphone usage. The questionnaires use the seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). The complete measurement instrument is presented in the Appendix.

5. Data analysis and results

Partial least squares (PLS) analysis was used to examine the data. PLS is a powerful structural equation model that has been used widely in IS research (Chin *et al.*, 2003). The data were tested in a second-order model with reflective measures for the first and second factors of user competence. All measures in this study were treated as reflective constructs. In a reflective measurement model, indicators are considered consequences of the latent variable to which they belong (Jarvis *et al.*, 2003). Therefore, reflective indicators should be highly correlated (Hanseler and Fassott, 2010). PLS-Graph version 3.00 was used to perform the analysis.

5.1 Instrument validation

Self-reported data on two or more variables collected from the same source have the potential to lead to the common method variance problem. Therefore, Harman's single-factor test is used to test for this bias (Podsakoff *et al.*, 2003). The test assumes that if a high level of common method variance is present, then when all of the variables are entered together, they will load on one factor, thereby accounting for a majority of the variance (Wilson, 2010). The single-factor test results do not indicate that a single-factor structure accounts for the majority of the variance, suggesting that common method bias is not a concern in the data. An exploratory factor analysis with varimax rotation results in six factors with eigenvalue > 1 (see Table IV). Depth of knowledge and breadth of knowledge were excluded from this analysis, because these constructs are calculated based on responses (in contrast to the other measures, which are measured using a seven-point Likert scale).

For the analysis, a single indicator (i.e. the sum of questionnaire items) measured scores for breadth and depth of knowledge. An important characteristic of the PLS measurement model is that latent variables with only one indicator are set equal to this indicator, no matter which type of measurement model is chosen (Hanseler and Fassott, 2010). In the first step, we calculated the latent variable scores, subsequently using them for further analysis. We conducted confirmatory factor analysis (CFA) by checking item loadings, reliability, and discriminant validity. Convergent validity is

Table IV.
Exploratory factor analysis results

Ease of use	EOU1	*0.80*	0.24	0.27	0.17	0.21	0.12
	EOU2	*0.72*	0.24	0.28	0.16	0.31	0.24
	EOU3	*0.75*	0.30	0.19	0.19	0.21	0.25
	EOU4	*0.78*	0.26	0.24	0.24	0.22	0.18
Explorative use	EXR1	0.27	*0.77*	0.28	0.15	0.17	0.24
	EXR2	0.23	*0.82*	0.24	0.19	0.17	0.20
	EXR3	0.25	*0.69*	0.24	0.16	0.26	0.29
	EXR4	0.30	*0.71*	0.24	0.18	0.30	0.10
Perceived usefulness	USF1	0.34	0.19	*0.74*	0.26	0.24	0.16
	USF2	0.32	0.23	*0.77*	0.21	0.23	0.14
	USF3	0.18	0.34	*0.77*	0.19	0.18	0.19
	USF4	0.18	0.47	*0.63*	0.18	0.15	0.20
Satisfaction	SAT1	0.26	0.21	0.31	*0.66*	0.16	0.08
	SAT2	0.05	0.11	0.10	*0.86*	0.07	0.14
	SAT3	0.16	0.15	0.16	*0.83*	0.17	0.03
	SAT4	0.15	0.08	0.11	*0.87*	0.03	0.13
Exploitative use	EXT1	0.40	0.21	0.34	0.16	*0.63*	0.27
	EXT2	0.35	0.27	0.33	0.19	*0.64*	0.27
	EXT3	0.34	0.29	0.34	0.17	*0.62*	0.34
	EXT4	0.25	0.36	0.15	0.15	*0.71*	0.25
Finesse	FNS1	0.27	0.13	0.48	0.16	0.16	*0.64*
	FNS2	0.27	0.25	0.22	0.13	0.22	*0.79*
	FNS3	0.15	0.31	0.07	0.16	0.31	*0.77*

assessed using three criteria. First, standardized path loadings, which are indicators of the degree of association between the underlying latent factor and each item, should be > 0.7 and statistically significant (Gefen *et al.*, 2000). Second, composite reliabilities, as well as Cronbach's α, should be larger than 0.7 (Nunally, 1967). Third, the average variance extracted (AVE) for each factor should exceed 50 percent (Fornell and Karcker, 1981). Gefen and Straub (2005) suggested that it is common to have higher cross-factor loadings in PLS. The value of item loadings should be above 0.70, showing that more than half of the variance is captured by the construct. All the items herein have significant score loadings above the threshold of 0.70 (see Appendix). Likewise, composite reliability (CR) and Cronbach's α for all the constructs exceeded 0.7, and the AVE for each construct was greater than 0.5, supporting convergent validity (Campbell and Fiske, 1959; Fornell and Karcker, 1981; Nunnally, 1967).

Discriminant validity is assessed by determining whether (1) the indicators load highly on their own theoretically assigned factors, and not highly on other factors and (2) the constructs share more variance with their own measures than they share with other constructs in the model. In variance analysis, the square root of every AVE is much larger than any correlation among any pair of latent constructs (see Table V). Discriminant validity was thus supported herein (Bhattacherjee and Sanford, 2006).

Next, we obtained factor scores for each of the first-order user competence dimensions, which were in turn used as inputs for the second-order constructs. We evaluated the second-order model in several ways according to the methodology of Petter *et al.* (2007). We checked whether our second-order construct, user competence, was appropriately modeled as a formative latent construct by examining the correlations among the dimensions. All correlations among the four dimensions were significant. Table IV shows modest correlations among the first-order factors (correlation coefficients = 0.377~0.672). We then checked multicollinearity among the first-order constructs. Low variance

Table V. Correlations between constructs

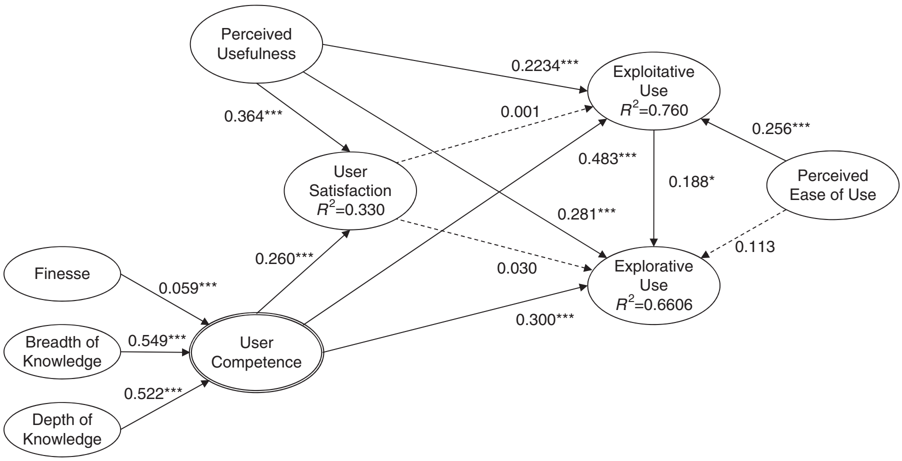
Construct	Cronbach's α	CR	AVE	FN	BK	DK	PU	EOU	ET	SF	ER
FN	0.871	0.921	0.795	*0.892*							
BK	–	1.000	1.000	0.377	*1.000*						
DK	–	1.000	1.000	0.617	0.672	*1.000*					
PU	0.924	0.947	0.817	0.638	0.421	0.592	*0.904*				
EOU	0.939	0.957	0.846	0.639	0.483	0.710	0.699	*0.920*			
ET	0.922	0.946	0.814	0.745	0.505	0.742	0.729	0.773	*0.902*		
SF	0.886	0.920	0.743	0.422	0.324	0.463	0.524	0.495	0.478	*0.862*	
ER	0.926	0.948	0.820	0.655	0.475	0.687	0.721	0.697	0.744	0.470	*0.906*

Notes: FN, Finesse; BK, breadth of knowledge; DK, depth of knowledge; PU, perceived usefulness; EOU, perceived ease of use; ET, exploitative use; SF, user satisfaction; ER, explorative use; leading diagonal shows the square root of AVE of each construct inflation factor values excluded the potential for a multicollinearity problem: breadth of knowledge = 1.83, depth of knowledge = 2.94, and finesse = 1.62 in the case of exploitative use; breadth of knowledge = 1.83, depth of knowledge = 2.53, and finesse = 1.62 in the case of explorative use. In addition, the weights of first-order constructs on user competence were all significant. In sum, these tests supported the proposed second-order formative model of user competence, and verified its construct validity.

5.2 Hypothesis testing

The structural models were examined for their explanatory power and path significance using a bootstrapping technique. The size of the bootstrapping sample used in PLS analyses was 500. Figure 3 presents the results of the hypothesis tests. All path coefficients were significant except for *H5a* and *H5b*. The results show that all first-order factors of user competence were significantly linked to the second-order factor. User satisfaction was predicted by perceived usefulness ($\beta = 0.364, p < 0.001$) and user competence ($\beta = 0.260, p < 0.001$), which explained 33.0 percent of user satisfaction variance. Hence, *H1* and *H3* were supported. Exploitative use was predicted by perceived usefulness ($\beta = 0.223, p < 0.001$) and user competence ($\beta = 0.483, p < 0.001$), but not by user satisfaction. Both of these significant predictors explained 76.0 percent of the variance of exploitative use. Therefore, *H2a* and *H4a* were supported, while *H5a* was not supported. Explorative use, in turn, was predicted by perceived usefulness ($\beta = 0.281, p < 0.001$) and user competence ($\beta = 0.300, p < 0.001$), but not by user satisfaction. Both of these significant predictors explained 66.0 percent of the variance of exploitative use. Thus *H2b* and *H4b* were supported, while *H5b* was not supported.

Perceived ease of use was significant for exploitative use, yet it was insignificant for explorative use. To measure the relationship between exploitative use and explorative use, we found that exploitative use had a significant effect on explorative use ($\beta = 0.188, p < 0.05$), thereby supporting *H6*. We further conducted a post-hoc analysis and found a significant effect of user competence on perceived ease of use (path coefficient = 0.74, $p < 0.001$). The results are similar to the findings of Venkatesh and Morris (2000).



Notes: *p<0.05; **p<0.01; ***p<0.001

Figure 3.
Results of hypothesis testing

The test results further showed that 54.9 percent of the variance of perceived ease of use was explained by user competence.

6. Discussion and implications

6.1 Discussion of findings

Several important and interesting findings emerge from this study. The results demonstrate that perceived usefulness and user competence are strong predictors of both exploitative and explorative use behaviors. The above findings, however, indicate that user satisfaction is not a predictor of exploitative or explorative use. These findings make several important contributions to our understanding of the two types of use in the IS infusion stage. First, we provide an integrated model of exploitative and explorative use for application to the IS infusion stage. Second, this study adds user competence to the IS continuance model to understand individual differences in exploitative and explorative technology use. Third, satisfaction is not found to reinforce a user's post-adoption usage, which is inconsistent with the findings of Bhattacherjee (2001). Finally, our findings clearly illustrate the relationship between exploitative use and explorative use. Furthermore, perceived ease of use affects only exploitative use, which may account for the more repeated and automatic usage behaviors of exploitative use as opposed to the innovative behaviors of explorative use, regardless of direct experience. Specific explanations of the results of hypothesis testing are presented below.

First, our results reveal that perceived usefulness is a strong predictor of user satisfaction ($\beta = 0.378$***). This finding is consistent with prior studies (e.g. Bhattacherjee, 2001; Hsieh and Wang, 2007; Limayem *et al.*, 2007), indicating that this particular predictor is still applicable as an antecedent of user satisfaction in both the adoption and post-adoption stages (i.e. infusion stage). Second, we find that user competence is an important determinant of user satisfaction ($\beta = 0.260$**). This suggests that user capability (ranging from novice to expert) may influence satisfaction levels among many different users. Certain individual users may know how to do only one thing with their Smartphones, while others, in contrast, may master the full scope of functionality and diverse Apps of Smartphones. IS usefulness and usage need to be captured at the level of functions and features (Jasperson *et al.*, 2005; Saeed and Abdinnour, 2013). In terms of exploitative use and exploitative use, perceived usefulness is a value-adding attribute of Smartphone usage. On the other hand, user competence involves reconfiguring or combining different features of one or more technologies, and integrating these accumulated skills with depth and breadth of knowledge. By examining user competence from a knowledge-based perspective, we posit that knowledge is gained through information consumption. With the advanced technology of mobile computing (i.e. Smartphones), knowledge aspects (breadth, depth, and finesse) are thus important determinants of user competence.

A third finding is that satisfaction is not a driver of both types of use. We conjecture the reason for the result. Assuming a satisfied user is increasingly habitual in nature until finally reaching a decision to discontinue usage of a specific technology (Bhattacherjee, 2001), exploitive use in routine activities in the infusion stage can no longer be perceived as new or novel (Limayem *et al.*, 2007). Hence, both types of use are not determined by user satisfaction. These results are not consistent with conclusions in previous studies that satisfaction is found to directly influence IS continuance intentions among users (Bhattacherjee, 2001; Limayem *et al.*, 2007). The reason is that user satisfaction in the infusion stage does not necessarily stimulate a more expansive utilization of a technology's functionalities, which, however, is not necessarily important when usage is originally creative. Measuring and investigating use behaviors that remain standard and routine may not provide new insight to IS, but may instead provide insight on how perceived usefulness and user competence lead directly to a better understanding of user behavior.

Fourth, the significant path from exploitative use to explorative use is consistent with arguments in previous research (Alba and Nee, 1997) positing that the use of more features increases the chances of using systems more creatively. This study also finds that exploitive use stimulates explorative use ($\beta = 0.188$*). As a control variable, perceived ease of use is positive and significant for exploitative use, but not for explorative use. These findings are consistent with the findings of a study by Hsieh and Wang (2007). We propose two explanations for these findings. First, when individuals consider exploitative use, users are likely to exploit existing IT functions. To this extent, the importance of perceived ease of use is likely to marginalize the effect of satisfaction on extended use (Hsieh and Wang, 2007). Second, perceived ease of use may become less important with increasing experience. This would result in user perceptions of ease of use receding to non-significance in determining exploratory usage. In other words, perceived ease of use is expected to have a significant effect on near-term consequences (i.e. repeated and automatic use) only. Because we use perceived ease of use as a control variable, further study is required for validation.

6.2 Limitations and directions for future research

The results of this study should be interpreted within the context of its limitations. One potential limitation is related to the operationalization of user competence herein. The first-order factors of breadth and depth of knowledge were measured by summing the score items of three dimensions of competence in different ways. Because self-reported measures are recognized as effective for measuring user competence (Munro *et al.*, 1997), we believe the competence measures used in this study are reasonable. However, further research is needed to verify the results by employing different technology domains. In addition, this study collected data from Smartphone users in South Korea only, thus the test results may be influenced by contextual and cultural effects. Cross-cultural studies should be considered in future research. Furthermore, the research model in this study does not reflect any of the unique features of Smartphones. The research model herein considers the general features of IS by focussing on the generalizability of the findings. Future studies also needs to consider the unique features of Smartphones in comparison to other types of IS, and should reflect them in the theoretical research model. Another limitation is the possibility of common method bias although the single-factor analysis results indicated that common method bias is unlikely. Regardless, further studies need to test the model based on the collection of objective data from different sources. As another issue, this study does not find the significance of satisfaction in leading to explorative and exploitative uses directly. Future research can consider develop a theoretical model based on the combination of TAM and user competence in examining IS infusion. Finally, an empirical test of explorative and exploitative use requires a longitudinal study. Interesting issues may be discovered through extended research on the topic.

6.3 Implications for research and practice

The current study presents important implications for research. This study is one of the first empirical studies to examine and contrast exploitative use and explorative use. While Burton-Jones and Straub (2006) discussed the two types of IS use (i.e. exploitative use and explorative use) in the post-adoption stage, empirical research on the determinants and the differences between exploitative and explorative use is scarce. A key contribution of this study is the examination of the three dimensions of user competence and the significance of user competence on exploitative use and explorative use, findings on which have never been discussed in previous research.

Specifically, this study conceptualizes exploitative use and explorative use and compares key characteristics between them. Exploitative use is related to the use of more system features to complete individual tasks in automatic ways, while explorative use is associated with the use of a system in innovative manners to enhance individual tasks. In the context of Smartphones, our findings suggest that out of the two main determinants of IS continuance (Bhattacherjee, 2001), perceived usefulness is the only determinant of both explorative use and exploitative use. More specifically, both exploitative use and explorative use are significantly determined by perceived usefulness and user competence. This study also demonstrates that explorative use is further influenced by exploitative use.

From a theoretical perspective, this study adopts the IS continuance model (Bhattacherjee, 2001) as the main overarching theory, because the IS continuance model (including perceived usefulness and user satisfaction as the two main determinants) has been typically used for explaining the post-adoption of IS. However, IS infusion (i.e. using a system to its full potential) requires high-level skills and knowledge among users when it comes to using a system. For this reason, we add a factor of user competence to the IS continuance model by conceptualizing competence as a second-order construct with three dimensions (finesse, breath of knowledge, and depth of knowledge). In this way, this study contributes to the IS continuance model by incorporating the concept of user competence.

This study also adds value to existing IS literature, particularly with regard to the concept of user competence. Regarding user competence, Venkatesh and Morris (2000) explained that competence/self-efficacy influences usage behavior indirectly through perceived ease of use. However, both UTAUT (Venkatesh *et al.*, 2003) and UTAUT2 (Venkatesh *et al.*, 2012) do not consider competence/self-efficacy as a main determinant of usage behavior. In contrast, our study incorporates user competence to the IS continuance model and proposes user competence as a main determinant of the two types of IS usage in the infusion stage. The results of testing, as shown in Figure 2, also highlight the significance of user competence on exploitative use and explorative use, even controlling for perceived ease of use. While previous research (Venkatesh and Morris, 2000; Venkatesh *et al.*, 2003; Venkatesh *et al.*, 2012) has explained the indirect effects of competence on IS usage, this study highlights the direct effects of user competence on IS usage behavior.

The work of Hsieh *et al.* (2011b) finds that user self-efficacy and knowledge influences the initial usage intentions and continued usage intentions of information and communications technologies (ICT) users across different social-economic groups. Saga and Zmud (1994) identified different stages of IT diffusion, including adaptation, acceptance, routinization, and infusion. IS continuance represents the routinization stage. Post-adoption represents the last two stages (routinization and infusion), after the acceptance stage. Exploitative use and explorative use are types of IS use that occur during stages of IS infusion. Hsieh *et al.* (2011a, 2011b) examined the effects of self-efficacy and knowledge on acceptance intentions and IS continuance intentions, but not on IS infusion. In sum, one of the key contributions of this study is discovery of the significance of user competence on the two types of IS use during IS infusion, in contrast to the findings of previous research (Hsieh *et al.*, 2011b; Venkatesh and Morris, 2000; Venkatesh *et al.*, 2003, 2012).

The current study provides important implications for practice. In particular, underutilization of a system has been repeatedly identified as one of the major causes of low return on IS investment (Venkatesh *et al.*, 2003). The success of IS hinges on turning mere acceptance of IS into IS infusion (Hsieh *et al.*, 2011a) among technology users and enthusiasts. Accordingly, this study and its findings are significant in terms of understanding IS infusion and increasing the return on IS investment at the level of individual users.

Mobile computing technologies (i.e. Smartphones) have advanced wildly over the last seven years. The use of Smartphones may circumscribe our personal lives into specific systems. Accordingly, appropriate processes for the infusion of Smartphone devices are critical for Smartphone manufacturers, business owners, individual users, and app software developers. Smartphones should be designed for users to continually engage the technology to its full potential, with the goal of enriching the daily lives of users through usage. The ability of manufacturers, business owners, and App developers to provide integrated multitasking applications and to offer advanced features with high functionality is recognized as the key to winning market share. The Smartphones of today have more advanced capabilities than any previous generation, so mobile App developers and business owners with a platform should provide more sophisticated features and services in lockstep. To encourage explorative use, novel and useful Apps that benefit our work and daily lives should be emphasized. The development of Smartphones in the near future will be enhanced through the use of computer-generated sensory input such as sound, video, graphics and GPS data, correlating computer data to what we see and experience in real life.

This study finds that advanced users are likely to exploit and explore the existing technology provided by Smartphone developers and service providers. The results associated with exploitative use are more certain and instantly gratifying, while the results associated with exploration are more variable. In both types of use, users are likely to innovate through their smart devices in IS infusion scenarios. Smartphone manufacturers continue to set new trends in functionality, including big screens, wearable device connections, fast network connections, wireless charging, and higher-resolution screens. In this context, business owners and relevant App service providers should decide which factors are the most important based on the stages of IT diffusion. For example, wellness in conjunction with wearable functions in Apps can facilitate a more complete picture of an individual's health, condition, caloric intake, and level of fitness. Combining Smartphones with the diverse functions of traditional machines leads to Apps that allow competent users to create new uses and functions that were not originally envisioned by developers, thereby generating unexpected business for new Apps. Through this medium, more adventurous users can work with prototypes and perform innovative experiments. Practical strategies along these lines will boost individual usage behavior to some degree.

7. Conclusion

The main goal of this paper is to identify the role of user competence and to understand IS infusion usage behaviors (i.e. exploitative use and explorative use) in the context of Smartphone usage through the theoretical combination of the IS continuance model and the concept of user competence. The results of analytical testing reveal that both user competence and perceived usefulness are the main predictors of both exploitative and explorative use. In contrast, user satisfaction and perceived ease of use have inconsistent effects on the two subtypes of IS infusion. Thus this study contributes to the advancement of our understanding of IS infusion behaviors (i.e., explorative use and exploitative use), as well as to our understanding of infusion behaviors from a user competence perspective in the context of Smartphone use. Our findings also offer suggestions for Smartphone researchers and practitioners to increase the level of Smartphone usage among individual users.

Note

1. www.idc.com/getdoc.jsp?containerId=prUS24461213

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Appendix

Construct	Wording
Perceived Usefulness	The Smartphone makes it easier to do my tasks
	The Smartphone enables me to do my tasks faster
	The Smartphone enhances my effectiveness in doing my tasks
	The Smartphone increases my productivity in doing my tasks
Ease of use	Learning to operate the Smartphone is easy for me
	I find it easy to get the Smartphone to do what I want it to do
	I find that the Smartphone system is easy to use
	I find the smartphone to be flexible to interact with
Exploitative use	I fully use the available Smartphone features to complete my tasks
	I use most of the available Smartphone features in performing my tasks
	I make thorough use of the available Smartphone features to accommodate my tasks
	I use all the available Smartphone feature to help me with my tasks
Explorative use	I explore new uses of the Smartphone to support my tasks
	I often experiment with new ways of using the Smartphone to accomplish my tasks
	I often find new uses of the smartphone in performing my tasks
	I use the Smartphone in novel ways to complete my tasks
Breadth and Depth of Knowledge	Can you add any new application on your Smartphone?
	Have you installed new applications on your Smartphone?
	Do you have any knowledge about general applications that were not yet installed?
	Have you used typing and input elements (i.e., the touchpad)?
	Do you know how to link your Smartphone with other devices (e.g., your computer)?
	Do you know how to link your Smartphone with the Internet?
	Have you used its Bluetooth or WiFi applications?
	Have you used its camera/video/audio and recording functions?
Finesse	In general, I'm capable of using my Smartphone to solve my problems
	In general, I can say that I'm sufficiently creative in using my Smartphone to deal with my tasks
	In general, I can say that I'm an innovative user when it comes to using my Smartphone to deal with my tasks
Satisfaction	How do you feel about your overall experience with Smartphone use? Dissatisfaction (1) ---------------------------- Satisfaction (7) Displeased (1) ---------------------------- Pleased (7) Frustrated (1) ---------------------------- Contented (7) Terrible (1) ---------------------------- Delighted (7)

For Breadth and Depth of Knowledge, each question was formatted as follows:
Can you add any new application on your Smartphone?

☐ Yes ☐ No

If yes, please indicate your current level of knowledge with this function:

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