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Antecedents and consequences of mobile phone usability: Linking simplicity and interactivity to satisfaction, trust, and brand loyalty

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Highlights

- We propose simplicity and interactivity as key determinants of usability.
- We examine the effects of usability on user satisfaction, trust, and brand loyalty.
- Increasing simplicity will increase interactivity and usability experience.
- Usability is a distal determinant of brand loyalty.

Satisfaction and trust mediates the effects usability on brand loyalty.

Abstract

Usability is a central issue for mobile phone design and service as users need to access various functionalities via limited user interfaces (UI) while they are often on the road. In this paper, we propose simplicity and interactivity as key determinants of mobile phone usability and assess their significance in an empirical setting. Further, we examine the effects of mobile phone usability on user satisfaction, trust, and brand loyalty, and provide a holistic view of the causal relationships between the proposed UI features and important organizational variables for building and maintaining long-term customer relationships. The study was conducted using survey questionnaire data collected from 310 mobile phone users in South Korea. The findings of the study confirm that simplicity and interactivity are two significant determinants of mobile phone usability, and that interface simplicity is an important precondition for positive interactivity and usability experience. Our findings also show that usability is a distal determinant of brand loyalty, exerting its influence indirectly through the mediators of satisfaction and trust. We discuss the implications of the study findings for usability research and UI design.

Keywords: simplicity; interactivity; usability; satisfaction; trust; brand loyalty; mobile phone; user interface

1. Introduction

"Simplicity is the ultimate sophistication."— Leonardo da Vinci

The wide availability of high-speed telecommunication networks and wireless Internet services has spurred the rapid expansion of the mobile service market. In addition to telephony, smart phones enable various mobile services including multimedia broadcasting, messaging, and social networking services through mobile applications. Usability is a central issue for mobile services as such various and ever-expanding functionalities have to be accessed via their limited input/output facilities on a small mobile phone while users are often on the road. The limited input interface and screen size demand a high level of effort on interacting with the mobile device, highlighting the need for effective user interface (UI) design. Moreover, it is a well-known fact that recent innovations in UI had a significant positive effect on the success of mobile services [1]. A recent study also found that users failed to estimate their usage of product functionalities before purchasing multifunctional products (e.g., mobile phone), which in turn negatively influenced product satisfaction [2]. Besides, simplicity of UI may signal product value that persuades users to purchase a product [3]. Thus, mobile phone manufacturers continuously seek to improve user experience by offering a well-designed interface that seeks to best utilize the limited screen space. However, due to the unique characteristics of mobile phones (e.g. small screen size, non-traditional input methods, and navigational difficulties), many mobile applications remain difficult to use [4].

Usability has been a major theme in human-computer interaction (HCI) research. While there is no clear consensus on the definition of usability, it has been commonly associated with the notion of the ease of using a target object. According to ISO/IEC 9126-1, usability is "related with attributes of the product that make it understandable,

learnable, easy to use, and attractive [5].” Nielsen [6] also defines usability as ease of use and learning. In addition, IEEE standards define usability as “the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component [7].” We adhere to the definition of ISO/IEC 9126-1 for our conceptualization of usability tailored to a mobile service context.

Given that the user perception of usability has a considerable impact on the successful adoption of a phone, our study proposes a holistic research model that links key design features (simplicity and interactivity) of a mobile phone to its consequent effects (user satisfaction, trust, and brand loyalty) via perceived usability. This study extends Flavian et al.[8]’s study, which found that perceived usability of a website positively influenced a user’s satisfaction and trust, which jointly influenced the user’s website loyalty.

We include in our research model two antecedents of usability: simplicity and interactivity – concepts that have been identified as important for improving user experience with mobile services, yet which remain understudied [9-12]. Simplicity is considered a crucial concept for a successful UI design because the increasing complexity of technology makes our lives uncomfortably cluttered [9]. Interactivity has been studied as an essential feature of websites that drives user attitudes and activities [12]. Interactivity entails the sense of fun and satisfaction, improved user engagement, and subsequent performance quality [11]. Today, mobile phones provide multiple functionalities, as well as different responses, feedback messages, and navigational cues and routes when users try to access these functionalities. Simplicity and interactivity are proposed as key determinants of usability in this context.

In sum, the primary goal of this study is to theorize and empirically validate the effects of simplicity and interactivity on the usability of mobile phones, which in turn

affects user satisfaction, brand trust, and brand loyalty. To the best of our knowledge, no study in information systems (IS) or HCI has examined these relationships in an empirical setting. The findings of this research have practical implications for mobile user experience design as well as theoretical implications for usability research.

2. Theoretical Development and Research Hypothesis

The research model and the hypothesized relationships are shown in Figure 1. Specifically, the research model is designed to examine the effects of simplicity and interactivity, which we propose as two major characteristics of mobile phone interface, on usability and its consequent variables. In the proposed model, simplicity is conceptualized as a second order formative construct while interactivity is conceptualized as a second order reflective construct, following Bollen and Lennox [13] and prior research on those constructs. Extending prior research findings on website usability, the model links usability to user satisfaction, trust, and brand loyalty in order to validate the effects usability has on those consequence variables in a mobile service setting.

*** Insert Figure 1 about Here ***

2.1. Simplicity

Nielsen [6] emphasizes that the consideration of the trade-offs between features and simplicity is critical in designing any UI. System complexity increases with as the number of features increase, because the system inevitably has to provide more menu items, screen elements, interactive steps, and user options, all of which most likely require increased processing time. Consequently, he recommends that UI designers should minimize features and pursue simplicity for most projects. Thomson et al. [14] also suggest that adding features improves the initial attractiveness of a product but ultimately decreases customer satisfaction by incurring feature fatigue. Moreover,

Miyamoto [3] provides the analytical evidence that how UI simplicity can be used to signal the product value and to persuade users to purchase a product.

While acknowledging that both complexity and simplicity are important and that striking the right balance between the two is difficult, Maeda [9] posits that "the more complexity there is in the market, the more that something simpler stands out" (p. 45). Accordingly, when competing products offer compatible features and functions, simplicity is an indication of more thoughtful and superior design.

The concept of simplicity not only covers the concept of simple layout, but also includes interface organization, functionality, structure, work flow, and framework. Specifically, based on the prior work on simplicity [9, 10], we classify simplicity into four sub-constructs: reduction, organization, integration, and prioritization. At the same time, we theorize that simplicity is a formative second-order factor rather than a reflective one because each sub-construct measures a different aspect of simplicity. Thus, changes in any of these sub-constructs would cause a change in the simplicity, and changes in one of the sub-constructs are not necessarily accompanied by changes in any other sub-construct.

Reduction refers to the aspect of simplicity in which an application is reduced to its essentials [9]. Reduction can be applied to all aspects of application design: the functionality (goals), the structural and navigational complexity, and the interface (screen) complexity.

Organization refers to the extent to which an application's structure, functionality, and navigation are logically arranged and ordered. A user's performance is higher if an application's structure, navigation, functionality, and screens are well organized. Efficient organization also simplifies an application, which has an additional positive impact on performance.

Integration denotes the aspect of simplicity that puts fragmented components of application into a coherent framework. According to the SAP Design Guide [10], "simplification can lead to the creation of many simple and isolated tasks. It is necessary to integrate these tasks in order to make them accessible to users." Thus, the integration of simple tasks into a coherent unit is important in the process of simplification.

Finally, *prioritization* means that an application should focus on the essential tasks without trying to serve a multitude of diverse goals. This includes optimization of the important aspects of a task. Consequently, reduction, organization, integration, and prioritization form the latent construct of simplicity in this research.

Simplicity is expected to have a positive effect on a user's perception of usability. A mobile device that is reduced to its essentials that are well organized, integrated, and prioritized in accordance to users' frequent tasks and operations is likely to improve the usability perception of the system. This is because such an interface should be less cluttered, in turn making it easier to access frequently needed functions and features, and easier to understand and learn how to interact with the interface. Nielsen [6] suggests simplicity as a key factor for designing a usable interface. Therefore, we hypothesize that:

H1: Simplicity has a positive effect on usability.

2.2. Interactivity

We define interactivity as a state experienced by a user during his or her interaction with a mobile phone. Wu [12] posits that the degree of actual interactivity depends on the perceiver because it is up to the user to realize the potential adequacy provided by actual interactivity. Hence, perceived interactivity plays an important role in realizing

actual interactivity's potential on the user. However, there is little research that has empirically studied perceived interactivity in the context of mobile phone use.

Perceived interactivity has been conceptualized as a multi-dimensional construct in prior research. Wu [12] conceptualized perceived interactivity as being comprised of three dimensions: perceived control, perceived responsiveness, and perceived personalization. Johnson et al. [15] found that responsiveness, nonverbal information, and speed of response were significantly related to perceived interactivity. Song and Zinkhan [16] measured perceived interactivity on the three dimensions of communication, control, and responsiveness. Synthesizing the findings of these studies, we theorize interactivity as a second-order construct consisting of perceived control, perceived responsiveness, nonverbal information, and perceived personalization. Prior research conceptualized these sub-constructs to be effects, rather than causes, of perceived interactivity. Following the conceptualization offered by those prior studies on interactivity, we theorize the relationship between those sub-constructs and the latent construct (i.e., perceived interactivity) to be reflective.

Perceived behavioral control is defined as the perceived ease of executing the target behavior, reflective of one's past experience as well as anticipated impediments and obstacles [17]. Environmental psychology has found that individuals who perceive that they have more control over the environment tend to feel and behave more actively [18], highlighting the major role of control in governing interactivity. In addition to environmental constraints, perceived behavioral control reflects one's confidence in executing the courses of action required to effectively handle prospective situations. Users become confident in interacting with a product when they have an adequate mental model, which refers to the internal construction of some aspects of an object that are essential in understanding and operating the object [19].

Thus, perceived behavioral control is closely related to the development of a mental model which is pivotal in properly interacting with a mobile device.

While perceived control over the interaction process reflects a user's confidence in performing requisite activities, *perceived responsiveness* captures how the system responds to the user input properly and in a timely manner. Johnson et al. [15] refer to responsiveness as "the degree to which the responses in a communication are perceived to be appropriate and relevant and resolving the information need of the interaction episode or event" (p. 41). In addition, providing an immediate response is an important aspect for interactive communication. Users enjoy the interaction process when the device provides relevant responses without delay. The relevance of the responses and the response speed are both key aspects of interactivity.

Nonverbal information is the extent to which the communication is perceived to be accomplished through the use of multiple channels [15, 20]. In most instances, people utilize more than a single channel in communicating information. For example, nonverbal elements such as gestures, facial expressions, tone of voice, voice quality, pace of speech, and loudness work together to augment verbal elements during normal discourse. In print communications, the message is conveyed not only by the words, but also by nonverbal elements such as accompanying pictures, size and type of letters, their positions, the use of bold faces and punctuations, and the use of video, audio, and other multi-media objects. Prior research confirmed that the richness of nonverbal elements influence the interactivity of the communication channels [15, 20]. Thus, the size of bandwidth becomes an important feature of the technologies used in communication.

Perceived personalization refers to the extent to which the responses of communicative information systems are perceived as being appropriate or personally

relevant to the user's communicative behaviors. Song and Zinkhan [16] empirically validated a linear relationship between the personalization level of the message on the website and interactivity perceptions. In the context of mobile phone use, perceived personalization reflects how the technology treats a user during the interaction process in terms of both personal and message relevance.

The interactivity of a mobile phone may have a positive effect on perceived usability. According to our definition of interactivity, high interactivity means that a user can control the mobile phone in the way he or she wants while the mobile phone provides personally relevant and useful information in a timely fashion via multiple channels. Usability mainly assesses how easy it is to find, understand, learn, and use the device. Perceived behavioral control has been found to greatly influence the ease of use perception [21]. Further, the access to more personally relevant information via multiple channels without delay is assumed to positively contribute to the searchability and understandability of the presented information, collectively leading to higher learnability. Thus, we hypothesize that:

H2: Interactivity has a positive effect on usability.

Simplicity has a positive relationship with interactivity. Lee et al.[22] posit that the simplicity of blog interface positively influences perceived control, which is one dimension of interactivity in this research. In addition, Chang et al.[23] argue that interaction design is defined by several principles of simplicity. When the interface is simple, well organized, and integrated into a coherent unit, and optimized for important aspects of a task, users are likely to feel that they have more control over the use of the device and that the device is more responsive to their requests and actions. Hence, we hypothesize that:

H3: Simplicity has a positive effect on interactivity.

2.3. Consequences of Usability

Usability highlights the ease with which a technology artifact can be utilized for the accomplishment of a particular goal [4]. Flavian et al. [8] found that perceived usability of a website was related to user satisfaction, trust, and loyalty, and confirmed the significant role of usability in explaining these variables. Applying their findings to the context of mobile phone use, we posit that mobile phone usability has a positive effect on user satisfaction, brand trust, and brand loyalty.

2.3.1. Satisfaction

According to Oliver [24], satisfaction is a consumer's post-purchase evaluation and affective response to the overall product or service experience. In the IS area, satisfaction has been identified as a key construct that represents IS success for individual users [8]. Satisfaction in the present study is defined as the summary affective response of a mobile phone user. The higher the user considers the usability experience with a mobile phone, the greater the user satisfaction with the mobile phone. Prior research has empirically validated the relationship between usability and satisfaction [8, 25]. Extending these findings, we examine the relationship between usability and satisfaction in a mobile phone usage setting by testing the following hypothesis:

H4: Usability has a positive effect on satisfaction.

2.3.2. Brand Trust

Trust plays a central role in forming a long lasting customer relationship. Chaudhuri and Holbrook [26] define brand trust as the "willingness of the average

consumer to rely on the ability of the brand to perform its stated function" (p. 82). In general, trust involves two exchange partners. In the context of our research, the two exchange partners are the user of the mobile phone and the mobile phone company. Brand trust is based on the perception that the company represented by the brand is reliable and responsible for the interest and welfare of the user. Greater usability provides a better chance to complete a series of tasks that a user must perform in order to successfully accomplish an objective, thereby potentially improving the level of trust toward the company associated with the device used. Previous research on website usability provides empirical evidence of a positive relationship between usability and trust [8, 27]. In line with those studies, we expect the usability of a mobile phone to positively influence the level of trust in the company associated with the phone. Thus, we hypothesize that

H5: Usability has a positive effect on brand trust.

The dissatisfaction of customers commonly leads to negative word of mouth regarding the inability of the service provider or manufacturer [28]. Conversely, satisfaction is associated with positive word of mouth and increased levels of trust [29]. Satisfaction accumulated through the use of mobile phones is likely to generate positive affect toward the manufacturer of the phone, thereby increasing the level of brand trust. Thus, we hypothesize that

H6: Satisfaction has a positive effect on brand trust.

2.3.3. Brand Loyalty

Brand loyalty is a deeply held commitment to repeat the buying or patronizing of a preferred product or service in the future [30]. Despite situational influences or marketing efforts that can cause switching behavior, a loyal user is committed to the

idea of repurchasing the same-brand or brand-set. The current mobile phone market is characterized by growing competition. In this context, it is important not only to attract new customers, but also to retain them over time and motivate the repeat purchasing of mobile devices and services. Jackson [30] theorized usability as the driver of brand loyalty. Cyr et al. [31] also conceptualized ease of use, the key aspect of usability, as an antecedent to mobile service loyalty. Users are less likely to remain loyal when they find the mobile phone less usable, and vice versa. Thus, we hypothesize that

H7: Usability has a positive effect on brand loyalty.

Prior studies found that a greater degree of satisfaction leads to a greater degree of loyalty [32]. If consumers perceive that a product has fulfilled the agreed premises, they tend to believe that this behavior will continue in the future [8]. Anderson and Srinivasan [32] suggested that a dissatisfied customer is more likely to search for information on alternatives and more likely to switch to competitor offerings than is a satisfied customer. Hence, in the mobile phone use context, customers are likely to continue using the phone when they are satisfied. Therefore, we hypothesize that

H8: Satisfaction has a positive effect on brand loyalty.

Brand trust leads to brand loyalty or commitment because trust creates exchange relationships that are highly valued [33]. One important consequence of trust is a lasting relationship. Researchers who empirically examined the relationship between trust and loyalty have found that trust is a key determinant of brand loyalty [8, 26, 34]. A mobile phone user is very unlikely to remain loyal if he or she cannot trust the manufacturer of the phone. On the contrary, when a customer has high trust in the manufacturer, the brand loyalty is likely to be high. Therefore, we hypothesize that

H9: Brand trust has a positive effect on brand loyalty.

3. Methodology

The research hypotheses were empirically tested against the data collected using a survey questionnaire. The survey questionnaire was composed of measures developed through iterative validation steps. First, based on our extensive review of prior research, we generated the initial version of the items for the constructs in the model. We received comments on the initial items from a panel of experts consisting of two university professors, a mobile device interaction designer, a UI designer, and two graduate students. Based on the feedback from the panel, some of the items were revised to better fit the intended meaning of the construct and to improve readability. The initial version of the survey instrument was pilot tested on 48 mobile phone users in South Korea. A few items were revised on the basis of exploratory factor analysis and reliability analysis of the pilot test data. The revised survey questionnaire items are presented in Appendix 1. All of the items were measured on a seven-point Likert scale ranging from -3 (strongly disagree) to +3 (strongly agree).

The main field study was conducted involving mobile phone users in South Korea, the country with the highest penetration rate of mobile phone services in the world [35]. The survey participants consisted of college (undergraduate and graduate) students from universities in Daejeon and Chungnam province of Korea, and a general adult population from churches in those regions. We conducted the survey using a paper-based questionnaire and collected a total of 310 usable survey responses. Table 1 presents the participants' demographic information including gender, age, month of using the current mobile phone, average calling minutes per day, average sending SMS (Short Message Service) messages per day, and service provider.

*** Insert Table 1 about Here ***

51.6% of the respondents were males (n=158) and 48.4% of the respondents were females (n=148). The age of the respondents ranged from 19 to 83. 66% of the respondents were between 21 and 30 years old. The average age was 27.79 years. Most respondents' had used their mobile phones for less than 2 years. Respondents had used their current mobile phones for an average of 14.64 months. In addition, 35.4% of the respondents were calling from 5 minutes to 10 minutes daily, and 24.9% of the respondents were sending 4 to 10 messages daily. The average of calling minutes per day was 22.29 and that of SMS messages sent per day was 32.37. The respondents were using mobile service provided by SKT (50.9%), KT (30.6%), and LGT (18.5%). The demographic information presented in Table 1 is similar to the profile of mobile phone users reported by the Korea Information Society Development Institute [35, 36]. More than half (62%) of Korean mobile phone users were calling less than 30 minutes and the average of SMS messages sent per day was 27.8 [35]. Moreover, the market share of mobile service providers was 50.6% for SKT, 31.3% for KT, and 18.1% for LGT in 2009 [36]. Therefore, our study sample can be considered as representative of Korean mobile phone users.

4. Results

Data analysis was performed using PLS-graph 3.0, which is a structural equation modeling package based on the Partial Least Squares (PLS) method for the assessment of a measurement model and a structural model. The emphasis of PLS is on predicting the responses as well as understanding the underlying relationships among the variables. PLS is useful in screening out factors that have an insignificant effect on the dependent variable. In addition, PLS is more suitable than the

covariance-based approach for conducting both exploratory and confirmatory research together. This research examines the two new latent variables, simplicity and interactivity, as antecedents to usability of mobile phone, and analyzes the consequences of usability, implementing both exploratory and confirmatory approaches. In short, the primary focus of this research is on understanding each specific path coefficient and variance explained rather than overall model fit. Thus, PLS is a more appropriate method for this research, relative to covariance-based tools.

4.1. Measurement Model Validation

The measurement model was tested for reliability and validity. The composite reliability and average variance explained (AVE) of each latent variable in this study are presented in Table 2. The composite reliability for each of the latent variables was higher than 0.80 and the AVE was higher than 0.50, indicating strong reliability and convergent validity, respectively.

*** Insert Table 2 about Here ***

Table 3 presents the ratio of the square root of AVE of each first-order latent variable and the correlation coefficients between the study variables. The diagonal elements in parentheses are the correlations of each construct with its own measure, which is the square root of AVE. Off-diagonal elements, are correlations between constructs. Diagonal elements should be larger than the entries in corresponding rows and columns for adequate discriminate validity. As shown in Table 3, it is clear that each construct is more highly correlated with its own measure than with any other constructs, indicating strong discriminant validity. In addition, the loadings and cross-loadings of the items (see Appendix 2) compared across all latent variables show strong convergent validity with high loading scores (all higher than 0.7) and strong

discriminant validity with all the loading scores of the items higher than their cross-loading scores without exception.

*** Insert Table 3about Here ***

We included "Spending off hours" as a marker variable to check out common method bias at the data collection stage. The measurement items of the marker variable were placed between the ultimate dependent variable (brand loyalty) and the independent variables to examine the common method variance artifact. After data collection, we found that there were very low correlations between the marker variable and other variables. The subtraction of the variable did not affect the significance of the original correlations between the study variables, indicating that the data was not contaminated by common method variance.

4.2. Structural Model Testing

Figure 2 summarizes the results of the structural model test. Out of the seventeen paths examined, fourteen paths are significant at $p < 0.001$ and two paths are significant at $p < 0.01$. All hypotheses, except H7, are supported. In particular, the path coefficient of simplicity to interactivity is the highest among the others ($\beta = 0.684$). The path coefficient of interactivity to usability ($\beta = 0.622$), brand trust to brand loyalty ($\beta = 0.564$), usability to satisfaction ($\beta = 0.513$), satisfaction to brand trust ($\beta = 0.454$), and simplicity to usability ($\beta = 0.217$) are considerably high and significant at $p < 0.001$. The path coefficient of usability to brand trust ($\beta = 0.161$) and that of satisfaction to brand loyalty ($\beta = 0.129$) are significant at $p < 0.01$. However, the path from usability to brand loyalty is not significant ($\beta = 0.009$, ns).

*** Insert Figure 2 about Here ***

In the model, simplicity explains 47% of the variance in interactivity while simplicity and interactivity together explains 62% of the variance in usability,

showing that simplicity and interactivity are the major antecedents of usability and that the effect of simplicity on usability is partially mediated by interactivity. Consistent with the conceptualization of simplicity as a formative second-order construct, the sub-constructs, reduction (β = 0.333), organization (β = 0.316), integration (β = 0.375), and prioritization (β = 0.292), are all significantly related to its higher order construct, simplicity, at $p < 0.001$. Also, consistent with the conceptualization of interactivity as a reflective second-order construct whose effect is manifested via its sub-constructs, interactivity has a significant effect on perceived control (β = 0.840), perceived responsiveness (β = 0.691), nonverbal information (β = 0.776), and perceived personalization (β = 0.726), all of which were significant at $p < 0.001$. Further, empirically validated are the effects of usability on its consequent variables. Usability explains 26% of variation in satisfaction and 31% of variation in brand trust. The three variables together explain 41% of variance in brand loyalty.

Hypothesis 7 is not supported. However, the relationship between usability and brand loyalty, without satisfaction and brand trust, is significant (β = 0.285, $p < 0.001$). The links between usability and satisfaction (β = 0.514, $p < 0.001$) and between usability and brand trust (β = 0.161, $p < 0.001$) are both significant. When brand loyalty is regressed on satisfaction, brand trust, and usability, the link between satisfaction and brand loyalty becomes no longer significant (β = 0.009, ns), indicating that satisfaction and brand trust fully mediate the effect of usability on brand loyalty.

5. Discussion and Implications

We present a holistic model of mobile phone use, which is one of the first (if not the first) studies, that conceptualizes and empirically examines the effects of

simplicity and interactivity on mobile phone usability. Simplicity and interactivity have been widely discussed in the UI design area [6, 9, 10]. Many practitioner guidelines assert that simplicity and interactivity play important roles in the user experience of products and services. For example, designers and engineers contend that the success of Apple's iPhone is attributable to its simplicity and interactivity [9]. However, as these guideline were developed on the basis of various designers' subjective viewpoints, each of the guidelines provide different views on simplicity and interactivity. Moreover, there has been little quantitative research on simplicity and interactivity in UI design. To fill this gap, we set out to theorize simplicity as a second-order construct having the four components of reduction, organization, integration, and prioritization, and interactivity as a second-order construct consisting of the four dimensions of perceived control, perceived responsiveness, nonverbal information, and perceived personalization.

The study results confirm that simplicity and interactivity are two key antecedents of mobile phone usability, collectively explaining substantial variance in usability. Simplicity is also a significant antecedent of interactivity. The findings lend empirical support for the common conception that simplicity is a major factor of a highly usable interface [6, 9, 14]. Going further, the study findings show that simplicity makes a positive contribution to usability indirectly by influencing interactivity, in addition to its direct effect on usability. Thus, simple interface is an important precondition for positive interactivity and usability experience. Considering the limited interface space of a mobile phone, providing a simplified interface that is reduced to its essentials yet well organized, integrated, and prioritized according to users' frequent tasks and operations is extremely important. At the same time, settings that allow users to feel that they can control the device as they want, while also providing relevant

information in a timely manner via multiple channels, would provide most optimal usability experience, according to our study model.

This research also empirically validates the effects of usability on its consequent variables. The study results clearly show that a user's usability experience translates well into brand loyalty via satisfaction and brand trust. Brand loyalty implies a long-term, unwavering relationship with the company in spite of alternative choices from competing companies. Given the mature diffusion of mobile devices and diverse choices available from multiple companies around the globe, customer retention becomes more and more critical. The study results indicate that usability is a distal determinant of brand loyalty, exerting its influence indirectly through the mediators of satisfaction and brand trust. In particular, the results highlight that the usability-satisfaction-trust-loyalty linkage is the central brand loyalty building mechanism, similar to prior research [8].

Some limitations of this research should be noted when interpreting the findings. Even though the data was not limited to a certain age group, more than 60% of the respondents were in their twenties. While mobile devices are especially popular among young people, it should be noted that the study findings are largely based on relatively younger adult population. Also, the data was collected from mobile phone users in South Korea, which has the highest penetration rate of mobile phone services in the world. For generalizability, the study findings need to be validated in other countries to account for potential cross-cultural variations in simplicity of UI perceptions. Finally, this research was conducted as a cross-sectional study. A longitudinal study can be implemented to further corroborate the findings from the cross-sectional analysis used in this study.

There are several opportunities for future research to expand the findings of this study. According to Coursaris and Kim [4], user context plays an important role in mobile usability research. The context of use may impact usability. Contextual usability consists of multiple sub-dimensions such as user, task, environment, and technology. Our proposed research model focused on the technology side. Key aspects of the other dimensions need to be identified and incorporated into the model to account for contextual usability.

It would also be fruitful to cross validate the findings of the current study using other usability assessment methods. In addition to the questionnaire approach used in this research, usability can be assessed in alternative ways including focus group interview, observation, and usability testing. The effects of simplicity and interactivity can be assessed against data collected in any of these approaches.

Moreover, our study was conducted with regard to mobile phones, which typically have very tight and limited space. It would be interesting to examine whether the findings on simplicity and interactivity are also applicable to tablet computing devices that share some common characteristics with mobile phones but have larger interface screens.

For measuring brand loyalty, Dick and Basu [37] classify three antecedent categories of brand loyalty: cognitive, affective, and conative. This research concentrates on perceived usability as a cognitive antecedent to brand loyalty. Thus, affective antecedents such as habit or emotion [38] and conative antecedents such as switching cost and expectation have the potential to influence users' brand loyalty toward a mobile phone. Future research can extend the proposed research model to include those antecedents of brand loyalty.

This study provides important insights to practitioners. While companies are fiercely competing to add new functions and features, our study shows that simplicity matters. Unless those functions and features are filtered and organized through the lens of simplicity, they are likely to hamper the quality usability experience of a user, leading to a negative effect on the long-term relationship with the company. The measurement items developed in this study can serve as diagnostic tools during the product development phase. In addition, the measures can be periodically deployed to collect user feedback, which can then be used to improve simplicity and interactivity.

In conclusion, we have empirically shown that simplicity and interactivity are two central determinants of usability, which in turn has a positive impact on brand loyalty via user satisfaction and brand trust. The proposed research model provides a complete account of the relationships between the design features of simplicity (reduction, organization, integration, and prioritization) and interactivity (control, responsiveness, nonverbal information, and personalization) and brand loyalty, which have direct implications for an organization's bottom line. The measures of simplicity and interactivity used in this research are applicable to studying effective UI design for a wide array of computing and mobile devices.

Appendix 1. Questionnaire items

Simplicity – Reduction

- I feel that it is too complex to use my mobile phone because of many unnecessary features on the screen. (reverse worded)
- My mobile phone has many unnecessary operational steps for managing the phonebook (reverse worded)
- My mobile phone is complex as it requires many steps in taking and managing pictures. (reverse worded)
- Overall, my mobile phone is operationally complex with many unnecessary functions. (reverse worded)

Simplicity – Organization

- My mobile phone has well-structured phonebook.
- I can manage my contents (e.g. photos, mp3 files, movie clips) systematically through my mobile phone. (e.g. arranging, deleting, and grouping of the contents).
- Various setting functions of my mobile phone are well organized.
- My mobile phone has well-structured menu on the screen.

Simplicity – Integration

- Related sub-menus are grouped well by their upper menu in my mobile phone.
- My mobile phone can search, save, and modify the phone numbers seamlessly.
- My mobile phone can take, modify and save pictures continuously.
- Overall, my mobile phone interface gives a feeling of consistency and unity.

Simplicity – Prioritization

- My mobile phone screen menu is organized by frequently used functions.
- I can execute frequently used functions in mobile phone without many steps.
- I can find and execute frequently used functions in mobile phone without any difficulties.

Interactivity – Perceived Control

- I can freely move through my mobile phone menu.
- I know how to control my mobile phone efficiently.
- I can manage information in my mobile phone as I want.
- Overall, I can control my mobile phone well.

Interactivity – Perceived Responsiveness

- My mobile phone quickly responds to my input (e.g. textual input, numeric input).
- My mobile phone gives relevant information with respect to my input.
- My mobile phone has no delay in operations. (e.g. loading time, saving time).

Interactivity – Nonverbal Information

- My mobile phone provides interactive interface by using icons, images, and moving pictures.
- My mobile phone provides appropriate auditory and tactile feedback (e.g. sounds, vibration).
- My mobile phone provides auditory and tactile inputs (e.g. voice recognition, touch screen).
- My mobile phone provides intuitive icons and images on its interface.

Interactivity – Perceived Personalization

- My mobile phone's ringtone can be personalized to my preference.
- My mobile phone background picture can be personalized to my preference.
- My mobile phone menu can be personalized to my preference.
- Overall, my mobile phone can be tuned to use for myself.

Usability

- I can easily understand the overall interface of my mobile phone.
- It is easy to learn how to use my mobile phone.
- I can easily and quickly find what I want in my mobile phone.
- It is easy to use my mobile phone.
- It is easy to remember how to use my mobile phone.

Satisfaction

- My mobile phone has functions that I want and it is not contrary to my expectation.
- I can get satisfying information and services through the use of my mobile phone.
- Overall, I'm satisfied with my mobile phone.

Brand Trust

- I trust the software and service from my mobile phone manufacturer.
- Overall, I trust my mobile phone brand.
- The other products from my mobile phone brand are not contrary to my expectations.

Brand Loyalty

- I prefer the current mobile phone brand rather than other mobile phone brands.
- I intend to buy a product of the current mobile phone brand in my next purchase.
- I recommend the current mobile phone brand to others (e.g. friends, family).
- I intend to pay more money for the current mobile phone brand than other mobile phone brands.

Appendix 2. Cross-loading matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
REDUC1	0.778	0.233	0.157	0.267	0.314	0.128	0.137	0.228	0.275	0.230	0.039	0.054
REDUC2	0.801	0.248	0.203	0.342	0.372	0.254	0.144	0.240	0.422	0.305	0.056	0.069
REDUC3	0.715	0.187	0.140	0.215	0.250	0.154	0.065	0.150	0.327	0.186	0.066	0.065
REDUC4	0.853	0.380	0.315	0.412	0.448	0.266	0.213	0.247	0.500	0.350	0.089	0.143
ORGAN2	0.200	0.752	0.411	0.329	0.375	0.247	0.351	0.347	0.326	0.343	0.129	0.193
ORGAN3	0.317	0.886	0.533	0.402	0.361	0.327	0.299	0.264	0.379	0.403	0.237	0.259
ORGAN4	0.316	0.857	0.547	0.397	0.333	0.359	0.339	0.204	0.378	0.436	0.223	0.219
INTEG1	0.182	0.433	0.747	0.393	0.360	0.198	0.334	0.273	0.369	0.311	0.102	0.094
INTEG2	0.218	0.468	0.796	0.382	0.320	0.274	0.260	0.254	0.335	0.311	0.155	0.174
INTEG3	0.082	0.398	0.744	0.282	0.234	0.273	0.305	0.255	0.241	0.233	0.105	0.131
INTEG4	0.324	0.561	0.830	0.469	0.404	0.353	0.388	0.355	0.437	0.409	0.214	0.206
PRIOR1	0.220	0.298	0.311	0.795	0.311	0.261	0.249	0.235	0.312	0.274	0.131	0.102
PRIOR2	0.350	0.416	0.449	0.826	0.428	0.328	0.249	0.383	0.504	0.364	0.272	0.186
PRIOR3	0.363	0.344	0.383	0.712	0.565	0.263	0.178	0.269	0.508	0.334	0.174	0.091
PCONT1	0.340	0.350	0.392	0.505	0.814	0.325	0.262	0.305	0.585	0.317	0.239	0.200
PCONT2	0.417	0.332	0.343	0.508	0.884	0.353	0.295	0.362	0.739	0.403	0.171	0.193
PCONT3	0.348	0.425	0.374	0.409	0.843	0.398	0.327	0.420	0.643	0.418	0.157	0.198
PCONT4	0.421	0.363	0.355	0.476	0.902	0.404	0.347	0.427	0.756	0.448	0.216	0.219
PRESP1	0.265	0.340	0.320	0.321	0.394	0.864	0.327	0.287	0.422	0.414	0.226	0.140
PRESP2	0.231	0.357	0.372	0.354	0.445	0.838	0.357	0.315	0.466	0.526	0.202	0.168
PRESP3	0.135	0.227	0.177	0.225	0.215	0.774	0.244	0.172	0.223	0.319	0.103	0.108
NVERB1	0.199	0.433	0.392	0.282	0.375	0.399	0.836	0.422	0.416	0.431	0.237	0.224
NVERB2	0.246	0.397	0.450	0.397	0.472	0.463	0.858	0.483	0.452	0.385	0.233	0.241
NVERB4	0.153	0.330	0.400	0.223	0.290	0.253	0.784	0.373	0.346	0.347	0.180	0.193
PPERS1	0.195	0.250	0.275	0.304	0.350	0.253	0.409	0.871	0.365	0.343	0.215	0.173
PPERS2	0.285	0.308	0.354	0.315	0.356	0.290	0.395	0.887	0.417	0.315	0.154	0.138
PPERS4	0.230	0.264	0.309	0.364	0.425	0.265	0.385	0.805	0.465	0.402	0.153	0.141
USAB1	0.392	0.324	0.403	0.463	0.659	0.302	0.352	0.452	0.870	0.378	0.322	0.283
USAB2	0.416	0.356	0.405	0.496	0.647	0.363	0.285	0.387	0.895	0.406	0.290	0.263
USAB3	0.418	0.369	0.381	0.490	0.694	0.462	0.349	0.434	0.860	0.465	0.218	0.209
USAB4	0.458	0.425	0.372	0.518	0.744	0.435	0.357	0.438	0.893	0.507	0.280	0.242
USAB5	0.470	0.442	0.400	0.522	0.742	0.441	0.342	0.431	0.902	0.501	0.302	0.245
SATIS1	0.287	0.458	0.388	0.366	0.410	0.496	0.356	0.342	0.475	0.894	0.386	0.376
SATIS2	0.311	0.383	0.327	0.360	0.395	0.428	0.327	0.353	0.452	0.909	0.357	0.376
SATIS3	0.328	0.436	0.378	0.392	0.437	0.452	0.381	0.413	0.447	0.889	0.420	0.398
BTRUS1	0.131	0.266	0.267	0.326	0.302	0.308	0.253	0.214	0.385	0.489	0.867	0.474
BTRUS2	0.161	0.307	0.285	0.266	0.276	0.254	0.323	0.280	0.364	0.496	0.933	0.628
BTRUS3	0.079	0.284	0.204	0.222	0.226	0.278	0.268	0.234	0.317	0.465	0.889	0.576
BLOY1	0.080	0.213	0.158	0.097	0.182	0.108	0.138	0.173	0.249	0.333	0.522	0.914
BLOY2	0.106	0.244	0.167	0.176	0.201	0.155	0.170	0.161	0.240	0.382	0.490	0.937
BLOY3	0.120	0.262	0.197	0.167	0.229	0.207	0.252	0.175	0.263	0.450	0.515	0.913
BLOY4	0.070	0.243	0.178	0.146	0.228	0.130	0.167	0.115	0.250	0.355	0.304	0.787

*** Note:** (1) Reduction (REDUC), (2) Organization (ORGAN), (3) Integration (INTEG), (4) Prioritization (PRIOR), (5) Perceived Control (PCONT), (6) Perceived Responsiveness (PRESP), (7) Nonverbal Information (NVERB), (8) Perceived Personalization (PPERS), (9) Usability (USAB), (10) Satisfaction (SATIS), (11) Brand Trust (BTRUS), and (12) Brand Loyalty (BLOY)

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Figures

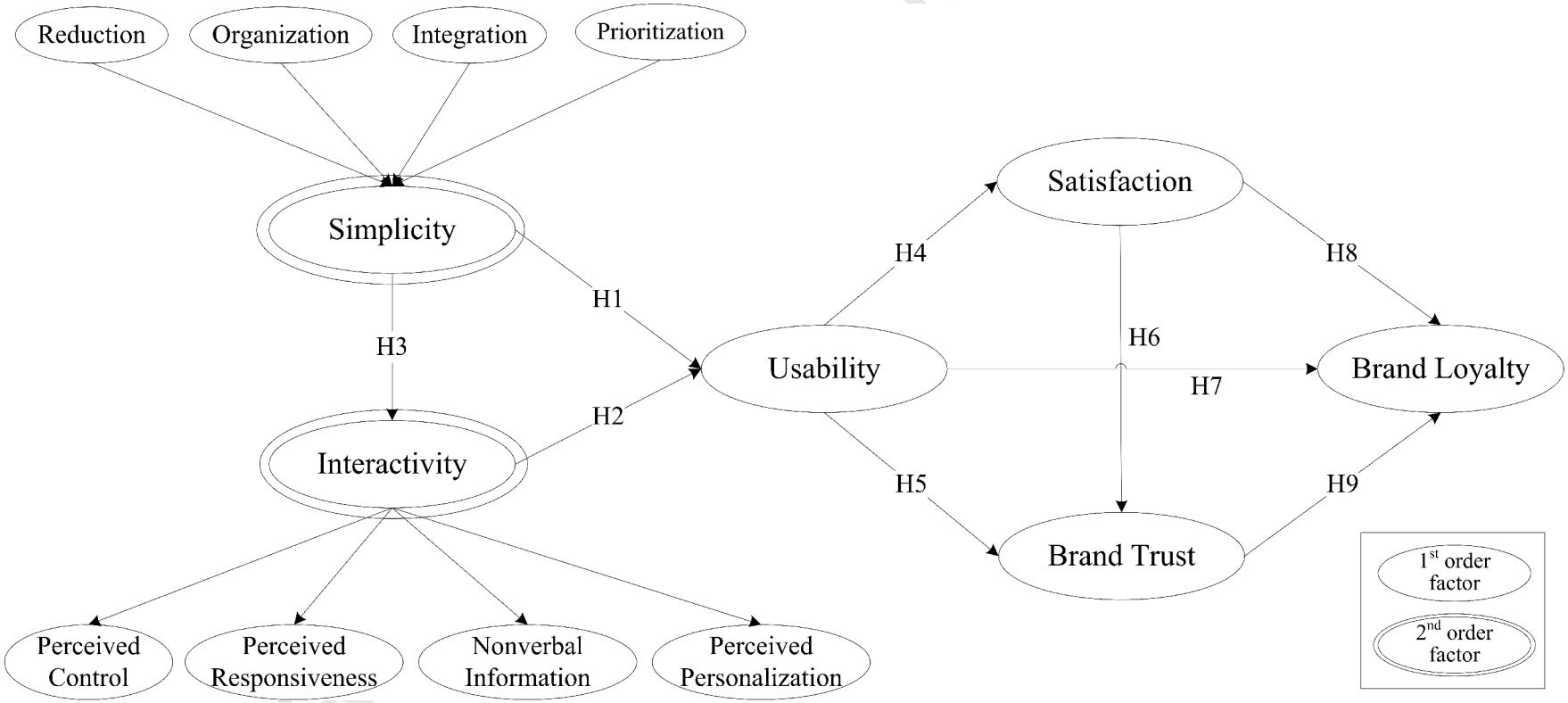

Figure 1. Research model and hypothesized relationship

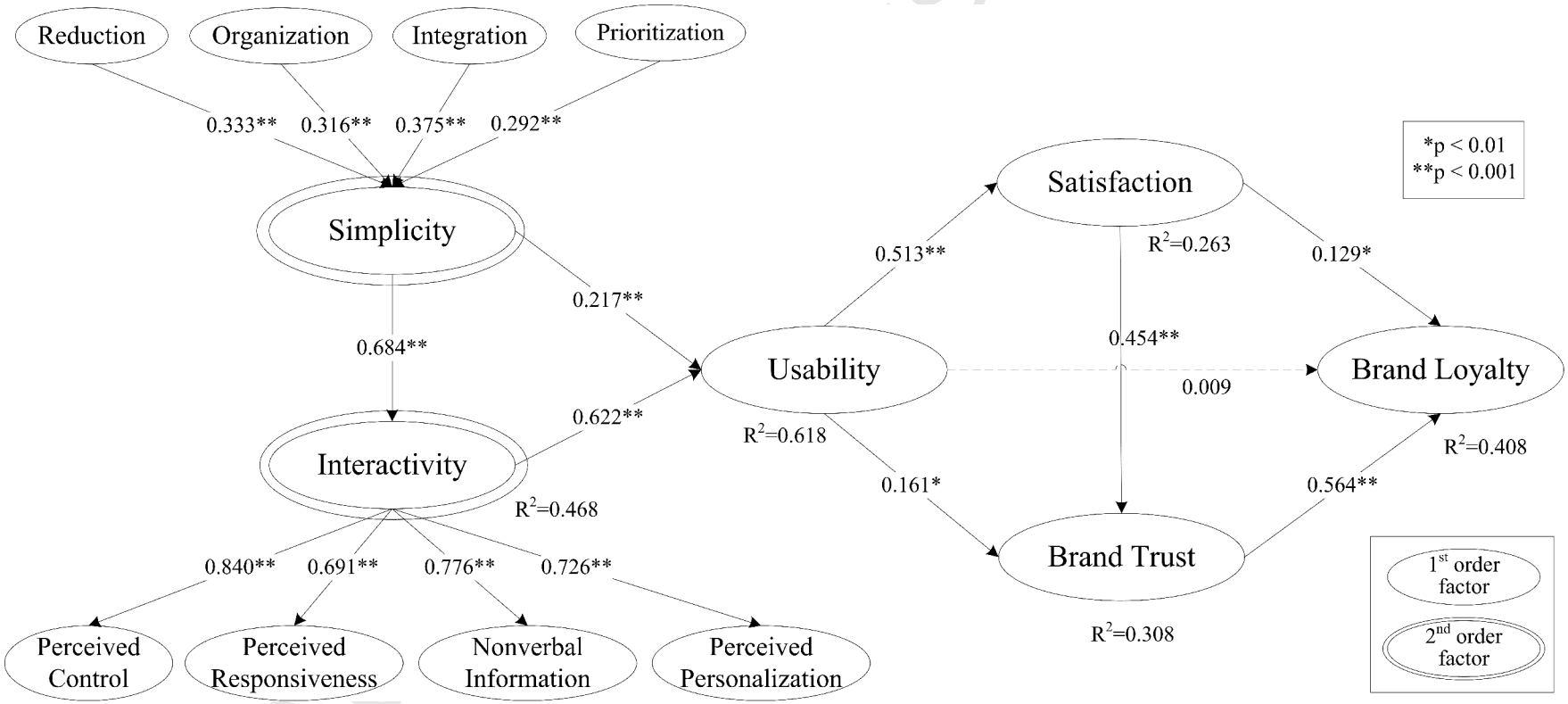

Figure 2. Data analysis results

Tables

Table 1. Demographic results

	Criteria	Frequency	%
Gender	Male	158	51.6
	Female	148	48.4
Age	19-20	29	9.5
	21-30	202	66.0
	31-40	21	6.9
	Over 40	54	17.6
Months of using current mobile phone	0-6	94	30.9
	7-12	78	25.7
	13-24	86	28.3
	Over 24	46	15.1
Average calling minutes per day	0-4	20	6.6
	5-10	108	35.4
	11-20	83	27.2
	21-40	62	20.3
	Over 40	32	10.5
Average sending SMS messages per day	0-3	40	12.9
	4-10	77	24.9
	11-20	63	20.4
	21-40	58	18.8
	41-80	38	12.3
	Over 80	33	10.7
Service Provider	SK Telecom (SKT)	155	50.9
	KT	93	30.6
	LG Telecom (LGT)	56	18.5

Table 2. Composite reliability and AVE

Latent variable	Composite reliability	AVE
(1) Reduction	0.867	0.620
(2) Organization	0.856	0.601
(3) Integration	0.861	0.608
(4) Prioritization	0.821	0.606
(5) Perceived Control	0.920	0.742
(6) Perceived Responsiveness	0.866	0.683
(7) Nonverbal Information	0.828	0.553
(8) Perceived Personalization	0.873	0.635
(9) Usability	0.947	0.782
(10) Satisfaction	0.926	0.806
(11) Brand Trust	0.924	0.802
(12) Brand Loyalty	0.938	0.791

Table 3. Correlations of the latent variables and the square root of AVE

Latent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) REDUC	(.787)											
(2) ORGAN	0.337	(.834)										
(3) INTEG	0.262	0.600	(.780)									
(4) PRIOR	0.397	0.453	0.489	(.778)								
(5) PCONT	0.444	0.425	0.424	0.551	(.861)							
(6) PRESP	0.257	0.376	0.354	0.366	0.430	(.826)						
(7) NVERB	0.242	0.469	0.501	0.366	0.462	0.453	(.826)					
(8) PPERS	0.277	0.321	0.366	0.381	0.439	0.315	0.517	(.855)				
(9) USAB	0.487	0.434	0.443	0.563	0.789	0.453	0.491	0.484	(.884)			
(10) SATIS	0.344	0.474	0.406	0.415	0.461	0.510	0.470	0.411	0.511	(.898)		
(11) BTRUS	0.139	0.319	0.280	0.301	0.299	0.310	0.361	0.272	0.395	0.536	(.896)	
(12) BLOY	0.107	0.270	0.196	0.165	0.235	0.169	0.266	0.176	0.281	0.427	0.624	(.889)