Journal of Interactive Marketing 27.2 (2013): 98-111

**DOI:** http://dx.doi.org/10.1016/j.intmar.2012.10.001

# Perceived Ubiquity in Mobile Services

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**Abstract**

Ubiquity has been referred to as one of the most important characteristics of mobile services. In this study, an instrument for the measurement of perceived ubiquity reflecting the benefits derived from continuity, immediacy, portability, and searchability is developed using a multiple stage approach. In the initial stage, perceived ubiquity is conceptualized through interdisciplinary perspectives as a multidimensional, 32 item eight factor construct. In the second stage, the original measurement is pretested on a student sample and recalibrated into a 16 item four factor instrument. In the third stage, general consumers are invited to complete a task in which they are asked to perform a search with a mobile device before rating the measurement items. A confirmatory factor analysis produces a 12 item four factor instrument. Furthermore, a second order structure results from a statistical comparison of alternative models through a competing model strategy. In the final stage, we use a scenario method to validate the measurement tool while establishing discriminant, nomological, and known group validities. The thorough validation results demonstrate the value of our instrument as a measurement tool of perceived ubiquity that is useful in describing the unique nature of mobile devices and predicting differences in user perceptions of mobile services and desktop PC services. Theoretical and managerial implications are discussed, important limitations are recognized and future research directions are suggested.

*Keywords:* Flow; Interactivity; Measurement development; Mobile marketing; Telepresence; Ubiquity

## Introduction

Since the introduction of the iPhone in 2007, the usability of mobile phones has drastically improved. A tiny keyboard and a screen—the principal impediments to the adoption of smartphones—were replaced by a multifunctional touch screen. This easy-to-use electronic visual display allows users to directly interact with the device by using their fingers. This breakthrough in technology, along with advanced computing and connectivity capabilities, brought about the explosive worldwide growth of smartphone use. A recent survey shows that many industrialized countries, including Australia, Denmark, Ireland, Norway, the Netherlands, New Zealand, Spain, Sweden, Switzerland, and the UK, have reached over 40% of smartphone penetration. In the U.S., 80% of smartphone owners refuse to leave home without their devices (Electronicsweekly.com 2012).

The emergence of the smartphone also has broken ground in the development and use of mobile software applications (mobile apps). As of June 2012, the number of worldwide App Store downloads exceeded 30 billion, while Android's Google Play reached 15 billion downloads by May 2012 (TechCrunch 2012a,b). These figures represent the enthusiasm of the fast-growing audience that is seeking out a wide range of mobile services that can be accessed anytime and anywhere. These types of time- and location-sensitive properties have collectively been referred to as ubiquity in the related literature (e.g., Kleijnen, de Ruyter, and Wetzels 2007; Nysveen, Pedersen, and Thorbjørnsen 2005; Okazaki, Li, and Hirose 2009). According to recent reviews by thought leaders, the ubiquitous nature of mobile services may change the paradigm of marketing, especially in retailing (Shankar and Balasubramanian 2009; Shankar et al. 2010).

The conceptualization of ubiquity in a marketing context can be traced back as early as 2002 (e.g., Balasubramanian, Peterson, and Jarvenpaa 2002; Barnes 2002; Watson et al. 2002). However, our literature review finds an important research

gap: no *formal* measurement instrument has been theoretically developed and empirically validated. An interesting exception is Junglas and Watson (2006), who explored the dimensionality of the ubiquity construct. However, their viewpoints differ substantially from ours in two ways. First, their study was purely conceptual and primarily based on the information systems literature. Second, ubiquity was conceptualized as one of four u-commerce constructs, along with uniqueness, universality, and unison.

To fill this research gap, the present study uses multiple steps to develop a multidimensional instrument to measure the perceived ubiquity of mobile services. For item generation, qualitative research is combined with published scales derived from an extensive literature review. After establishing content validity, three empirical surveys are conducted to examine psychometric properties. We believe that this measurement instrument represents significant progress toward a comprehensive understanding of mobile services. Therefore, the formal objectives of this study are:

1. To conceptualize the basic properties of perceived ubiquity based on a literature review;
2. To qualitatively examine perceived ubiquity;
3. To develop, refine, and validate an instrument to measure perceived ubiquity in mobile services.

The remainder of the manuscript is organized as follows. First, a theoretical framework of the ubiquity concept is established based on a literature review. Next, focus groups are used to begin the measurement development procedure and their results form the foundation upon which key dimensions and items of perceived ubiquity are proposed. Next, the validation of the proposed instrument is examined and three empirical surveys are described in detail. Finally, theoretical and managerial implications are discussed, important limitations are recognized and future research directions are suggested.

## Conceptual Background

As a starting point of the study, an extensive literature review was performed in multiple steps. First, we conducted an exhaustive search of the mobile marketing literature in various disciplines, including management, marketing, business, engineering, information science/management, finance, and operations research. We used keywords such as "mobile commerce," "mobile marketing," and "mobile promotion", among others. The following databases were examined: ABI/INFORM Global, Academic Research Library, Arts & Humanities Full Text, EBSCOhost Business Source, Emerald, Elsevier SD Freedom Collection, IEEE Xplore, and Wiley InterScience. Second, we focused mainly on the journals that are currently indexed in either the Social Sciences Citation Index (SSCI) or the Science Citation Index (SCI) of the ISI Journal Citation Report. This procedure is in line with most recent citation analyses in business and marketing (Zou 2005). Next, each article was manually evaluated to determine if its main focus was on marketing or commerce rather than information technology (e.g., software development or programming). Finally, we selected studies that explicitly reference or define ubiquity. Based on these criteria, 12 articles were chosen. The results of the literature review are shown in Table 1. None of the studies in Table 1 has empirically explored the full dimensionality of ubiquity.

In terms of conceptual definition, the studies have unanimously agreed that ubiquity is one of the most important attributes of mobile services. Watson et al. (2002) offer a pioneering discussion and describe ubiquity as synonymous with omnipresence: "not only that they are everywhere but also that they are, in a sense, 'nowhere,' for they become invisible as we no longer notice them" (p 332). However, this definition envisages a more heuristic adoption of ubiquitous computing built into everyday objects and activities. Perhaps a more commonly accepted notion of ubiquity in the context of mobile services has been the anywhere, anytime nature (Balasubramanian, Peterson, and Jarvenpaa 2002) or combined flexibility of space and time (Kleijnen, de Ruyter, and Wetzels 2007; Ko, Kim, and Lee 2009; Okazaki, Li, and Hirose 2009; Scharl, Dickinger, and Murphy 2005).

The summary in Table 1 indicates that, although these studies have examined various dimensions underlying ubiquity, the specific dimensions differ from study to study. Thus, we attempted to ascertain both the central and tangential dimensions identified in the articles chosen through the previously mentioned procedure. The objective was to refine our understanding of ubiquity in an iterative process by contrasting thoughts, ideas and descriptions in the literature. This exercise revealed four pairs of key dimensions representing mobile users' experiences with ubiquity: (1) continuity and simultaneity, (2) immediacy and speed, (3) portability and mobility, and (4) searchability and reachability. In each pair, two similar dimensions are identified according to prior research. This was preferred over a method that theoretically delineates a limited number of ubiquity dimensions. Domain sampling suggests that "a measure be composed of a sample of items from a large hypothetical domain of items;" thus, the initial domain of the construct should capture a broad "universe" (Netemeyer, Bearden, and Sharma 2003, p 95). Each set of dimensions is briefly explained below.

### *Continuity and Simultaneity*

Continuity refers to the state or quality of being continuous, which seems to correspond to one of the characteristics of 3G: being "always on." Kleijnen, de Ruyter, and Wetzels (2007) see continuous access to services as a unique ability of the mobile device that cannot be offered by traditional channels. This concept of continuity is very similar to that of simultaneity: happening, existing or doing at the same time (Leung and Wei 2000). The defining distinction between continuity and simultaneity could be illustrated by a theoretical explanation of "temporal mode of work" vs. "temporal mode of the actor" in an organizational setting (Lee and Sawyer 2010).

Table 1
Prior conceptualizations of ubiquity.

| Author(s) (year) | Concepts |
|---|---|
| Balasubramanian et al. (2002) | - The second characteristic highlights the *ubiquitous* "anywhere, anytime" nature of m-commerce. |
| Watson et al. (2002) | - The *ubiquity*, or omnipresence, of computer chips means not only that they are everywhere but also that they are, in a sense, "nowhere" because they have become invisible and we no longer notice them. |
| Barnes (2002) | - *Ubiquitous* interactivity can give customers even more control over what they see, read, and hear…The personal and *ubiquitous* nature of devices means that interactivity may be provided anywhere. |
| Scharl et al. (2005) | - The *ubiquity* of mobile devices extends the time-space paradigm of traditional marketing and amplifies the importance of location, time, and personalization…Mobile phones amplify two key arguments for electronic commerce: location independence and *ubiquity*. |
| Nysveen et al. (2005) | - Mobile services are becoming increasingly important for firms and consumers because of *ubiquitous*, universal, and unison access to information and services and the possibility for unique and personalized exchange of information. |
| Junglas and Watson (2006) | - *Ubiquity* incorporates the idea of accessibility, reachability, and portability into one construct. People are able to access networks at any time from anywhere, and in turn, are reachable at any time and any place. |
| Kleijnen et al. (2007) | - From a consumer's perspective, a uniquely defining characteristic of m-commerce is its *ubiquity*; that is, the ability it offers to engage in commerce anytime and anywhere…Research on mobile transaction services reveals that as many as two-thirds of the financial service transaction needs of respondents such as the ability to access services "when sitting in a public place" or "walking along" remain unfulfilled because traditional channels do not offer the *ubiquity* provided by a mobile channel. |
| Muk (2007) | - The *ubiquity* of the mobile phone extends the traditional time-space media model. Mobile phones increase the accessibility, frequency, and speed of communication through which timely mobile ads can be delivered to consumers based on their demographic characteristics and geographic information. |
| Ko et al. (2009) | - M-commerce is distinguished from the Internet in terms of its delivery of value by offering more convenience and access at any time and any place. Such *ubiquity* allows people to download and use real-time information wherever they are. |
| Gao et al. (2009) | - Certain unique characteristics of the mobile platform make advertising, which is called "*ubiquitous* interactivity," on mobile phones very promising. Mobile devices are portable, personal, nearly always on, and convenient to respond…Compared to desktop computers, mobile devices have the characteristic of *ubiquitous* availability: Users carry handsets such as cell phones every day and everywhere, and handsets are almost always "on." |
| Kim and Garrison (2009) | - Perceived *ubiquity* refers to an individual's perception regarding the extent to which mobile wireless technology (MWT) provides personalized and uninterrupted connection and communication between the individual and other individuals and/or networks. |
| Okazaki et al. (2009) | - *Ubiquity* or time- and location-flexible usage represents a unique feature of mobile phones…We conceptualize perceived *ubiquity* as a second-order construct consisting of time flexibility (three items) and spatial flexibility (three items). |

The "temporal mode of work" refers to the temporal nature of tasks and events. While some events occur irregularly or sporadically, others take place regularly and follow a predetermined, or at least predictable, sequence (monochronic). The "temporal mode of the actor" relates to how workers organize their time to manage tasks and events. A polychronic worker addresses tasks and events spontaneously as they arise, whereas a monochronic worker only addresses tasks and events at specified times and addresses one thing at a time, allocating defined increments of time for specific tasks. In other words, whereas the temporal mode of work relates to how work is structured, the temporal mode of the actor is concerned with the process of working. When a mobile device is incorporated into our work processes, it could help us to disrupt monochronic temporal order by altering the ways in which we structure our work patterns so they become more polychronic (Lee and Liebenau 2000). Using mobile devices, whether to e-mail, search, or download, enables us to involve ourselves in several tasks (which would have previously forced us to relocate ourselves) simultaneously *and* seamlessly.

### *Immediacy and Speed*

Immediacy and speed both refer to the quickness of an action or occurrence. However, immediacy implies light, effortless, easy displacement while speed is the state of being in rapid motion. This motion fills the gap between departure and arrival, or desire and fulfillment, and refers to the manifest concrete realities of spatial separation (Tomlinson 2004). Castells (1996) argues that the occurrences of the phenomena are compressed for instantaneity due to our perceived temporality—a concept that explains the meaning of time. Temporality is demonstrated, for example, when we assess that things "take too long" or "move too fast." Temporality helps us to explain to others and helps others make sense of the notion that 1 min of time in a tender embrace with a loved one is experienced as "shorter" than 1 min of time stuck in an elevator. Thus, speed is relative to one's sensory system and vested interests.

The vested interest theory states that an object is of high vested interest if it can cause important personal consequences. Vested interest is affected by the immediacy of these consequences as well as a person's self-efficacy in enacting necessary behaviors, among other factors (Crano and Prislin 1995). Here, immediacy is defined as one's perceived amount of time between an action and its resulting consequences (Crano 1995), which is the meaning we seek in the development of this instrument. Immediacy and speed are directly related to the issues of timing, responsiveness, and customer wait times, which have extensively been addressed in the service encounter literature (Smith, Bolton, and Wagner 1999). Prior research has also referred to the immediacy or speed of mobile devices as instant connectivity (Barnes and

Huff 2003; Ko, Kim, and Lee 2009) or ubiquitous availability (Gao, Rau, and Salvendy 2009).

### *Portability and Mobility*

Portability is the quality of being light enough to be carried, which relates to the physical characteristics of the device (Barnes 2002; Bruner II and Kumar 2005; Kleijnen, de Ruyter, and Wetzels 2007). According to Junglas and Watson (2006), portability reflects "the physical aspects of mobile devices that enable them to be readily carried for long periods of time" (p 573). Gao, Rau, and Salvendy (2009) note that ubiquity means being portable, which enables an extensive reach beyond our spatial and temporal constraints. Portability has been associated with the use and effectiveness of information and communication technologies and reflects the high levels of mobility in our social lives (Garfield 2005). Such portability is essential for an information system (IS) to "support all forms of mobility" by being smaller in size, "ergonomic," and "stylistic." In prior research, the extent of portability has been noted as one of the key factors that influences the use and satisfaction of an IS (Kuziemsky, Laul, and Leung 2005).

Likewise, mobility has often been considered synonymous with portability as a determinant of time–place independence (Chatterjee et al. 2009; Mallat et al. 2008). More formally, mobility has been defined as people's independence from geographical constraints (Makimoto and Manners 1997). According to Kristoffersen and Ljungberg (2000), spatial mobility can be classified into three types: traveling, wandering, and visiting. Wandering refers to "local mobility in a building or local area," whereas traveling and visiting signify more extensive mobility in which users may be going from one place to another (i.e., "traveling") or going to a particular location and remaining in that location for a certain period of time, such as during a vacation (i.e., "visiting"). This study extends this view, defines mobility as the quality or state of being mobile, and particularly refers to something that can be operated while in transit—whether traveling, wandering, or visiting.

### *Searchability and Reachability*

Searchability refers to the capability of making a thorough examination. This dimension has been widely discussed in context awareness computing (Pascoe, Ryan, and Morse 2000). Searchability is somewhat similar to the notion of localization proposed by Junglas and Watson (2006), which is defined as the ability to pinpoint the position of a user or entity. Nonetheless, searchability is not limited to geographically specific services or location-based services because it covers information or data search in a computer-mediated environment.

Reachability is the capability of contacting or communicating with another party. Junglas and Watson (2006) define reachability as the ability to "be in touch with and reached by other people 24 h per day, 7 days per week, assuming that the mobile network coverage is sufficient and the mobile device is switched on" (p 573), although users can limit their reachability to particular persons or times.

In a study on e-service quality, Heinonen (2006) viewed spatial flexibility as the spatial approachability of the service, which is defined as "the customer's choice of and latitude in performing the service at various locations" (p 389). Although her study centers on a PC-mediated environment, we could interpret spatial approachability as amorphous to searchability. Similarly, the ability to perform services anytime—particularly the abilities of being on site quickly and reaching the company when needed—has been discussed in the service quality literature (Zeithaml 2000).

Searchability and reachability have been used interchangeably in prior research. For example, Kim and Garrison (2009) define searchability as the extent to which one can "reach" others "anytime and anywhere" via mobile devices. However, this study distinguishes between the two concepts as defined above.

## Methods

Closely following the widely accepted literature on marketing construct development, we established measurement development procedures as summarized in Fig. 1.

The first stage includes a qualitative approach to a literature review. We conducted a series of focus groups based on which the construct domain was defined and an initial pool of items was proposed. In the second stage, a multidimensional measurement instrument for perceived ubiquity was proposed and examined through exploratory assessment with a student sample. The third stage reexamined the measurement instrument with a general consumer sample and performed a confirmatory assessment, further refining the measurement items. Finally, in the fourth stage, we validated the instrument and established its convergent, discriminant, nomological, and known-group validities as conclusive evidence of its generalizability.

## Stage 1: Qualitative Inquiry and Initial Measurement Development

### *Domain and Dimensionality*

The goals of this phase of the investigation were to confirm each dimension of perceived ubiquity proposed in the previous section and generate an initial pool of measurement items. The primary basis for the development of the items was the literature review, supplemented by the use of focus groups. In total, eight focus groups were conducted using an interpretative approach.

Each focus group consisted of five to eight general consumers. The first half of the sessions included consumers aged between 20 and 30 years old, while the remaining sessions included consumers from the ages of 30 to 40. These age groups represent the majority of smartphone owners in Japan (D2 Communications 2012). The moderator asked open-ended questions related to the consumers' personal experiences, anecdotal stories, perceptions, and emotions

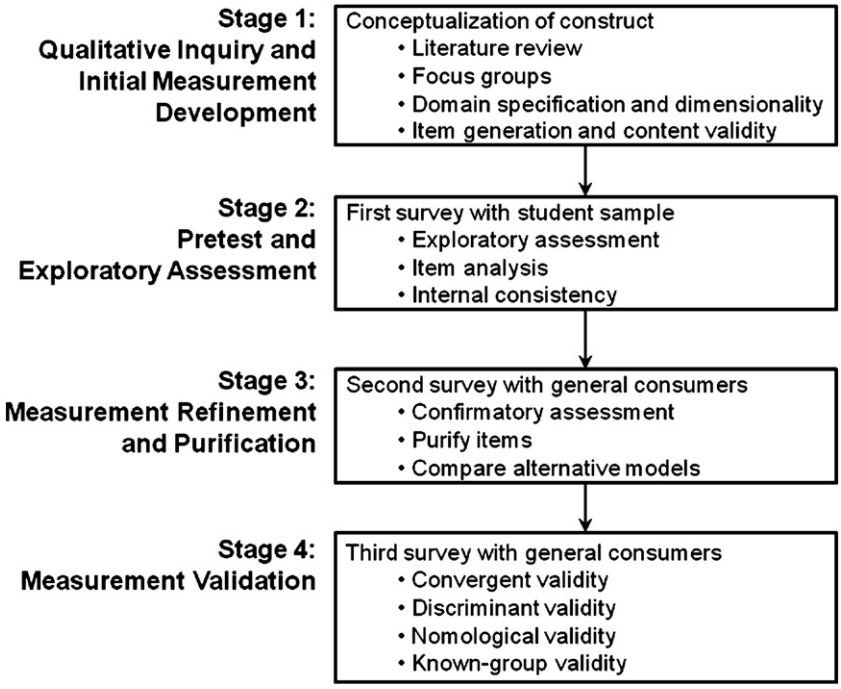


Fig. 1. Measurement development and validation process.

related to mobile services. To stimulate active discussions, visual images or photos of mobile services, such as Short Message Services (SMS), Global Positioning System (GPS), and Quick Response (QR) codes, were projected on PowerPoint slides. The main objective of this was to allow focus group participants to freely and spontaneously associate their thoughts and perceptions with mobile service usage. All conversations were recorded and transcripts were generated immediately following each session.

Our interpretative approach involved qualitative content analysis, which adopted two techniques of grounded theory—coding and constant comparison. The transcripts generated after the sessions were analyzed by conducting three types of coding (Charmaz 1995). First, we examined the focus group transcripts through initial coding (word-by-word and line-by-line coding) according to consistency and relevance. Next, we scrutinized these results through focused coding to identify the most significant and/or frequent dimensions associated with perceived ubiquity. The properties of each dimension were examined through axial coding. These coding results were constantly compared across focus groups. This procedure continued until a theoretical saturation was achieved in which no additional novel insights were gained.

*Item Generation*

The insights gained from the focus groups were combined with the published scales to generate an initial pool of construct items (Childers et al. 2001; Handelman and Arnold 1999; Heinonen 2006; Kleijnen, de Ruyter, and Wetzels 2007; Leung and Wei 2000; Mathwick, Malhotra, and Rigdon 2001; Okazaki, Li, and Hirose 2009). To ensure that the items were a proper and representative sample of the theoretical domain of the construct, four items were generated for each dimension. In total, 32 items were proposed. These items were then converted to Likert scales for content validation.

To ensure content validity, 12 expert judges were recruited from a relevant population (Lewis, Templeton, and Byrd 2005; Netemeyer, Bearden, and Sharma 2003). The judges received the list of 32 items with a description of the study's purpose. Eight judges were university marketing and advertising professors and four judges were practitioners in the telecommunications and IT industries. The panel was asked to assess each questionnaire item on a four-point scale (completely adequate, somewhat adequate, somewhat inadequate, and completely inadequate). If they rated an item as questionable, the judges were asked to explain their reasons and make recommendations for improvement. The expert members rated most of the scale items to be "completely adequate" or "somewhat adequate," but two members noted that five items were "somewhat inadequate" in terms of wording. After incorporating their recommendations, a final pretest involving all value dimensions was administered to a convenience sample of 44 university students. The pretest indicated no specific wording or comprehension problems. Thus, face validity was also considered.

*Construct Specification*

The construct indicators can be treated as reflective (the underlying constructs are hypothesized to cause changes in the indicators) or formative (changes in the indicators are hypothesized to cause changes in the underlying construct) (Jarvis, MacKenzie, and Podsakoff 2003). According to Diamantopoulos and Winklhofer (2001), the choice between a

formative and a reflective specification should primarily be based on theoretical considerations. Based on previous theoretical discussions, we concluded that when ubiquity is modeled as a multidimensional construct, a reflective measurement approach should be used because causality flows from the construct to the indicators.

## Stage 2: Pretest and Exploratory Assessment

### *First Survey*

We pretested 32 items measuring eight constructs on a student sample. Our sample consisted of 345 undergraduate students at a large public university located in a Southern European country. The students were business majors primarily over 20 years of age and the sample included approximately the same proportion of males and females. A structured questionnaire was developed in which the items of the different dimensions were mixed and randomly rotated to minimize halo effects. Each item was written as a brief statement measured by a 7-point Likert scale, with 1 being "completely disagree", 7 being "completely agree", and 4 being "neutral". Respondents were told that the questionnaire presented statements pertaining to their own experiences with three mobile services: SMS, GPS, and Web browsing. Our objective was to capture their overall perceptions of mobile-based services or transactions. The evaluated services are different in terms of their technical nature but capture the majority of mobile content revenue, thus justifying their use as survey stimuli.

### *Exploratory Factor Analysis*

Prior research recommends that an exploratory factor analysis (EFA) be employed to empirically derive the initial set of factors for the constructs (Lewis, Templeton, and Byrd 2005; Netemeyer, Bearden, and Sharma 2003). Through EFA, the instrument can be "purified" (Churchill 1979), meaning that certain items will be added, deleted, or modified according to the results (Smith, Milberg, and Burke 1996). Before proceeding with the analysis, we tested two primary assumptions: the Kaiser–Meyer–Olkin test and the Bartlett sphericity test. Both results were positive. According to Hair et al. (2006), the number of factors obtained from the factor analysis procedure should be based on the criterion that the eigenvalues of the chosen factors be one or greater. According to the results, we dropped items that did not load as expected. A careful examination of the EFA results revealed that there were cross-loadings among the proposed constructs. The continuity and simultaneity dimensions converged into a single factor, continuity. Similarly, from the immediacy and speed dimensions, only immediacy was retained because consistently greater loadings were observed. The reachability dimension was dropped due to its low loadings, as was the mobility dimension. This process was consistent with our initial conceptualization because we assumed that there would be a certain level of redundancy in generating "a large hypothetical domain of items" (Netemeyer, Bearden, and Sharma 2003). As a result, the original 32-item eight-factor model was reduced to a 16-item four-factor model representing continuity, immediacy, portability, and searchability. The final rotated four-factor component matrix is shown in Table 2.

## Stage 3: Measurement Refinement and Purification

### *Second Survey*

Although stage 2 resulted in reasonable validation results, the survey respondents rated the items based on their past experiences without actually accessing mobile services. Thus, recall bias could have distorted the results. In addition, discriminant validity could have been problematic because the correlations across constructs seem high. Furthermore, a non-student sample of respondents is desirable for increased generalizability of the measurement validation. To this end, an internationally known professional research firm was employed for data collection. To obtain a national sample in which general consumers with mobile service experiences were well represented, 225 smartphone users were pre-screened. The subjects were invited to the firm's research laboratory by appointment. The study took place in three cities. The first and second cities represent the regions with the highest 3G penetration whereas the third city has among the lowest levels. The combination of high and low 3G penetration regions enabled us to obtain less biased results. Trained interviewers explained to the subjects that the investigation focused on consumer responses to mobile service usage. Only those who had used or regularly use mobile services participated in the survey. Each subject was then asked to use his or her mobile handset to seek information related to the *Louvre Museum* in Paris. Specifically, they were asked to connect to the Internet with their mobile device and find (1) a general description of the museum and (2) its exact location on a map. After performing this task, the respondents were asked to complete

Table 2
Preliminary instrument structure EFA results (stage 2).

| Item # | Continuity | Immediacy | Portability | Searchability |
|---|---|---|---|---|
| CON2 | **.79** | .30 | .10 | .23 |
| CON3 | **.77** | .05 | .17 | .24 |
| CON1 | **.72** | .23 | .14 | .18 |
| CON4 | **.61** | .14 | .55 | .09 |
| IMM1 | .16 | **.84** | .05 | .02 |
| IMM4 | .15 | **.71** | .28 | .26 |
| IMM3 | .21 | **.69** | .20 | .25 |
| IMM2 | .18 | **.67** | .55 | .10 |
| POR1 | .16 | .32 | **.72** | .20 |
| POR2 | .20 | .15 | **.69** | .22 |
| POR4 | .54 | .12 | **.62** | .09 |
| POR3 | .07 | .01 | **.60** | .69 |
| SEA3 | .27 | .19 | .02 | **.81** |
| SEA4 | .47 | .37 | .28 | **.77** |
| SEA1 | .32 | .26 | .20 | **.75** |
| SEA2 | .56 | .13 | .14 | **.64** |

Note: principal component analysis with varimax rotation.
Numbers in bold indicate the factor loadings of the items loaded on the hypothesized factors.

the questionnaire and indicate their perceptions of the items on a seven-point scale ("completely disagree" to "completely agree"). The final usable sample included 225 respondents.

*Confirmatory Factor Analysis*

Next, on the basis of the EFA, we proceeded with a confirmatory factor analysis (CFA) of 16 items. Amos 18 was used with the maximum likelihood method. The calibration process across the constructs indicates high modification indexes for four items, one for each construct. Removing these constructs left us with a 12-item four-factor model. The resulting indexes indicated a good fit: $\chi^2_{48}=219.43$ ($p<.001$), CFI = .90, NFI = .90, TLI = .89, and RMSEA = .069. Convergent validity was established by the strength of loadings with all $t$ values being statistically significant. However, discriminant validity was demonstrated only in a weak sense. After calculating confidence intervals (plus or minus two standard deviations) around the factor correlations, one of the confidence intervals surrounding the factor correlations contained 1.00 (Bagozzi and Yi 1988).

The modest results of discriminant validity in stage 2 indicate a multidimensional, hierarchically organized construct because the existence of a second-order factor structure implies that the first-order factors of perceived ubiquity share a common variance (Mathwick, Malhotra, and Rigdon 2001). Thus, the superiority of the first- and second-order models needs to be assessed. Brown (2006) explains that the difference in the overall model fit among the nested models can be evaluated using the traditional chi-square difference test. In Table 3, the significance tests of the chi-square differences are shown for four alternative models of perceived ubiquity. Model A hypothesizes a single first-order construct that accounts for all 12 indicators. Model B hypothesizes that the 12 items form four uncorrelated or orthogonal first-order factors. By conventional standards, neither Model A nor Model B is far from being considered a good fit with the data. However, these models are inconsistent with our theoretical framework. Model C hypothesizes that the four first-order factors are correlated with each other. Model D hypothesizes one second-order factor.

Table 3 indicates that Model C (first-order model with correlated factors) fits the data significantly better than Model B (four uncorrelated factors), and the improvement from Model C to Model D (second-order model) is statistically significant ($p<.05$). Furthermore, our theoretical landscape, along with prior research in this field, suggests the existence of a single overall ubiquity construct. For these reasons, we can conclude that Model D is of greater theoretical and empirical interests than Model C. The final instrument to measure perceived ubiquity is shown in Fig. 2.

Table 3
Alternative models (stage 3).

| Model specification | $\chi^2$ ($df$) | Comparison | $\Delta\chi^2$ ($\Delta df$) | $p$ |
|---|---|---|---|---|
| First-order model with correlated factors | 219.43 (48) | A vs. C | 29.02 (5) | .00 |
| Second-order model | 227.33 (50) | D vs. C | 7.9 (2) | .02 |

Note: AMOS18 with maximum likelihood method.

## Stage 4: Measurement Validation

*Third Survey*

The results of stage 3 generated two motives requiring the third survey: small sample size and weak discriminant validity. Moreover, prior research suggests that the measurement validation should take nomological validity into account. To this end, the same research firm collected data from a national sample that included regular smartphone users. Unlike stage 3, in which all pre-screened respondents completed the questionnaire, in stage 4, potential respondents were asked to complete the following screening task to avoid self-report bias:

> *You are on your way to work and just got on the subway. You receive a phone call from your boss. She explains that she had a business meeting in Florence, Italy. Her Italian colleagues invited her to a nice restaurant and they enjoyed a wonderful dinner. She left Florence this morning to catch a flight to Tokyo. After boarding, she suddenly realized that she forgot her agenda at the restaurant. She does not remember the name of the restaurant, but remembers that it was a luxury fusion style restaurant located very close to a river. She asks you to find out where the restaurant is and to call them and ask them to keep her agenda. She cannot use the Internet for the next 10 hours while on the airplane.*

The respondents were then asked to access TripAdvisor with their mobile devices to find the restaurant in Florence. To do so, the respondents were asked to use a search engine, a sorting function, and a virtual map on the site, all of which represent important ubiquity functions in mobile services. To check for consistency, we included two questions that could be answered only by using the mobile version of TripAdvisor. The sample profile is described in Appendix A.

*Confirmatory Factor Analysis*

A CFA was run on the four-factor model with 12 items. The goodness-of-fit indexes improved: $\chi^2_{48}=173.82$ ($p<.001$), CFI = .96, NFI = .96, TLI = .95, and RMSEA = .067. Convergent validity was established by the strength of loadings with all $t$ values being statistically significant (Table 4). Discriminant validity was evaluated using two different approaches (Table 5). First, we performed the test of discriminant validity suggested by Fornell and Larcker (1981). This test is supportive of discriminant validity if the square root of AVE by the underlying construct is larger than the correlations with other latent constructs. This condition was satisfied for all cases. Second, we checked whether the correlations among the latent constructs were significantly less than one. None of the confidence intervals surrounding the factor correlations contain 1.00. Overall discriminant validity is therefore suggested (Bagozzi and Yi

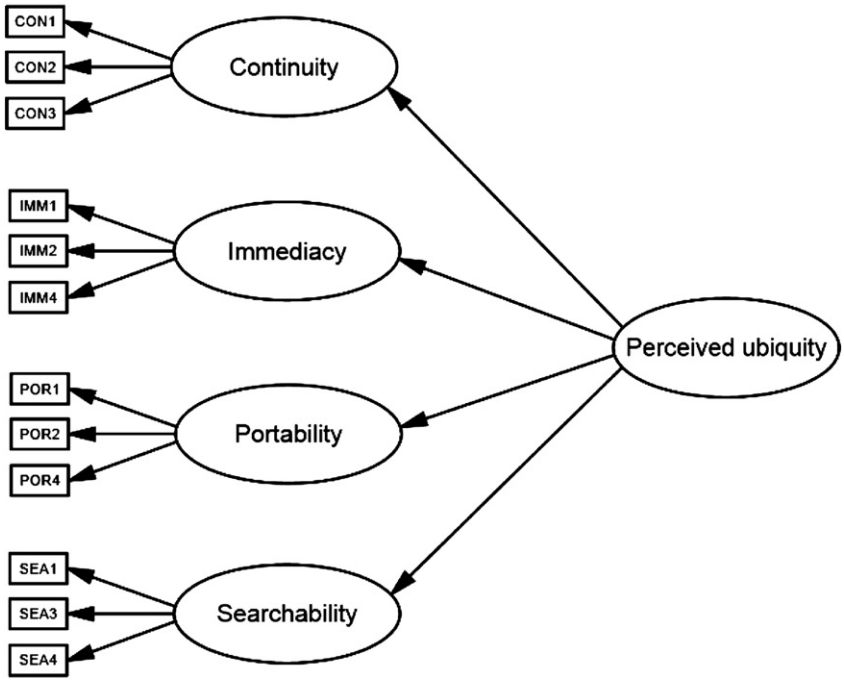


Fig. 2. Final measurement of perceived ubiquity.

1988). The means and standard deviations of each construct are shown in Table 6, beside those of stages 2 and 3.

Next, consistent with the results from stage 3, a second-order factor structure of perceived ubiquity was examined. The goodness-of-fit indexes improved: $\chi^2_{50} = 177.46$, CFI = .96, NFI = .96, TLI = .95, and RMSEA = .075. The difference of chi-square values between the first-order and second-order models was not statistically significant ($p < .16$). However, in addition to our theoretical justification and the evidence from stage 3, the R-square scores are consistently high for all first-order factors (immediacy = .85, continuity = .76, portability = .79, and searchability = .67). Thus, our validation concludes that a second-order factor structure is preferred over a first-order factor structure. The standardized loadings of a second-order model are summarized in Table 7.

Common method bias was examined by the single-method-factor approaches suggested by Gentry and Calantone (2002). The change in R-square was calculated between the original model and an alternative model after the item errors for each factor were allowed to covary within the factor. The difference was .15, resulting in a 15% bias in the observed relationships among constructs. However, this figure is far below the benchmark recommended by Doty and Glick (1998). Thus, common method bias is not a serious threat to our study.

Table 4
CFA results (stage 4).

| Construct items | Loading [a] | *t* Value | *p* |
|---|---|---|---|
| Continuity (CR .83, AVE .64) | | | |
| • Using these services keeps me well informed at all times. | .91 | 25.66 | *** |
| • With these services, I can always keep up with the world. | .89 | 12.29 | *** |
| • When I use these services, I don't have to interrupt my current task. | .54 | | |
| Immediacy (CR .81, AVE .60) | | | |
| • These services allow me to access information at the best moment for me. | .87 | 20.87 | *** |
| • When I cannot wait and I need a certain type of information immediately, I will use these services. | .83 | 13.42 | *** |
| • When I need to receive an urgent response, I will use these services. | .60 | | |
| Portability (CR .85, AVE .65) | | | |
| • These services are practical because I can use them without difficulty wherever I am. | .80 | 16.68 | *** |
| • Using these services outside my home or my workplace is not a problem for me. | .75 | 20.02 | *** |
| • I find it convenient to use these services because they don't make me dependent on any fixed installation. | .88 | | |
| Searchability (CR .86, AVE .68) | | | |
| • With these services, I can check out new things regardless of where I am. | .80 | | |
| • Using these services helps me to reach my target information regardless of where it comes from. | .86 | 19.31 | *** |
| • When I use these services, I can achieve things that I cannot achieve in any other way. | .81 | 18.24 | *** |

[a] Standardized loadings; goodness-of-fit indexes: $\chi^2_{48}$ 173.82 ($p < .001$), CFI .96, NFI .96, TLI .95, and RMSEA .067.
*** $p < .001$.

Table 5
Discriminant validity (stage 4).

| Constructs | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Continuity | **.80** | (.66 .97) | (.60 .91) | (.66 .99) |
| 2. Immediacy | .81 | **.77** | (.56 .88) | (.66 .90) |
| 3. Portability | .76 | .83 | **.81** | (.57 .92) |
| 4. Searchability | .72 | .74 | .75 | **.82** |

Note: Diagonal elements in bold are the square root of average variance extracted (AVE).

Table 6
Descriptive statistics.

| Constructs | Stage 2 | | | Stage 3 | | | Stage 4 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *M* | SD | α | *M* | SD | α | *M* | SD | α |
| Continuity | 5.08 | .46 | .79 | 5.44 | .35 | .61 | 5.34 | .48 | .80 |
| Immediacy | 5.80 | .14 | .73 | 5.63 | .25 | .70 | 5.81 | .17 | .80 |
| Portability | 5.52 | .24 | .77 | 5.59 | .26 | .66 | 5.56 | .23 | .85 |
| Searchability | 5.40 | .16 | .78 | 5.52 | .03 | .63 | 5.63 | .03 | .86 |

*M* means, SD standard deviations, α Cronbach's alpha.

### *Nomological Validity*

To test the external validity of the measurement instrument, we examined a nomological network in which the measurement instrument for perceived ubiquity is associated with "other constructs with which it would be expected to be linked (i.e., antecedents and/or consequences)" (Diamantopoulos and Winklhofer 2001). Nomological validity refers to the degree to which the construct, as measured by a set of indicators, predicts other constructs that past theoretical and empirical work suggests it should predict (Lewis, Templeton, and Byrd 2005; Netemeyer, Bearden, and Sharma 2003).

The nomological net of perceived ubiquity was tested in a context of Hoffman and Novak's (1996) network navigation model. Our conceptualization of perceived ubiquity implies that ubiquity is associated with an individual's perceptual capacity beyond his or her physical presence, which seems closely related to telepresence (Janelle 2004). Hoffman and Novak (1996) define network navigation as the process of self-directed movement through a hypermedia computer-mediated environment (CME). Here, hypermedia CME refers to a dynamic distributed network, connected with the associated hardware and software needed to access the network, that enables consumers and firms to (1) provide and interactively access hypermedia content and (2) communicate through the medium. This type of navigation contrasts with the restrictive navigation options available in traditional media, such as television or print. This study employs the network navigation model as a nomological net because mobile devices can be viewed as one of the pieces of "hardware" used to access the same network, in which consumers freely choose which view of the mediated communication is best suited for a given moment.

In doing so, we replace telepresence with perceived ubiquity to examine its impact on five variables that reflect the antecedents and consequences of mobile service usage: interactivity, flow, focused attention, positive affect, and continuous usage. We propose that, in accordance with the role of telepresence in Hoffman and Novak's (1996) model, perceived ubiquity should have similar positive relationships with its related variables. In terms of antecedents, interactivity has often been closely related to ubiquity (Barnes 2002), but its formal relationship has not been tested empirically. Second, focused attention is defined as "a centering of attention on a limited stimulus field" (Csikszentmihalyi 1990, p 40), which depends on the speed of a computer-mediated environment. This speed, in turn, is influenced by a number of factors including the type of Internet connection and the user's hardware and software (Hoffman and Novak 1996). In terms of the consequences, flow has also been linked to a distortion in time perception (Csikszentmihalyi 1990) in which the consumer is unaware of the passage of time. Flow leads to concurrent subjective perceptions of positive affect and mood (Csikszentmihalyi 1991), as well as continuous usage that replaces the exploratory behavior of the original model, because the latter is likely to lead to more uses (Hoffman and Novak 1996). The scales used to measure these variables are adopted from prior research (Bhattacherjee 2001; Engeser and Rheinberg 2008; Liu 2003; Novak, Hoffman, and Duhachek 2003; Novak, Hoffman, and Yung 2000). All measures are listed in Appendix B.

A CFA consisting of 13 latent variables with 34 observed variables (i.e., a second-order perceived ubiquity with four first-order factors, a second-order interactivity with three first-order factors, plus four nomological net constructs) was run with the maximum likelihood method. The results indicate a good fit: $\chi^2_{511} = 1719.32$ ($p < .001$), CFI = .90, NFI = .90, TLI = .89, and RMSEA = .065. Convergent validity was established by the strength of loadings with all *t* values being statistically significant. Discriminant validity among the constructs was established by the same method employed previously. Based on this, a structural model was examined in which a second-order four-factor perceived ubiquity construct was related to five variables based on Hoffman and Novak (1996). The results are summarized in Fig. 3. The standardized coefficients of the hypothesized paths were all statistically

Table 7
Second-order CFA results (stage 4).

| Constructs | | | Loading [a] | *t* Value | *p* |
|---|---|---|---|---|---|
| Perceived ubiquity | → | Continuity | .87 | 14.71 | *** |
| Perceived ubiquity | → | Immediacy | .93 | 15.22 | *** |
| Perceived ubiquity | → | Portability | .89 | 13.56 | *** |
| Perceived ubiquity | → | Searchability | .82 | | |
| Continuity | → | CON1 | .91 | 25.68 | *** |
| Continuity | → | CON2 | .89 | 12.22 | *** |
| Continuity | → | CON3 | .54 | | |
| Immediacy | → | IMM1 | .89 | 19.92 | *** |
| Immediacy | → | IMM2 | .83 | 11.65 | *** |
| Immediacy | → | IMM4 | .59 | | |
| Portability | → | POR1 | .80 | 16.66 | *** |
| Portability | → | POR2 | .75 | 20.02 | *** |
| Portability | → | POR4 | .88 | | |
| Searchability | → | SEA1 | .80 | | |
| Searchability | → | SEA3 | .86 | 19.38 | *** |
| Searchability | → | SEA4 | .81 | 18.27 | *** |

[a] Standardized loadings; $\chi^2_{50}$ 177.46, CFI .96, NFI .96, TLI .95, and RMSEA .075.
*** $p < .001$.

significant at $p<.001$, except the path between perceived ubiquity and focused attention ($p=.47$). The R-square scores are consistently high in all constructs. The fact that seven out of eight structural paths were empirically confirmed is sufficient to conclude that nomological validity was established.

*Known group Validity*

One final test of the development of the measurement was to establish known-group validity. Known-group validity refers to "the extent to which a measure differs as predicted between groups who should score low and high on a trait" (Netemeyer, Bearden, and Sharma 2003, p 80). Comparing mean scores across independent samples typically provides supportive evidence of known-group validity. To this end, we collected data from PC service users, using the same task employed for mobile service users. Here, the respondents were asked to perform the search via a TripAdvisor PC site. The wording of measurement items was modified accordingly. In total, 457 general consumers from a nationwide online panel responded to the questionnaire.

A multigroup CFA was run to test invariant latent mean structures. Following Steenkamp and Baumgartner (1998), we first validated the measurement properties to check for invariant structures between the two models: the mobile service and PC service models. The configural invariance of the four factors was supported because the simultaneous estimation of the unconstrained model showed a good fit: $\chi^2_{96}=468.67$ ($p<.001$), CFI=.95, NFI=.94, TLI=.93, and RMSEA=.065. All parameter estimates were significantly loaded on their respective factors. The metric invariance was tested by placing constraints on all the factor loadings (i.e., constrained model), which resulted in a good fit: $\chi^2_{104}=483.57$ ($p<.001$), CFI=.95, NFI=.94, TLI=.93, and RMSEA=.064. The comparison between the unconstrained and constrained models yielded a chi-square difference value of 14.9 ($df=8$), which was not statistically significant at $p<.05$. Thus, full metric invariance was established. Next, the parameters were freely estimated in the mobile service model whereas those in the PC service model were fixed to zero as a reference group. We thereby examined whether the latent means of the former were significantly different from those of the latter (Byrne 2001). Table 8 shows the results of the test for invariant latent mean structures. As clearly shown, three out of four latent means were statistically greater in the mobile service model than in the PC service model. These statistically significant differences confirm the known-group validity of perceived ubiquity.

## Discussion and Conclusions

*Theoretical Implications*

Studies on mobile marketing have advanced in both number and variety. However, such growth has increased the width, not depth, of our theoretical knowledge. In particular, the ubiquity of mobile services has not received the attention it merits. To

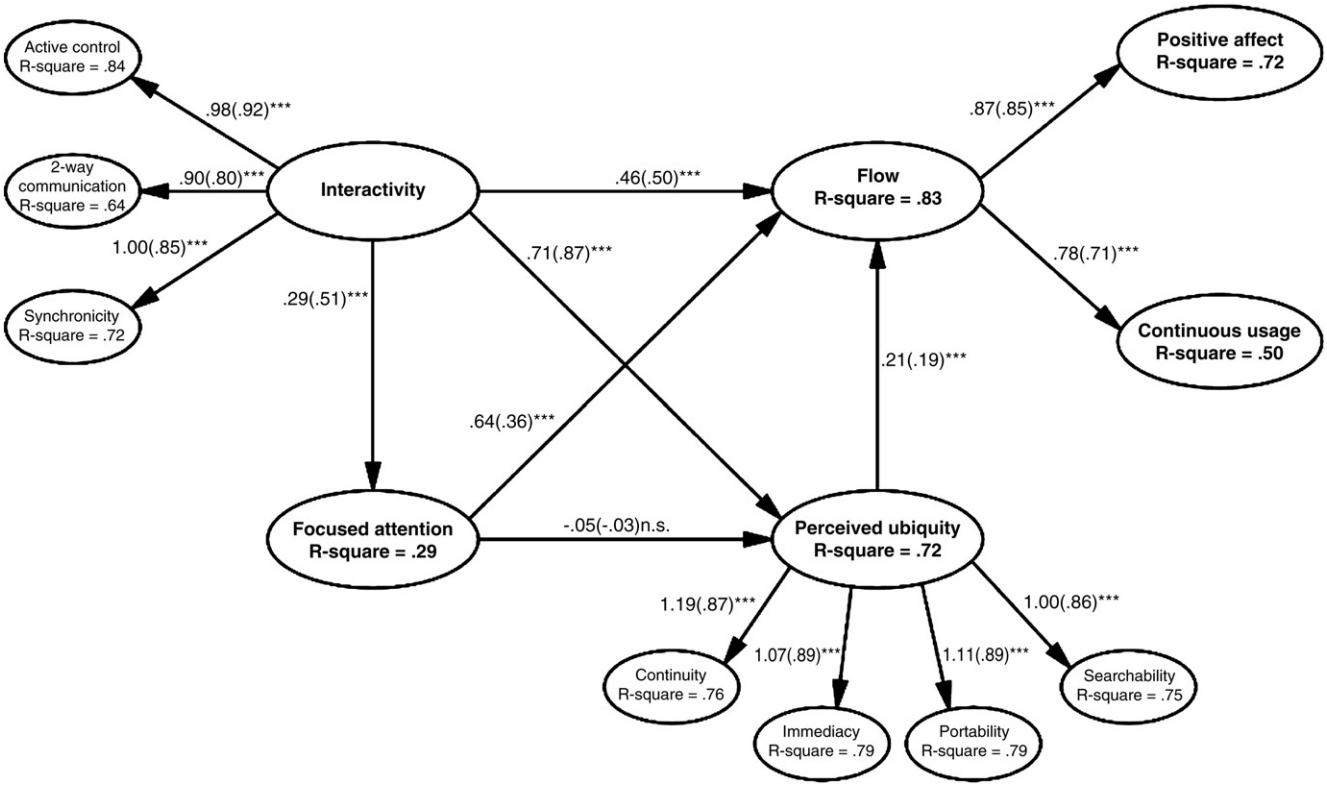


Fig. 3. Nomological validity of stage 4. Note: these results are based on stage 4 (n 457). $\chi^2_{511}$ 1719.32 ($p<.001$), CFI .90, NFI .90, TLI .89, and RMSEA .065. Unstandardized loadings with standardized loadings indicated in parentheses.*** $p<.001$, n.s. non-significant.

Table 8
Latent mean structures (stage 4).

| | PC service users [a] | Mobile service users | Standard error | *t* Value | |
|---|---|---|---|---|---|
| Continuity | 0 | .18 | .09 | 1.99 | * |
| Immediacy | 0 | .23 | .09 | 2.75 | ** |
| Portability | 0 | .02 | .08 | .22 | n.s. |
| Searchability | 0 | .35 | .07 | 4.83 | *** |

* $p<.05$, ** $p<.01$, *** $p<.001$.
n.s. non-significant.
[a] Reference value. The latent means of PC service users were fixed to 0.

the best of our knowledge, no formal measurement instrument for ubiquity has been developed or empirically validated. Our research explicitly fulfills this research gap.

This series of studies confirms that perceived ubiquity is a multidimensional construct consisting of continuity, immediacy, portability, and searchability. Following the main definition of ubiquity in prior research, this study empirically singled out these most relevant constructs. In multiple studies, we found the instrument to measure perceived ubiquity to be reliable and valid, with evidence in support of the measurement's convergent, discriminant, nomological, and known-group validities. While some may criticize such empiricism, our thorough review of the literature taking into account interdisciplinary perspectives has served as a solid foundation for such statistical analysis. It should also be noted that our alternative model comparison finds a second-order structure to be somewhat more appropriate due to high construct-to-construct correlations. Nonetheless, this point should be further investigated with additional samples in the future.

Our measurement instrument for perceived ubiquity also proved to be relevant to Hoffman and Novak's (1996) hypermedia environment. In adopting this model as our nomological net, we replaced telepresence with perceived ubiquity. Our structural equation modeling confirmed that the model fits well with our data. The high coefficients found in the paths between interactivity and perceived ubiquity suggest that perceived ubiquity is indeed an important consequence of two-way communication, active control, and/or synchronicity. In addition, as predicted, perceived ubiquity strongly and directly influenced flow. The only exception was the path between focused attention and perceived ubiquity, which was not statistically significant. Our interpretation is that this may represent a major divide between desktop PCs and mobile devices. The benefits of mobile services lie precisely in their ease of use and flexibility; users therefore do not need to be psychologically prepared to use them. That is, they may not have to be deeply engrossed, focused, or concentrated.

This parallelism between telepresence and perceived ubiquity was partially proven by the nomological net validation adapted from the network navigation model. This finding is significant because, whereas the ubiquity concept has often been discussed in relation to interactivity, little research, if any, has examined this relationship in a comprehensive manner. Here, we conceptualized perceived ubiquity as being parallel to telepresence in a computer-mediated environment. While we should avoid oversimplification of the results, our study demonstrates that perceived ubiquity operates as a key factor in hypermedia CME, and the mobile device can be deemed as a medium (i.e., hardware) that provides hypermedia content.

### *Managerial Implications*

It is inevitable that enthusiasm towards mobile marketing will increase because it will become one of the most significant business channels in the near future (Shankar et al. 2010). However, the lack of a formal instrument to measure perceived ubiquity has previously led to some fundamental problems in mobile marketing practices. For example, it would be extremely difficult to assess consumers' perceptions of, and responses to, mobile applications without taking this concept into consideration. The effectiveness of location-based services may not be accurately assessed because there is no way of measuring and testing how users perceive potential benefits to overcome time and space restrictions via such services. As the most important utility of mobile services, ubiquity is at the very heart of this issue. Our measurement instrument enables mobile marketers to not only gain a profound knowledge of the concept, uniqueness, and dimensions of perceived ubiquity, but also to better understand what mobile services bring to our present and future lives beyond traditional e-commerce. Our research can be an important step toward a practical understanding of the meaning of ubiquity.

Advances in the design and usability of smartphones, different sizes and forms of portable multimedia devices, and increasingly competitive pricing can all be expected to create greater business needs and opportunities for more time- and place-sensitive services. Our measurement can be of use to marketers and advertisers in measuring and comparing each dimension of perceived ubiquity for desktop PCs, tablets, and hand-held devices, aiding in the creation of multichannel strategy or optimal firm channel allocation decisions. In addition, as different types of mobile-based applications proliferate, it seems crucial to ensure that consumers perceive these e-services to be continuously and immediately available in addition to being easily searchable. It follows that if firms promote the same applications in both types of media, our instrument to measure perceived ubiquity would enable them to distinguish between PC- and mobile-based applications in terms of ubiquity.

The fact that perceived ubiquity is closely related to both interactivity and flow indicates that tablet PCs may indeed be a cutting-edge alternative to desktop PCs or smartphones. A tablet PC is as portable as a smartphone and allows consumers to use applications, search tools, and services in a continuous and immediate way. At the same time, nearly identical applications are available for tablet PCs and smartphones (e.g., App Store for iPad and iPhone). Firms may be increasingly pressured to clearly differentiate the nature and utility of applications that are available for distinct online media. In doing so, our measurement instrument for perceived ubiquity would provide firms with a useful tool for distinguishing between them, as well as for explaining which factors lead to better results.

If the increasing number of online marketers who promote goods and services for both PCs and smartphones do not

consider ubiquity, there will be no way of knowing which device better fits which application. In particular, in a time of accelerating differentiation among a diverse range of portable multimedia computing devices—smartphones, tablet PCs, and eBook readers—how users' perceptions of these devices differ according to size and convenience is virtually unknown. This type of differentiation among portable devices is expected to be of emergent importance because a certain level of cannibalization or media displacement may occur. Ubiquity would be one of the key variables that marketers could use to this end.

*Limitations and Future Research Directions*

To accomplish our measurement development objective, we should recognize some important limitations. First, prior research suggests that measurement tools need to be stable across weeks, months, or years (Netemeyer, Bearden, and Sharma 2003). However, test–retest reliability was not verified in this study. Second, the item we used to measure portability in known-group validity testing performed poorly. Portability, however, is one of the most evident characteristics of smartphones (i.e., size); thus, further refinement of this item should be attempted. Third, prior research indicates that, under certain circumstances, longer rather than shorter download times motivate Web users to keep surfing on desktop computers for a longer period of time (Selliera and Chattopadhyay 2009). This result seems to contradict our findings on immediacy but has not been examined in the present study. Finally, it should be noted that this study does not cover what Watson et al. (2002) termed as u-commerce—"the use of ubiquitous networks to support personalized and uninterrupted communications and transactions between a firm and its various stakeholders to provide a level of value over, above, and beyond traditional commerce" (p 332). According to Junglas and Watson (2006), ubiquity is only one of the four u-commerce constructs. Future research should address the remaining constructs: uniqueness, universality, and unison.

In addition to addressing these limitations, future research should examine the wider applicability of our measurement instrument. One obvious extension of this research is to utilize ubiquity as an antecedent to adoption, intention to use, or continued use (retention) models. Such models could be applied to devices or gadgets, general mobile e-services (e.g., mapping and social networking sites), or to location-based services. With regard to the latter, this might include retailing (e.g., ShopSavvy and Yelp), search tools (e.g., TripAdvisor and Urbanspoon), social geotagging (e.g., Sekai Camera and GeoLogTag), and location-based social applications (e.g., Foursquare and Gowalla). An increasing number of firms are trying to use these applications for their customized location-based promotions.

Future research should also offer specific predictions as to how continuity, immediacy, portability, and searchability might function differently from each other as antecedents. Similarly, depending on the type of application used, some dimension(s) may be more or less important than others. Another interesting extension could examine what might moderate the impact of perceived ubiquity on these types of outcomes. Some examples might include technological readiness, privacy concerns, age, culture, and uses and gratifications of the device/services. A study that examines the interrelations between these variables and perceived ubiquity would provide useful insights into the potential use of mobile services in different technological, cultural, and demographic contexts.


## Acknowledgment

The authors would like to thank the Editor and three anonymous reviewers for their valuable insights and constructive comments on earlier drafts of this manuscript. This research was funded by a grant from the Spanish Ministry of Science and Innovation (National Plan for Research, Development and Innovation ECO2011-30105).


## Appendix A. Sample Characteristics (stages 3 and 4)

| Demographic variable | Stage 3 (n 225) (%) | Stage 4 (n 457) (%) |
|---|---|---|
| Gender | | |
| Male | 53.4 | 66.0 |
| Female | 51.1 | 34.0 |
| Age | | |
| 20 29 years | 38.9 | 38.0 |
| 30 39 years | 36.7 | 33.1 |
| 40 49 years | 24.4 | 28.9 |
| Education | | |
| Junior high school | 9.0 | 2.4 |
| High school or less | 40.3 | 24.7 |
| Some college | 5.9 | 16.0 |
| College degree or more | 44.8 | 56.9 |
| Occupation | | |
| College student | 9.5 | 12.9 |
| Homemaker | 4.5 | .4 |
| Self-employed | 6.8 | 13.1 |
| Managerial/executive | 1.4 | 2.2 |
| Middle manager | 5.9 | 16.4 |
| Skilled professional | 35.7 | 32.2 |
| Office worker | 14.9 | 8.9 |
| Manual labor | 6.8 | 5.1 |
| Retired/unemployed | 14.5 | 8.7 |

## Appendix B. Questionnaire Items Used in Stage 4

(1) Interactivity (Liu 2003)

Active control:

I felt that I had a lot of control over my visiting experience on this Web site.

While I was on the Web site, I could freely choose what I wanted to see.

Two-way communication:

The Web site is effective in gathering visitors' feedback.

This Web site facilitates two-way communication between the visitors and the site.

The Web site makes me feel that it wants to listen to its visitors.

The Web site gives visitors the opportunity to respond.
Synchronicity:
Getting information from the Web site can be performed very fast.
I was able to obtain the information I wanted without any delay.
When I clicked on the links, I felt I was getting instantaneous information.

(2) Continuous usage intention (Bhattacherjee 2001)
My intention is to maintain my usage level of mobile services in the future.
I intend to continue using mobile services, rather than discontinue their use, in the future.
I will keep using mobile services as regularly as I do now.

(3) Flow (Engeser and Rheinberg 2008; Novak et al. 2003)
I often feel totally immersed when browsing on my mobile.
When connected to mobile services, I am completely absorbed.
Time disappears when I use mobile services.

(4) Positive affect (Novak et al. 2000)
Annoyed—Pleased
Unsatisfied—Satisfied
Unhappy—Happy

(5) Focused attention (Novak et al. 2000)
Not deeply engrossed—Deeply engrossed
My attention is not focused—My attention is focused
I am not fully concentrated—I am fully concentrated

Note: items (1)–(3) were measured on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) with 4 as an anchoring point. Items (4) and (5) were measured by a semantic differential scale.

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