

Relationship between User Interface Design Attributes in Smartphone Applications and the Intentions of Users

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Abstract

Smartphones, which debuted in the form of personal digital assistants (PDAs) in the late 1990s, have evolved continuously. However, hardware features and the external environment restrict their use, making it difficult to ensure high interactivity. The structure and usage of mobile applications are also becoming increasingly complex and it is often found to be difficult to understand the user interface (UI). These user environments and conditions inhibit the smooth interaction of the user with the application. This is expected to negatively affect the user's intention to use the applications eventually. However, past studies on information systems have not shown much interest in the impact of smartphone UI designs on the attitudes and behaviors of users. Thus, this study attempted to empirically explore the impact that UI application designs have on the attitudes and behavior intentions of the users utilizing the application. This study specifically looked at the following aspects of UI design: simplicity, consistency, and metaphors. The data was collected through a survey and structural equation modeling (SEM) was employed for the analysis. The results showed that these attributes have a significant effect on the interaction as well as a positive impact on the intention to use the application.

Keywords: user interface, design, attributes, intention, smartphone, application.

1. Introduction

Smartphones, which are more than merely a communication tool, have become an essential part of modern life. Smartphones have become ingrained into our lives within a relatively short time largely because they offer a variety of applications that are beneficial in real life and can be easily installed for use anywhere, anytime. The type and number of the applications that have been developed for use are incalculably abundant and diverse; numerous applications now are constantly developing and waiting for users to select them.

The reasons that users select and use certain applications vary between individual users. However, the most important reason is usefulness and ease of use. Many studies in the field of information systems have regarded usefulness and ease of use as an antecedent for user acceptance [1][2][11][12][13]. Furthermore, developers have tried to ensure that the applications they develop are useful and easy to use.¹

User-application interactions can be regarded as another reason for selecting applications along with the usefulness and ease of use of the applications. However, it is not easy to ensure high interactivity within the smartphone environment due to the restrictions that depend on the

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hardware features (e.g., a small display screen) and the external environment (for example, the brightness of the sun or ambient light). Ultimately, these restrictions affect the use of smartphones [3][4].

Smartphone users mostly interact with the smartphones using their fingers. Because smartphones have a small screen, it is difficult for the users with thicker fingers to accurately touch a specific location within the small display screen. It is difficult to mention the high interactivity of smartphones for this reason as well. Recently, display screen size has grown because users tend to prefer a wide screen and enhancements, such as a Stylus [5][6].

In addition, the small screen of smartphones doesn't provide sufficient space to contain lots of diverse information such as texts and graphics. Therefore, applications segment much diverse information and the features that help to locate them on several screens or they reduce the size of text and graphics to contain them on one screen[7][8].

If too much diverse information and features are contained on the same screen, users may have to frequently scroll up and down, as well as left or right; simplicity and consistency are highly likely to be lost in the user interface (UI) design.

UI is a part of a system through which users interact with the system [14][15] argued that a UI consists of diverse physical and conceptual design components to support the smooth interaction of the user with the system. UI designs vary in a variety of ways depending on the placement and use of the components; different UI designs affect the interactions with the system in different ways.

Several researchers have stated that a UI of a webpage that has been designed with user convenience in mind cannot only prevent the users from losing a sense of direction when using the web, but also provide a good impression and enable the user to enjoy the website[16][17].

On the other hand, several other researchers noted that UI design of a system contains the attributes of simplicity and consistency. According to the associated studies, it has been identified that simplicity has a significant impact on the usability, usefulness, and aesthetics of a system including interactions with the system. It has been reported that consistency also has a significant impact on interactions with the system. These prior studies have been conducted on PC-based information systems and webpages.

Conversely, if information and features are deployed on several screens, the structure of the applications will become complicated due to the increase in the number of the screens and users are more likely to lose their sense of direction. Both of these methods may negatively affect how the user interacts with the application.

Furthermore, the small display screen of the smartphones will reduce the readability and discernibility of texts. In order to complement this, metaphors can be used in UIs.

Metaphors are connotative messaging tools in the form of graphics instead of texts[18]. However, this method may also affect the interaction between the user and the application. When exposed to the icons and buttons, menus that use metaphors that users find hard to understand result in users hesitating to use them. To resolve this problem, users have to make a significant amount of cognitive effort and, consequently, suffer from mental fatigue and discomfort when using the interface. This may negatively affect the user's intention to use the application[6][7].

Recently, the structure and usage of mobile applications are becoming increasingly complex and it is often found to be difficult to understand UIs. These user environments and conditions inhibit a seamless user experience and are expected to negatively affect the user's intention to use the applications eventually. However, past studies on information systems have not shown much interest in the impact of UI designs of applications on the attitudes and behaviors of the users in smartphone environments[9][10][11][19].

Thus, this study will attempt to empirically explore the impact that UI designs of applications have on the attitudes and intentions of the users utilizing applications in smartphone environments. This research focuses on simplicity, consistency and metaphors as key attributes of UI designs. Through this research, this study will provide the practical recommendations for UI design. These recommendations will help to improve the interactions and usage intentions as well as suggest the academic implications for associated research fields. Therefore, the study will contribute to the body of research in both theoretical and practical ways. Thus, the study will attempt to identify these impacts through the hypothesis below.

Hypothesis 1: The simplicity in the UI of smartphone applications positively affects the interactions of users with the applications.

Hypothesis 2: The consistency in the UI of smartphone applications positively affects the interactions of users with the applications.

Hypothesis 3: The metaphors used in the UI of smartphone applications positively affect the interactions of users with the applications.

Hypothesis 4: The interactions between users and smartphone applications positively affect the attitudes of the users towards the applications.

Hypothesis 5: The attitudes of the users towards smartphone applications positively affect the users' intentions to use the applications.

2. Main

The path coefficients were examined to check the causal effects between the variables. To do so, the significance of the relationships between the variables in the proposed model was analyzed. As predicted in the hypotheses, simplicity had a significant influence on the interaction ($\beta = .396, p < .0001$), consistency also had a significant influence on the interaction ($\beta = .331, p < .0001$), and the metaphor was a significant determinant of the interaction ($\beta = .289, p < .0001$). In addition, the interaction had a positive impact on attitude ($\beta = .513, p < .0001$). Finally, attitude positively affected users' intentions to use the application ($\beta = .712, p < .0001$). Thus, all of the hypotheses were supported. Table 4 shows the results of the test of the structural model and Figure 2 below also presents the results of the structural model analyses with R^2 values. The study is meaningful in that it could identify the impacts of the UI design attributes on the user's intention to use the applications in smartphone environments and the role of the user-application interactions in the relationship. Many studies in the IS field in the past mostly examined the impacts of the UI design on the performance and use of the system through system qualities. However, not many studies have examined the direct impact of the simplicity, consistency, and metaphors as UI design attributes on interaction. The study showed that causality exists between these attributes; so, these findings have contributed to the existing interaction-related studies by identifying the attributes of UI design that affect interaction.

In particular, studies of metaphors in the IS field have been limited. The findings of this study showed the importance of using the metaphors that can be understood by the users when designing the UI of a smartphone application. For the first time, the study highlighted metaphors as UI design components; as a result, this study differentiates itself from other studies. In addition, the study contributed to the relevant studies by emphasizing the importance of the metaphors in terms of the interactions by actually identifying the direct impacts of the metaphors on the interactions.

The study makes a valuable contribution to the body of research because it was conducted in the smartphone environment and not the PC environment. Personal computing environments in recent years are now gradually evolving into wearable devices beyond smartphones.

Wearable devices, such as smart watches, require more efficient and seamless interactions than smartphones, but face more severe spatial constraints due to their smaller display screens. To resolve these limitations, UI designs that can make more intuitive understanding possible and that differ from PC-based information systems are required. The findings of the study indicate the direction in which UI design of wearable devices should precede.

Furthermore, this study identified the impacts of the UI design attributes on the attitudes and behavioral intentions of the users through the interactions. This means that the interactions with the applications and the user's attitudes and intentions for using the applications may alter depending on how the user perceives the UI design attributes. This does not only mean that the importance of the UI design and interactions were identified in explaining and understanding the factors affecting the user IT acceptance, but that it has also contributed to the extension of the model by adding new variables to TAM[12][13]. Therefore, the study makes an academic contribution.

The practical contributions include having provided the consultations related to the designs necessary for the development of user-friendly UIs. The study shows that the improvements of the interactions with applications can be made through UI designs, especially simplicity, consistency, and metaphors. Therefore, to realize user-friendly UI, the design should be consistent and simple, and use metaphors that establish familiarity and help users understand the application. The findings of the study especially emphasize that developers should be considerate when introducing new metaphors in UI.

Another practical implication is that the study can be utilized in checking the simplicity, consistency and metaphors of the application UI designs. That is, the study makes practical implications; it enables the multidimensional assessment of applications in terms of aspects of their UI design. More specifically, it provides systematic assessment indicators and the tools necessary for checking UI design.

Finally, the findings of the study provide suggestions to promote the use of applications and improve sales revenue. Application designers who have considered UI design attributes when developing applications have improved the competitiveness of the applications; they have ensured high interactivity but also greatly increased sales revenue by securing large numbers of users who wanted to use the applications. The economic value and ripple effects that the developers can achieve are significant.

3. Discussion

Despite some interesting findings, this study is subjected to the limitations of empirical research. For example, undergraduate students accounted for 66.7% of the participants and about 79% of the participants were in their twenties. Moreover, the diversity of the applications was not large. About 62% of the applications that the participants had used just before they answered the questions on the survey were social networking- and communication-related applications. These are areas of concern for external validity. Thus, follow-up research with large-scale testing is needed to address these limitations.

4. Conclusion

This study explored the UI design attributes — simplicity, consistency, and metaphor of smartphone applications. The UI design attributes of smartphone applications had significant effects on the interaction between users and the applications. The interaction had a significant effect on the intention to use the applications through the mediating variable of users' attitudes. Consistency and simplicity of UI designs as well as the use of suitable metaphors are essential

in the development of user-friendly UIs. Those metaphors should provide a familiar way for the user to understand the application.

References

- [1] A.D. Angeli A. Sutcliffe, and J. Hartmann(2006), "Interaction, usability, and aesthetics: What influences users' preferences?" in Proceedings of Designing Interactive Systems 2006, 272-280, New York, NY: ACM.
- [2] D.Barclay C. Higgins and R. Thompson, "The Partial Least Squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration," *Technology Studies*, 2, 285-324.(1995)
- [3] M. Black, M. "More about Metaphor," in *Metaphor and Thought*, A.Ortony(editor, Cambridge University Press(1988)
- [4] R.P. Bostrom, L. Olfman and M.K. Sein "The Importance of learning style in end-user training.*MIS Quarterly*, 3, 101(1990)
- [5] J.M. Buzhardt, J., M. and Y. Tapia sability testing of the class wide peer tutoring-learning management system," *Journal of Special Education Technology*, 20, 19(2005).
- [6] V.Cantoni, V., M. Cellario and M. Porta *Journal of Visual Languages and Computing*, 15, 333(2004)
- [7] S.K.CardT.P. Moran, and A. Newell, *The psychology of human-computer interaction*, Hillsdale, NJ: Erlbaum(1983)
- [8] W.W. Chin modeling. In: Marcoulides, G.A. (editor, *Modern Methods for Business Research*. pp. 295-336. Mahwah, NJ: Lawrence Erlbaum(1998)
- [9] Chou, C.(2003), "Interactivity and interactive functions in web-based learning systems: A technical framework for designers," *British Journal of Educational Technology*, 34(3), 265-279.
- [10] C. Chu, and B.K. Chan, "Evolution of Web site design: Implications for medical education on the Internet," *Computer in Biology and Medicine*, 28, 470 (1998).
- [11] A.H. Crespo, and I.R. del Bosque, "The Effect of innovativeness on the adoption of B2C e-Commerce: A model based on the theory of planed behavior," *Computers in Human Behavior*, 24,6, 2830-2847 (2008).
- [12] G.H. Crowley, and T.S. Armstrong, "User perceptions of the library's Web pages: A focus group study at Texas A&M University," *The Journal of Academic Librarianship*, 28(4), 205-210 (2002).
- [13] F. Davis, F.(1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, 13,3, 319-339(1989).
- [14] F. Davis, R. Bagozzi, and P. Warshaw, "User acceptance of computer technology: A comparison of two theoretical models," *Management Science*, 35(8), 982-1003(1989).
- [15] S. Lauesen, S, *User interface design: A software engineering perspective*, Addison Wesley, UK(2005).
- [16] T. Moran, T, *An applied psychology of the use*," *ACM Computing Surveys*, 13, 1981).
- [17] J.W. Palmer, "Web site usability, design, and performance metrics," *Information Systems Research*, 13,2, 151(2002).
- [18] Y. Parkand J.V. Chen(2007), "Acceptance and adoption of the innovative use of smartphone," *Industrial Management and Data Systems*, 10, 1349 (2007).
- [19] A. Paivio, *Psychological processes in the comprehension of metaphor*" in *Metaphor and Thought*, A. Ortony (editor.), Cambridge University Press (1988).
- [20] P.A. Pavlou, "Consumer acceptance of electronic commerce: Integrating trust and risk with the Technology Acceptance Model," *International Journal of Electronic Commerce*, 7(3), 101-134(2006).
- [21] Polson, P.(1988), "The consequences of consistent and inconsistent user interfaces," in R. Guindon (ed.), *Cognitive science and its applications for human-computer interaction*, Hilsdale, NJ: Lawrence Erlbaum, 59-108.

