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# Research on the Usability Evaluation Model of Mobile Application Interface Design for Active Senior

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**Abstract**

Advances in information technology and the COVID-19 that has been sweeping the world since 2019 have affected people's lives and changed their consumption patterns in various ways, and the non-face-to-face consumption culture that has emerged from them has led to an increasing national usage rate of mobile applications. However, due to the initial aging of their bodies, the active elderly encounter difficulties in using mobile applications, such as the inability to use them smoothly due to the complicated design process or the difficulty in recognizing the font size, especially since the current mobile application interface is mainly designed with the younger generation in mind. Therefore, it is necessary to improve the usability of their mobile applications in order to make them use mobile shopping applications more easily and efficiently. Accordingly, the purpose of this thesis is to compile and summarize the characteristics of the active elderly and their mobile application status through the literature research method through relevant data and prior studies, and to grasp the main barriers to their use of mobile shopping applications. It also summarizes the visual elements of mobile shopping application interface into five elements: color, layout, icon, typography, and navigation. Secondly, based on the expert heuristic usability evaluation principles, specific usability evaluation principles are determined for the usability evaluation of mobile interfaces by combining the characteristics of active seniors, so as to establish a usability evaluation model of interface design that is relevant to active senior.

**Keywords:** mobile application, interface design, usability, active seniors, usability evaluation

## 1. Introduction

Active older adults, who have emerged due to changes in the digital environment under today's society, represent the elderly model of active use of information and communication devices in an aging society and can be said to be the main class of smartphone users (Heo Won-hoe, 2012). However, despite the release of cell phones that offer various conveniences based on the development of technology and convenience, they still often experience inconvenience in using them despite having cell phones with various convenient features due to the inconvenience and complexity of the operation stage. (Shu Feng Wei, 2015). Therefore, there is an urgent need for smartphone UI designs that active seniors can access and use efficiently. This requires not only research to consider their physical characteristics and information environment to improve their discomfort, but also to understand their tastes and desires and develop products to reflect their trends, and there is no mature model available today to evaluate the usability of the interface design to determine whether the designed interface is suitable for the elderly, which makes it impossible to accurately determine whether the designed interface is really suitable for the elderly and this makes it impossible to accurately determine whether and to what extent the designed interface is suitable for the elderly. Therefore, the purpose of this study is to analyze and develop a usability evaluation model for the interface design of active senior based on this aging background and the demand for mobile application interfaces to be age-appropriate.

## 2. Related Work

*2.1 Definition of Active Senior and Their Physical Characteristics*

With the advent of an aging society and the growing interest in the silver industry, active seniors are attracting the attention of researchers as a group that is distinctly different from traditional seniors, born between 1962 and 1973 during the baby boom era, a group of people who not only have a more youthful mentality but also have the ability to consume with the times. They are often very active and socially engaged, and sometimes create new lives for themselves in different ways.

Active seniors undergo a variety of physical changes as they get older. One of the most significant changes is aging. Aging is the process by which cells, tissues and organs undergo degenerative changes over time, gradually reducing their function and reserve capacity. Aging is biologically divided into physical aging, physiological aging, psychological aging, and social aging and varies depending on the variables an individual possesses. Physical aging is caused not only by changes in appearance, but also by structural and functional decline. The main physiological characteristics of physiological aging caused by changes in sensory organs and based on cognitive and intellectual changes are summarized in the table below.

Table 1. Physiological characteristics of active senior

| | | |
|---|---|---|
| Physiological aspects of aging | Visual acuity | Significantly reduced vision in dark environments, difficulty distinguishing or reading distant objects, insensitivity to perspective, reduced sensitivity to color differences, and reduced ability to read and write discriminatively. |
| | Listening ability | Hearing is weakened, and it is more difficult to hear high pitched sounds than low pitched sounds, walking sounds, door bells and other ambient sounds. |
| | Physical Fitness | Physical ability decreases, motor response is slow, grip strength decreases, finger strength and sensation declines, sensitivity decreases, and completing delicate tasks becomes difficult. |
| | memory skills | Memory loss, more pronounced in short-term memory than in long-term memory. |
| | Learning Ability | Learning skills become weaker, with significant weakening of repetitive and logical learning skills, especially logical learning skills. |

*2.2 The Concept of GUI Design and Its Constituent Elements*

Intelligent mobile terminal GUI (Graphical User Interface) design is a user interface applied to small, mobile smart electronic devices that allows users to communicate information through images (rather than textual commands) and humans are better at learning and recognizing visual elements such as pictures, images and colors than textual representations, so symbols and images play a very important role in GUI design. Therefore, symbols and images play a very important role in representing complex or difficult concepts in a clear manner. The GUI design of mobile applications plays a very important role in the interaction between smartphones and users. A characteristic of mobile devices is that they have smaller screens to increase portability. Therefore, in addition to the limited display space of mobile devices, the mobile GUI design process must overcome the impact of the smaller display space on the structure, color, and amount of information.

Compared to text-centric interfaces, GUIs significantly reduce the amount of learning for the user and allow for intuitive manipulation. Research on the components of interface design for visual interaction with users has been ongoing. The results of previous research on GUI components are summarized in the following table.

Table 2. Elemental composition of the GUI

| Researchers | Components of GUI design |
|---|---|
| Bukyung Kang (2018) | Layout, color, typography, non-textual graphics, burdens/icons, information graphics |
| Ubing (2015) | Layout, menu, color, typography, graphics |
| Wonseon Choi (2014) | Icons, layouts, metaphors, labeling, colors,<br>Typography, Images and Illustrations, Information Architecture, Navigation |

| | |
|---|---|
| Intention (2013) | Color, typography, layout, icons |
| Lim Ji-eun (2013) | Colors, menus, layouts, texts, icons |
| Go Yunji (2012) | Color, text, idle screen icon, menu, layout |
| Hyunjoo Lee (2011) | Color icons, text, layouts, menus |
| Dongsoo Lee (2011) | typography, color icons, layout |
| Sam Choi (2010) | Color, icons, buttons, labeling, layout, typography |
| Byun Jeong-hwa (2009) | Color, button, text, screen composition, video and animation, icon |
| Byung-geun Oh and Seong-gang Kang (2008) | Navigation, icons, input devices, output devices |
| Jinwoo Kim (2005) | Layout, color, shape, graphics, typography |

According to the interface design elements presented in the table above shows that, due to the diversity of the study, although each researcher's choice of elements is slightly different, it can be seen that there are some important keywords that are commonly used in the selection of elements. Based on the frequency of occurrence, the five most main commonly used are filtered in order, color, typography, navigation, and icons and layout.

## 3. Usability and Usability Evaluation

### *3.1 Understanding of Usability*

Usability is an important concept for organizations in the field of HCI (Human-Computer Interface) and is an important quality indicator for interactive IT products/systems, which refers to the extent to which a product is effective, easy to learn, efficient, memorable, error-free and satisfactory for the user, i.e., whether the user can accomplish his tasks with the product, how efficient it is, and what the subjective feeling is. ISO9241/11 defines the degree to which a product can be used effectively, efficiently and satisfactorily by a specific user in a specific situation to achieve a specific goal (The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use). In practice, however, it is Shekel's (1991) definition of usability that usability refers to the "capability" of a technology to be easily and effectively used by a specified range of users, with specified training and user support, to accomplish a specified range of tasks in a specified environmental context. "Reviewing previous research and compiling expert opinion, the following table shows the factors that influence usability.

Table 3. Usability Impact Factors

| Expert | Usability factors |
|---|---|
| Brinck, Gergle & Wood (2002) | Functionally correct, Efficient of use, Easy to learn, Error tolerant |
| ISO 9126 (2000) | Efficiency, Effectiveness, Satisfaction |
| ISO 1924-11 (1998) | Satisfaction, Efficiency, Effectiveness, |
| Preece, Rogers & Sharp (1994) | Effective of use, Efficient of use, Safe to use, Have good utility, Easy to learn, Easy to remember how to use |
| Nielsen (1993) | Learnability, Efficiency of use,<br>Memorability, Error Recovery, Satisfaction |
| Shackel (1986) | Effectiveness, Learnability, Flexibility, User Attitude |

### *3.2 Usability Evaluation*

Usability evaluation is the process of checking the usefulness and usability of a product through users' perceptions, attitudes, and use of the product. The purpose is to assess the physical, cognitive and emotional convenience of the product and to identify and improve the product's problems. With the recent development of network technology and the widespread use of mobile devices, smartphones, tablets, and other digital devices are appearing more and more frequently in people's lives, and the scope of usability evaluation is expanding. Usability evaluation techniques can be broadly classified into three types. The first one is the inspection method, the second one is the testing method, and the third one is the interrogation method. Usability evaluation techniques can be divided into evaluations conducted by users and evaluations conducted by experts, depending on the population of the evaluation interface. The main means of user-based evaluation are Surveys & Interview,

Thinking aloud, Observation, Field Observation, Questionnaires, Focus Group Interview, etc., while expert-based ones are mainly Heuristic Evaluation, Cognitive Walkthrough, etc. Thus, the representative evaluation techniques on usability are summarized in the following table.

Table 4. Usability Assessment Techniques

| NO. | Evaluation techniques | Description |
|---|---|---|
| 1 | Checklist | The expert evaluates whether the product meets the technical requirements of the project according to established usability principles. |
| 2 | Cognitive Walk Through | An evaluation technique that predicts problems at work by pre-estimating the user's problem-solving process. |
| 3 | Consistency Inspection | An evaluation technique that uses multiple evaluators in a team and focuses on the consistency of the interface. |
| 4 | Contextual Inquiry | An evaluation technique in which information about opinions and experiences is obtained by observing the use of a product or service, or by interviewing users. |
| 5 | Document Review | A technique for assessing whether there are any problems with target products and services based on usability-related criteria. |
| 6 | Feature Inspection | A technique for evaluating whether the various functions of a system are designed to meet the needs of the user. |
| 7 | Field Observation | A technique for observing user reactions or usage processes in an environment where the system is actually used. |
| 8 | Focus Groups Interview | A technique for identifying problems by having groups discuss specific products and services. |
| 9 | Heuristic evaluation | This is a technique used by usability experts to determine whether the evaluation target is designed according to usability criteria. |
| 10 | Interview & Surveys | A technique that asks users to express their opinions, experiences, and expressions about issues, or provides users with a list of questions and access to answers to those questions. |
| 11 | Logging Actual Use | A technique that directly operates and then automatically records all actions and evaluates the results. |
| 12 | Performance Measurements | It is a technique for obtaining various quantitative measurements through experiments. |
| 13 | Preference Measurement | A technique for measuring users' desired preferences through quantitative measurements obtained experimentally. |
| 14 | Task Analysis | A technique in which the evaluator analyzes the user's methods or procedures. |
| 15 | Thinking Aloud | The user describes his feelings in the experiment while the evaluator grasps the technique of the user's thoughts. |
| 16 | Questionnaires | A method of evaluation using a fixed form questionnaire. |
| 17 | Video Ethnography | A method of recording the entire experiment with a video or audio recorder and analyzing it. |

## 4. Usability Evaluation Model for Active Seniors

### *4.1 Principles of Expert-Based Usability Evaluation*

In this study, we attempted to find a GUI usability evaluation method suitable for active seniors to assess the usability of mobile application GUI to derive problematic points affecting the usability of active seniors from a GUI design perspective. The factors affecting usability were collected through literature research, and five common usability evaluation principles were summarized based on usability evaluation expert Jakob Nielsen's 10 Heuristics method, Alison J. Head's GUI design evaluation principles, Jietal's mobile interface usability evaluation principles, and other prior research combined with the characteristics of active seniors, as follows the table below shows.

Table 5. Principles of usability evaluation for Active Seniors

| Evaluation Principles | Description |
|---|---|
| Ease of Learning | Maintain consistency and design to make relevant applications easy to operate even without re-learning. |
| Consistency | There must be consistency in the composition of each GUI element to avoid visual recognition problems. |
| Simplicity | To prevent increasing the cognitive cost of active seniors, to Avoid the use of complex GUI elements and information structures. |
| Efficiency | Considering the inconvenience of active seniors to using advanced smartphones, the steps needed to operate functions faster, easier, and more efficiently with minimal movement should be provided. |
| Error Prevention | Considering the inconvenience of using advanced smartphones for active seniors, issues such as error prevention and error recovery should be easily addressed. |

*4.2 Design of an Interface Usability Evaluation Model for Active Seniors*

The usability evaluation model was designed considering the characteristics of active seniors and incorporating key GUI visual elements. In other words, UI usability created an interface usability evaluation model unique to active seniors by combining key usability factors for active seniors, such as ease of learning, consistency, error-proofness, simplicity, and efficiency, with key GUI components, such as color, layout, icons, typography, and navigation. This is shown in the figure below.

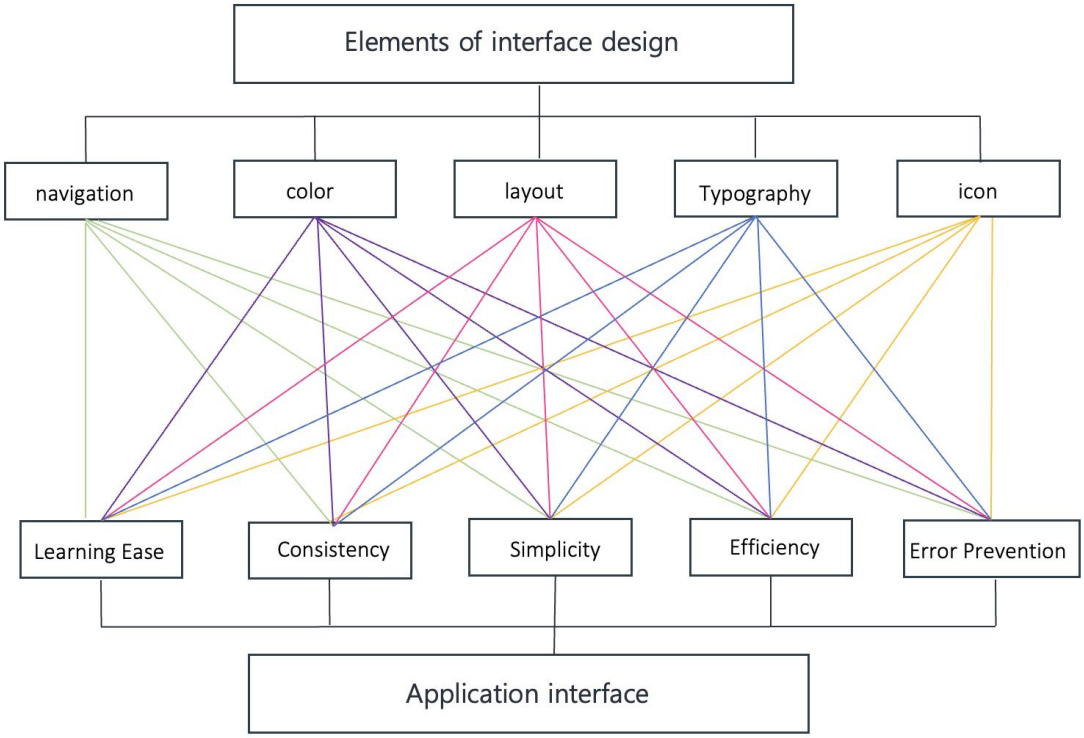


Figure 1. Usability evaluation model

## 5. Conclusion

This study aims to increase the usability of mobile shopping applications among the active elderly generation in the context of the rapidly aging population and the non-face-to-face consumption culture of the epidemic in China. The non-face-to-face consumer culture has led to an increase in the use of mobile shopping applications

among the population. However, since mobile shopping apps are not designed with active seniors in mind, who are different from younger people, it is difficult for active senior users, who are used to face-to-face transactions, to adapt. Active seniors, unlike the middle-aged and elderly layer of the past, are a generation that not only has strong spending power, but also has active and independent lifestyle habits. However, due to the initial aging of their bodies, they still encounter some difficulties in operating smartphones compared to the younger generation, which to some extent causes inconvenience when shopping on the go. Therefore, we conducted a usability evaluation model study of interface design for this group.

With this research purpose, this thesis firstly analyzes the characteristics of active seniors and prior research related to mobile application interface design through relevant materials and prior research, then composes the concepts of usability and usability evaluation and the current research status and organizes and summarizes the main usability evaluation methods. Finally, based on the expert heuristic usability evaluation principles, the usability evaluation items of mobile application interfaces are developed, and an evaluation model is established. The model was developed for active elderly people, and the evaluation principles of ease of learning, consistency, efficiency, simplicity, and error prevention compiled in the model can provide some theoretical reference for future researchers in the usability evaluation of mobile application interface usability with active seniors as the research target.

The model will be iterated in the future as technology evolves and the design trends of interface design change with it and will be tested and improved in more practice in the future.

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