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The Effect of Design Characteristics of Mobile Applications on User Retention: An Environmental Psychology Perspective

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ABSTRACT

As many people have adopted mobile applications for their hand-held devices, mobile applications are becoming widely used in everyday life. Nonetheless, some applications are used only few times and then abandoned. Particular since many firms have launched mobile applications for communicating with and delivering their products or services to customers, user retentions toward mobile applications can be critical. To address this challenge, we identify how design characteristics of mobile application enhance user retention toward mobile applications, particularly in the context of cross-channel commerce. Drawing on an environmental psychology, we address that user beliefs stimulated by environmental cues (e.g., design characteristics) affect users' cognitive and affective internal states, which in turn lead to their retention toward mobile applications. Contributions of this study include 1) theoretically, a suggested theoretical framework for effective mobile application design as an extension of website design, and (2) practically, helping practitioners to articulate effective mobile applications or the Internet strategy in mobile-based online markets.

Keywords

Mobile application, mobile application design, user retention, environmental psychology

INTRODUCTION

As the Internet has played a role in more than 45 percent of US retail sales, consumers who shop across a numbers of channels such as physical stores, the Internet, and catalogs spend about four times more annually than those who shop in just one (Noble et al. 2009). Reflecting the situation of a retailer that sells through several channels, which is called cross-channel commerce¹, retailers should understand and be able to exploit the interactions between channels (Bock et al. 2012). Particularly with the rapid emergence of social and mobile technologies, mobile device and its applications are recently regarded as a valuable channel for interacting with general public as well as online consumers, just as websites to date have done (Noble et al. 2009; Oracle 2011).

A mobile application is software application that runs on a smartphone or other portable devices. As more people are accessing the Internet from their mobile devices than from desktop computers (Lamont 2012b), a mobile application is much more pervasive in people's lives. It also gives the access point for all sorts of 'anytime, anywhere' services (e.g., Cyr et al. 2006). As many people have widely adopted mobile applications for their hand-held devices, their demand for mobile applications is expected to continue growing (ICD 2011). The number of global downloads is anticipated to reach 182.7 billion in 2015, with a value of \$46 billion (IDC 2011). For instance, the Apple's App Store where is one of the most successful and well-known application stores, has over 730,000 applications and delivers 25 billion downloads in February 2012. Reflecting this phenomenon, many retailers have launched and utilized customized mobile applications as a tool not only for communicating with but for delivering products or services to their customers, along with websites. In addition, they plan their web strategies to ensure that their sites including website, mobile site, or mobile application provide an integrative customer experience (Lamont 2012b).

However, some people find their applications are less valuable than they expect, such that they barely use the majority of applications they download (Schonfeld 2009). For example, only 20% of application consumers utilize a free application the day after they download it. By 30 days out, less than 5% of application consumers are still using it. Paid applications have

¹ Cross-channel commerce is often used interchangeably with multi-channel commerce.

similar phenomenon, even though they have a slightly better performance record (Shapiro 2010). Particularly in the case of the commercial and business sphere, the retention rates (over 90days) of financial- and business-related mobile applications are about 26% and 27%, respectively (Flurry.com 2009). Thus, retaining customers to mobile applications can come to the fore as a major concern in electronic cross-channel commerce. This is also in line with earlier IS research presenting that post-consumption behaviors (e.g., repeated use, retention, and loyalty) are the keys for a firm's survival in the online environment (Kim and Son 2009; Zhang et al. 2011)

Prior studies have suggested that user interface design plays an influential role in enhancing customer satisfaction and contributing to repeat site visits (Cyr et al. 2006; Lee et al. 2000). As such, effectively designing mobile applications can be very critical, because it enables customers to keep in touch with the retailers, facilitates other business processes, and adds value in the era of quick communication (Globallogic.com 2011). Lessons learned from prior studies regarding website design could be helpful to solve the issues of mobile application design. However, mobile application design may be different from website design, in that mobile applications are required to use different contexts or technologies (Gualtieri 2011). For instance, small screen display, limited bandwidth, and the simplistic yet diverse functionality of mobile hand-held devices affect how to design mobile applications (Chan et al. 2002). However, to date, few studies have investigated the design issue of mobile applications (Adipat et al. 2011; Cyr et al. 2006). Therefore, this research aims to fill the knowledge gap by addressing two research questions:

- What kinds of characteristics are important in designing mobile applications?
- How design characteristics of mobile application may impact user retention toward the application?

In answering these questions, this study addresses two research objectives. First, we develop a framework that includes user beliefs stimulated by mobile application design (e.g., design characteristics of mobile applications), the organisms using mobile applications (e.g., cognitive and affective attitudes), and behavioral responses (e.g., user retention toward mobile applications). Second, it begins an empirical investigation of this framework by testing hypotheses about the environmental stimuli-organism-response (S-O-R) relationships in the mobile application context. To develop our proposed framework and hypotheses, we start with identifying the design characteristics for mobile applications, drawing on the environmental psychology perspective as a theoretical base. In doing so, this study endeavors to show how design characteristics of mobile applications beyond website design can enhance user retention toward mobile applications, particularly highlighting the users' cognitive and affective attitudes.

Next, we first describe the background for this research, and then present our research model and hypotheses. In the section that follows we discuss our proposed empirical methodology, and then conclude with a brief discussion.

BACKGROUND

Mobile Application and User Retention

A mobile application provides value to people by connecting them to Internet services traditionally accessed on desktop or notebook computers, and by making it easier to use the Internet on their mobile devices. It also enables people to live more productive and enjoyable lives as they gain near-instant access to the information and services they desire (Gravitytank 2009). Thus, mobile applications are already having direct impact on people's daily routines and behaviors, tapping into a deep-rooted desire to lead more optimized and productive lives (Gravitytank 2009). As a result, about 20 percent of mobile application users stopped or drastically decreased their use of desktop and laptop computers, as the majority today prefer smartphones to laptops or desktops (EricssonComputerLab 2011; Globallogic.com 2011; Stone 2009). That is because mobile applications are perceived as less time-consuming than browsers and less complex than applications on PCs; simply put, they provide direct access and the right functionality.

However, some people find their applications are less valuable than they expect, such that they barely use the majority of applications they download (Schonfeld 2009). For example, only 20% of application consumers utilize a free application the day after they download it. By 30 days out, less than 5% of application consumers are still using it. Paid apps have similar phenomenon, even though they have a slightly better performance record (Shapiro 2010). Particularly in the case of the commercial and business sphere, the retention rates (over 90days) of financial- and business-related mobile applications are about 26% and 27%, respectively (Flurry.com 2009). These results suggest that the potential for mobile applications to add value is not being reached, because it may not give the usefulness or relevance in a user's daily life. As with IS research presenting that post-consumption behaviors (e.g., repeated use, retention, and loyalty) are the keys for a firm's survival in the online environment (Kim et al. 2009), there is critical need to understand user retention toward mobile applications.

Electronic Cross-Channel Commerce

Cross-channel commerce is the instance of customers shopping across a retailer's channels. For example, most brick-and-mortar retailers mail out the occasional print catalog, provide phone service, and have online stores, with the more adventurous offering mobile device-friendly websites or applications. However, these channels are not isolated from one another; rather, they overlap (Evans 2009). As cross-channel commerce is regarded as the most compelling opportunity in retail today (Rigby 2011), consumers would like to have a faster, easier, more fluid experience when they buy something in online or offline environment. It enables consumers to be efficiently shifting seamlessly between various touchpoints to shop, buy and fulfill orders according to their preferences. To gain more information about or to complete the purchase of a product or service, consumers often use diverse channels including computers, mobile devices, bricks-and-mortar stores, catalogs, and customer service representatives (Oracle 2011). According to business research report (Oracle 2011), more than three-quarters of consumers use two or more channels to research and complete the transactions when they purchase a product or service. Particularly regarding mobile commerce as an important part of the cross-channel experience, nearly a third of consumers are using their mobile devices to browse or research products and services (Oracle 2011).

The rapid emergence of newly developed technologies including social and mobile technologies is transforming people's interaction with the retailers, and simultaneously transforming the way that business is conducted and delivered. In particular, mobile technology is becoming increasingly important because it allows users so much flexibility. For instance, mobile users can accomplish tasks or move a transaction along while away from their desks (Lamont 2012a). However, despite explosive growth of smartphone usage, many businesses still have a website that isn't optimized to fit on a small mobile screen. Many retailers are trying to develop a mobile-ready site or specific mobile application which is optimized for smartphone users (West 2011). Therefore, mobile applications, as an extension of website for a communication channel, are strongly linked with existing websites in commercial and business domains.

An Environmental Psychology Perspective

Environmental psychology is a branch of psychology that is concerned with providing a systematic account of the relationship between person and environment (Kaplan et al. 1982; Parboteeah et al. 2009; Russell et al. 1982). From this perspective, human behavior is determined by the environment as a powerful and direct causal influence. The environment plays a critical role as more than an antecedent of human behavior, because it also affords opportunities for future action (Russell et al. 1982). According to the environmental psychology perspective, one way in which humans cope with processing information is through the use of cognitive maps. As an accumulation or summary of experiences, people's cognitive maps can be used to make their way through an environment (Rosen et al. 2004). Particularly, people are motivated to use and extend these maps through environments designed to take advantage of these cognitive maps (Kaplan et al. 1982).

Prior environmental psychology research posits that various environmental stimuli have an impact on developing people's cognitive maps (Chang et al. 2008; Eroglu et al. 2001; Kaplan et al. 1982; Mehrabian et al. 1974; Parboteeah et al. 2009). Kaplan and Kaplan (1982) describe that the experience an individual has of the environment is structured and shaped by the appropriate representation of environmental stimuli, by highlighting four different aspects – simplicity, essence, discreteness, and unity. Drawing upon the stimulus-organism-response (S-O-R) paradigm, some studies posit that environmental cues as stimuli can be conceptualized as an influence that affects an individual's cognitive and affective reactions as internal, organismic states of the individual, and then it leads to the individual's behaviors (Eroglu et al. 2003; Mehrabian et al. 1974; Parboteeah et al. 2009). Much research to date has considered various environmental cues (e.g., website awareness, content quality, visual complexity, etc.) in the context of online environments, viewing them as similar to physical landscapes (Chang et al. 2008; Chang et al. 2009; Deng et al. 2010; Rosen et al. 2004).

In sum, environmental psychology explains how providing users with effective environments makes it easier for them to process information and function effectively (Rosen et al. 2004). Therefore, we have chosen to take an environmental psychology perspective in the current research, in that this perspective provides a theoretical foundation elucidating that human functioning can be determined by effectively designed mobile applications.

Mobile Application Design beyond Website Design

Many firms have spent millions of dollars to attract new customers and to retain their existing customers, considering websites as important components of Internet strategy and communication channel (Chang et al. 2009; Cyr et al. 2006; Mithas et al. 2007; Palmer 2002; Song et al. 2005). However, with newly developed technologies or contexts for mobile devices (i.e., location-, locomotion-, and immediacy-related technologies or contexts), mobile applications have become more permeated in people's everyday life, particularly in commercial and business domains. For example, Amazon.com, one of the biggest e-commerce firms, launched the Amazon App, and offers fast, convenient, and secured services to customers,

closely linking with its website. Figure 1 shows user interface in both website and mobile app of Amazon.com. Thus, mobile apps can be regarded as the alternative channel of websites.

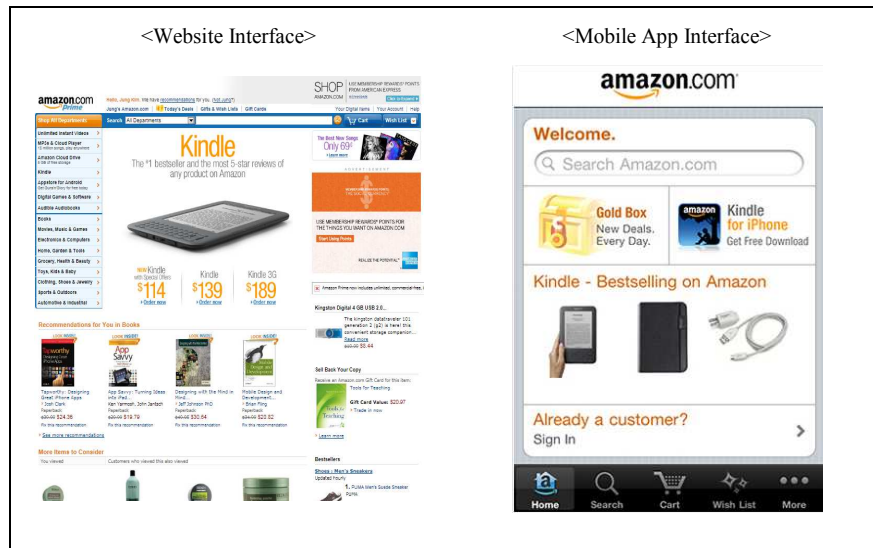


Figure 1. User Interface of Website and Mobile App for Amazon.com

With regard to website effectiveness, many studies to date have emphasized user's subjective experience with the web interface as one of the primary foci of human-computer interaction (HCI) research (Cyr 2008; Deng et al. 2010; Palmer 2002; Parboteeah et al. 2009). Prior studies have emphasized various website design characteristics such as information-, navigation-, and visual-design (Cyr 2008), website content, structure, and functionality (Mithas et al. 2007), visual complexity, design aesthetics, order, and human images (Cyr et al. 2006; Cyr et al. 2009; Deng et al. 2010). Some studies, based on the environmental psychology, have highlighted the website which is coherent (understand structure, content, and features quickly), legible (easily navigate it), various (enjoy vivid and dynamic image), and mysterious (be stimulated with features inspiring people's curiosity), regarding a website as an emulation of a physical store (Lee et al. 2009; Rosen et al. 2004).

Effectively designing mobile applications to enhance users' satisfaction, trust, and retention plays a critical role in enhancing mobile application effectiveness. These factors, which are important for website design, can also be applied for designing effective mobile applications. Designing mobile applications, however, may also benefit from consideration of other factors than those which were required to develop effective website design. For instance, customizing mobile applications with a smaller screen size or utilizing the right development technologies to support the mobility for mobile applications leads mobile app developers to use different approaches to its design (Gualtieri 2011).

RESEARCH MODEL AND HYPOTHESES

Figure 2 shows our proposed research model, including the major theoretical constructs and their hypothesized relationships. Based on past applications of the stimulus-organism-response (S-O-R) paradigm (Eroglu et al. 2001; Eroglu et al. 2003), our model incorporates that user beliefs stimulated by environmental cues including design characteristics (e.g., compatibility, simplicity, and functionality) have an impact on their cognitive and affective attitudes (e.g., perceived usefulness and perceived likability) toward mobile applications, which in turn lead to user retention toward mobile applications. A detailed rationale for this proposed research model now follows.

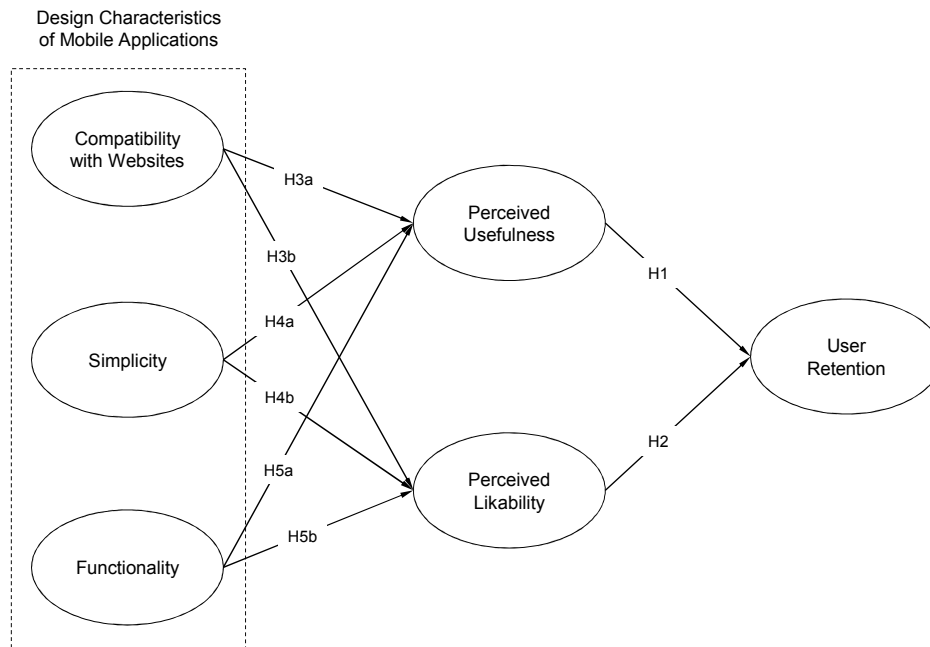


Figure 2. Research Model

User Retention toward Mobile Applications

In the consumer behavior literature, customer retention refers to the individual's deeply held cognitive and affective commitment toward the service (Kim et al. 2009; Oliver 1999). In specific, customer retention is regarded as a more prominent factor in the survival of online business, playing an important role in evaluating customer behavior in online service setting (Kim et al. 2009). Previous research suggests that customer retention in online setting can be enhanced by user satisfaction, trust, purchase intention, etc. (Cyr 2008; Cyr et al. 2006; Mithas et al. 2007). Cyr(2008) also addressed that if customers are satisfied with the design of a website, they are more likely to retain or revisit the website. Likewise, retaining users could rise as a critical issue in mobile application phenomenon. That is because people barely use the applications after they download them, though mobile applications are easily accessible and downloadable (Schonfeld 2009; Shapiro 2010). Therefore, *user retention* can be conceived as a consumer's intention which they will keep using the mobile application, regarding as a favorable attitude toward maintaining a long-term relationship with the mobile application.

Cognitive and Affective Attitudes in Mobile Applications

Focusing on the relationship between people and a mobile application (as an environment), environmental psychology has concerned 'place identity' and 'place attachment' as the core concept in environmental psychology (Knez 2005; Lewicka 2008). Place identity concerns sameness (continuity) and distinctiveness (uniqueness) of the place in terms of cognitive aspect, and place attachment more focuses on affective relationships between people and places that beyond goes beyond cognition (Knez 2005; Lewicka 2008). Prior studies regarding user attitudes have addressed different dimensional structure of attitudes including extremity, intensity, certainty, accessibility, usefulness, and affective-cognitive consistency (Krosnick et al. 1993). Among them, most studies have differentiated attitude constructs as two different dimensions: cognitive and affective attitude (Ajzen 2005; Koroleva et al. 2011; Voss et al. 2003). Cognitive attitude refers to evaluations of attitude object and the qualities it possesses, reflecting cognitively perceived usefulness or relevance. Affective attitude refers to how much people like the object and is emotionally attached to it, reflecting affectively perceived likability or emotional involvement (Koroleva et al. 2011). Hence, in the current study, we employ perceived usefulness and perceived likability as cognitive and affective attitudes, respectively.

First of all, the technology acceptance model regards the perceived usefulness as a key cognitive determinant of new IT system adoption (Davis 1989). *Perceived usefulness* is defined here as perceptions about enhanced effectiveness achieved through the use of a mobile application (Davis 1989; Kim et al. 2009). In keeping with this, perceived usefulness is expected to be the most salient ex-post expectation that influences users' post-behaviors (Bhattacharjee 2001). According to

Bhattacharjee (2001), the relationship between usefulness and intention can be well explained in the context of IS continuance, even though it was originally derived in an acceptance context. Prior research has supported that perceived usefulness positively affect individuals' loyalty, commitments, and retention to the technologies or systems (Amoako-Gyampah 2007; Bhattacharjee 2001; Kim et al. 2009; Oliver 1999).

Second, the feelings that people develop towards significant environments lie at the heart of environmental psychology (Hernández et al. 2007; Knez 2005; Wester-Herber 2004). It more focuses on the affective relationships between people and places that goes beyond cognition (Knez 2005; Lewicka 2008). In this study, we consider *perceived likability* as perceptions about how much people are emotionally attached to the mobile application. The affective link with mobile applications, conceived as perceived likability, has an impact on where users tend to remain and on where they feel comfortable (Hidalgo et al. 2001). Thus, affective attitudes (e.g., perceived likability) play a salient role in evaluating users' feeling and emotional states.

In sum, these two constructs for identifying the relationship between people and mobile applications can be considered important predictors which affect people's attitudes towards the mobile applications, reflecting their cognitive and affective states. Therefore, we propose that:

H1. Perceived usefulness will result in user retention toward mobile applications.

H2. Perceived likability will result in user retention toward mobile applications.

Design Characteristics for Mobile Applications

Different contexts or technologies from websites pose many constraints for designing effective user interfaces for mobile applications. For example, small screen display, limited bandwidth, and the simplistic yet diverse functionality of mobile hand-held devices affect how to effectively design mobile applications (Chan et al. 2002). According to 'The iPhone Human Interface Guideline (HIG)', mobile application design is defined as three different design styles – utility, productivity, and immersive – to ensure a consistent user experience (Ginsburg 2010). For instance, 'simplifying with core functions within small screen area' is one of the most critical design principles for mobile applications, by offering a good balance between functionality, visual design, and the small display area on mobile device (Gordon 2009). In addition, the compatibility of mobile applications with websites should be considered as an important design factor for mobile applications, highlighting the complementary relationship between mobile applications and websites. The user experience with website also enables people to construct their cognitive maps for mobile applications. Taken together, reflecting the context of mobile applications and considering prior research on website design, we present three different design characteristics in this study: compatibility with websites, simplicity, and functionality.

First, *compatibility with websites* is defined as the degree to which mobile app design is perceived to be consistent with the existing website design (Wu et al. 2005). Concerning the interaction between wired (websites) and wireless (mobile applications) channels for supporting user activities (e.g., e-commerce activities, online shopping, online discussion, etc.) in online environments (Chan et al. 2002), the compatibility between mobile applications and websites would be one of the critical factors in mobile application design. In particular, mobile applications, as an extension of website for a communication channel, are strongly linked with existing websites in commercial and business domains. Moreover, the prior experience in websites may shape users' cognitive maps, which in turn influence their experience in mobile applications. Therefore, I need to consider how much mobile application design is compatible with website design in this study, highlighting the complementary role of mobile applications and websites. High compatibility with website will lead to preferable adoption of mobile applications, improving users' cognitive and affective attitudes in mobile applications. Therefore, we hypothesize that:

H3a. Compatibility of mobile applications with websites will result in users' perceived usefulness.

H3b. Compatibility of mobile applications with websites will result in users' perceived likability.

Second, due to limited space in user interface of mobile applications (e.g., small screen display), it is not possible to deliver much information to mobile applications. In other words, there is far less information in a representation than in the many experiences that led to it (Kaplan et al. 1982). Thus, compared with website design, mobile application design is needed to be more simplified. Mobile applications designed by such characteristics as minimal setup, simple flows and layouts, and standard user interface enable people to enrich their experiential values with regard to their cognitive and affective states

(Ginsburg 2010). Therefore, the *simplicity* of mobile applications can be considered as one critical factor for effectively designing mobile applications. Taken together, we propose that:

H4a. Simplicity of mobile applications will result in users' perceived usefulness.

H4b. Simplicity of mobile applications will result in users' perceived likability.

Third, the loss of information should be highly systematic, not random, in simplified design of mobile applications. Mobile applications are designed with *functionality*, which means mobile applications should be designed with core functions used in the websites in addition to different mobile technology functions such as location-based services, near-field communications, and barcode scanning. In line with this, we consider the functionality of mobile application as two dimensions: functional essentiality and functional extensibility. The former refers to the extent to which mobile application design includes core functions operated in websites, whereas the latter refers to how much mobile application design is extended through the addition of new functionality or through modification of existing functionality. Moreover, designing functionality in mobile applications can be used to help or hinder users as they access to 'anytime, anywhere services' on their mobile devices. Therefore, when mobile applications offer newly developed functions in addition to existing functions used in websites, people are more likely to perceive usefulness and likability. In sum, we address that:

H5a. Functionality of mobile applications will result in users' perceived usefulness.

H5b. Functionality of mobile applications will result in users' perceived likability.

RESEARCH METHODOLOGY

The next step of the research is to empirically test my proposed research framework. This study targets user perceptions of business-to-consumer (B2C) mobile applications. In particular, this study will focus on mobile applications in the context of cross-channel commerce including commercial and business domains such as financial and e-commerce applications (e.g., many firms including Wellsfargo, US bank, Amazon.com, and BestBuy provide their own applications as well as websites.). Hence, current or potential users who download and use these kinds of mobile applications will be included in this research. One of the biggest problems here is that it is hard to get appropriate dataset. To resolve this problem, we will recruit participants from an online panel like Amazon Mechanical Turk. It would be helpful to obtain the specific dataset we need.

The design of this study comprises two phases: *pilot* and *testing*. In the pilot phase, we will develop the measures for constructs used in the research framework, and then conduct preliminary testing of the reliability and validity of the construct measures. For each construct, we will identify existing measures in the literature and adapt them to our research domain. If we are unable to find the appropriate measure used in prior studies, we will generate new measures based on the relevant literatures. Then, the survey instruments will be pilot tested on a representative sample of the target population and the instrument will be modified based on the feedback from the respondents. In the testing phase, we will use the construct measures developed in the pilot phase to test hypotheses proposed in the research framework. For this, we will conduct main survey and analyze data using the Partial Least Squares (PLS) statistical package. As a component-based structural equation technique, PLS is well suited for highly complex predictive models (Barclay et al. 1995; Chin 1998).

DISCUSSION

This study aims to develop a framework for effectively designing mobile applications, by understanding the role of environmental stimuli in mobile applications such as design characteristics. In detail, we address that design characteristics (design compatibility, design simplicity, and design functionality) will influence users' perceived usefulness and likability which reflect their cognitive and affective internal states. As a result, mobile application users' cognitive and affective attitudes towards mobile applications, which are determined by mobile application's design characteristics, will encourage them to more retain in the application with regard to cross-channel experience.

This study contributes to both theory and practice. The major theoretical contribution of this study is the development of a research framework suggesting design principles for mobile applications. Considering design characteristics which are appropriate for designing mobile applications, this study will contribute to understand user interface for mobile applications

as an extension of website design. Particularly based on S-O-R paradigm from environmental psychology perspective, our proposed research framework will lead to the emergence of theoretically-based design principles for mobile applications, incorporating newly developed mobile technologies.

On the practical side, the current study will first contribute to help practitioners, particularly who work for e-commerce companies, to articulate effective mobile applications. For instance, 'simplicity with essential functions' of design elucidated in this study should be a major consideration in effective mobile application developments. Second, this study suggests that compatibility of mobile applications with users' prior experience for using websites will enable user to easily make sense and more involve in the mobile applications. Practically, the consideration of compatibility between mobile applications and websites as two important communication channels will enable practitioners to establish effective the Internet strategy for their companies, incorporating mobile-based online market with existing online market.

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