



# Evaluation of Touch-Based Interface Design for the Elderly Based on Cultural Differences

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**Abstract.** A study was conducted to evaluate the cross-cultural differences of the elderly preferences on touch-based interface design. Hofstede's theory of cultural dimensions [3] was used as the theoretical framework to guide this study. In this study, different age groups of Korean and Indonesian elderly were recruited to do the usability testing of a touch-based interface design. A prototype was designed with the culture-related features to compare their preferences. Value Survey Module (VSM) 2013 was used to collect their cultural dimensions scores. Usability rating questionnaires were used to measure their satisfaction scores toward the prototype. The interface features rating questionnaire was distributed to collect their preferences toward the touch-based interface design. The objectives of this study were: 1. To identify the differences in cultural dimensions scores, 2. To identify the differences in usability testing scores based on Nielsen's evaluation criteria, 3. To identify the differences in touch-based interface design preferences of the elderly based on different cultures. Significant differences are found in the cultural dimensions scores, as well as the touch-based interface features ratings. Significant differences are also found in the usability testing which included four criteria: efficiency, learnability, errors, and satisfaction. The results of this study can be used to improve the design of the touch-based interface for the elderly based on their cultural differences.

**Keywords:** Cross-cultural study · Usability · Touch-based interface  
Elderly

## 1 Introduction

A smartphone is a popular communication device that typically has a touchscreen interface. Although it is widely used, the elderly consistently have lower rates of this technology adoption than the general public [1]. Designing for the elderly involves more than designing to accommodate the physical and psychological changes due to the aging effect. Their preferences on the interface also can be different according to their cultural characteristics. Therefore, the cultural differences should be considered in designing the appropriate interfaces for the elderly.

There have been many studies that explored the interface design for the elderly, including one by Boustani [2]. On the other side, there has been a cross-cultural study that evaluated the user preferences on the cell phone based on cultural differences [5]. The purpose of this study is to evaluate the culture effects on touch-based user interface design preferences of the elderly based on nationality and age groups.

## 2 Literature Review

### 2.1 The Elderly Population

The definitions of an elderly person range from 50 to 80 years old and above [10]. There has been a research about the touchscreen mobile user interface for seniors that was aimed at people older than 50 years old [11]. ALTEC-Project study how elderly people deal with technologies that are used in everyday life. From 1400 subjects, 200 subjects were older than 60 years old [8].

### 2.2 Culture Dimensions

There are many aspects of culture that impacts the interface preferences, such as user's nationality, language, religion, the education level, and the form of education [9]. Hofstede's theory of cultural dimensions is the best known and most applied theory of intercultural communication [3]. Cultural dimensions were measured using Value Survey Module (VSM) 2013. In this questionnaire, there is a new dimension named Indulgence. Since there are only a few adaptations about this dimension, it will not be considered further in the study.

Power distance (PDI) is defined as the extent to which the less powerful people in society accept and expect that power is unequally distributed [3]. Individualism (IDV) represents a preference for a loosely-knit social framework where people are expected to look out for their own interests take care of themselves, whereas collectivism indicates an inclination toward a tightly-knit social framework where people expect their companions to look out for their welfare and where personal goals are subordinated to those of the group [3]. Masculinity (MAS) measures the degree to which a culture separates gender roles. Masculine cultures focus on the traditional assignment of assertiveness, competition, and toughness, and feminine roles focus on the orientation to home and children, people, and tenderness [3]. Uncertainty avoidance (UAI) is defined as the extent to which the members of a culture feel threatened by uncertainty and the unknown situations, along with the eagerness to avoid these situations [3]. Long-term orientation (LTO) indicates that the country fosters virtues oriented towards future rewards, in particular, perseverance and thrift [3].

### 2.3 Touch-Based Interface Features and Correlated Cultural Dimensions

Table 1 shows the interface features that have been summarized from the previous studies of touch-based interface design for the elderly [2] and cell phone interface design based on cultural differences [5]. Each attribute has been mapped with its

**Table 1.** Proposed interface features and correlated cultural dimensions

Interface features	PDI	IDV	MAS	UAI	LTO
Large amount of contents				Low	
Secondary information about contents				High	
Meaningful classification of contents	High				
Friendly and informative error messages			Low		
Icon or image-based style		Low			
Colorful interface		Low			
Large and clear font style				High	
Aesthetical interface			Low		
Clear menu labeling	High				
Minimal steps	High				
Large and clearly distinguished targets	High				
Single touch-based interaction					High

relationship according to the cultural dimension, based on the cross-cultural study of websites interface design [9].

### 3 Methodologies

#### 3.1 Research Questions and Hypotheses

This study has been designed to answer the following questions:

- What are the differences in cultural dimensions scores between the older adults and elderly groups across Korea and Indonesia?
- What are the differences in the usability testing scores between the older adults and elderly groups across Korea and Indonesia?
- What are the differences in touch-based interface ratings between the older adults and elderly groups across Korea and Indonesia?

The hypotheses corresponding to the research questions are listed as follows:

- There will be a difference in cultural dimensions scores between the elderly in Korea and Indonesia and between the older adults and elderly groups.
- Users with higher uncertainty avoidance and higher long-term orientation will have higher scores on efficiency, learnability, fewer errors, and higher rating on the task with the cultural related feature.
  - Users with higher uncertainty avoidance will have higher scores on all the tasks.
  - Users with higher long-term orientation will have the higher score on the task zooming a photo.
- There will be a difference in touch-based interface design preferences between Korean and Indonesian elderly, and between the older adults and elderly groups.

### 3.2 Usability Testing

The prototype has been designed with the features of high uncertainty avoidance and high long-term orientation cultures to compare the preferences of the Korean and Indonesian elderly. Its features include a strict amount of contents, secondary information about contents, large and clear font style, and single-touch interaction.

According to Nielsen [7], there are four evaluation criteria for the usability that need to be considered. Table 2 shows the parameter of each criterion.

**Table 2.** Nielsen's evaluation criteria

Criteria	Description	Parameter
Efficiency	Assessment of time needed for carrying out a task	Time
Learnability	Easiness to learn the system	Time
Minimal errors	Errors made by users when using the system	Number of error taps
Satisfaction	User preferences on the system	Questionnaire

Two experiments were conducted separately in Korea and Indonesia. First, participants were asked to complete the demographic questionnaire and VSM 2013 questionnaire to collect their demographic and cultural dimensions scores. Then, they were asked to carry out the tasks assigned to the touch-based interface: call a number, add a new contact, send a message, and zoom a photo. The last task reflects the long-term orientation as it utilizes a single-touch interaction. The execution time and the number of mistakes of each task were measured. The usability rating questionnaires were distributed after each task to measure their satisfaction scores toward the interface design. Finally, the interface features rating questionnaires were distributed to collect the data about their preferences toward the interface design.

## 4 Analysis and Results

### 4.1 Participant Demographics

A total of 40 participants were recruited in this study, 20 in Korea and 20 in Indonesia. The participants belong to two groups, the 50–59 years old group which is referred to as the older adults group and 60 years and older group which is referred to as the elderly group. Table 3 shows the demographics of participants.

### 4.2 Hypotheses

Cultural dimensions mean scores were calculated using the formulas in VSM 2013 manual. Table 4 indicates that all of the cultural dimensions are significantly different between Korean and Indonesian elderly.

**Table 3.** Participant Demographics

	Frequency	%
<i>Nationality</i>		
Korean	20	50
Indonesian	20	50
<i>Age</i>		
50–59 years old	17	42.5
60 years and older	23	57.5
<i>Gender</i>		
Male	13	32.5
Female	27	67.5
<i>Education level</i>		
High school/Diploma	28	70
Bachelor's degree	7	17.5
Master's degree	4	10
Doctoral degree	1	2.5
<i>Occupation</i>		
Private company employee	20	50
Entrepreneur	7	17.5
Unemployed	13	32.5
<i>Smartphone usage</i>		
	<i>Years</i>	
Korean	4.8	
Indonesian	3.95	

**Table 4.** Cultural dimensions scores (Two-way ANOVA)

Cultural dimension	Korean	Indonesian	Sig. (2-tailed)
Power distance	−5	39.56	0.021 <sup>a</sup>
Individualism	−5.25	60.192	0.000 <sup>a</sup>
Masculinity	28	−31.154	0.000 <sup>a</sup>
Uncertainty avoidance	6	−49.698	0.03 <sup>a</sup>
Long-term orientation	31.75	137.225	0.000 <sup>a</sup>
Cultural dimension	50–59 years	60 years and older	Sig. (2-tailed)
Power distance	25.214	13.846	0.498
Individualism	40	14.942	0.104
Masculinity	−4.5	1.346	0.665
Uncertainty avoidance	5.5	−62.857	0.439
Long-term orientation	90.821	78.154	0.449

<sup>a</sup>Significant at 0.05 level.

Table 5 shows that there are significant differences between the older adults and elderly groups in completing all tasks and task zooming a photo.

**Table 5.** Time measurement for efficiency and learnability (Two-way ANOVA)

Evaluation criteria	Korean	Indonesian	Sig. (2-tailed)
All tasks	33.325	33.091	0.913
Task zooming a photo	34.85	32.434	0.416
Evaluation criteria	50–59 years	60 years and older	Sig. (2-tailed)
All tasks	29.884	36.532	0.003 <sup>a</sup>
Task zooming a photo	28.607	38.677	0.002 <sup>a</sup>

<sup>a</sup>Significant at 0.05 level.

Table 6 shows that there is a significant difference between the age groups on the task zooming a photo.

**Table 6.** Number of Errors (Two-way ANOVA)

Evaluation criteria	Korean	Indonesian	Sig. (2-tailed)
All tasks	0.313	0.360	0.487
Task zooming a photo	0.55	0.473	0.620
Evaluation criteria	50–59 years	60 years and older	Sig. (2-tailed)
All tasks	0.384	0.288	0.166
Task zooming a photo	0.707	0.315	0.016 <sup>a</sup>

<sup>a</sup>Significant at 0.05 level.

Table 7 shows that there is no significant difference found between Korean and Indonesian elderly as well as the age groups.

**Table 7.** Satisfaction scores (Two-way ANOVA)

Evaluation criteria	Korean	Indonesian	Sig. (2-tailed)
All tasks	4.54	4.572	0.875
Task zooming a photo	4.638	4.913	0.2
Evaluation criteria	50–59 years	60 years and older	Sig. (2-tailed)
All tasks	4.708	4.403	0.14
Task zooming a photo	4.9	4.651	0.246

Table 8 shows that there is a significant difference between Korean and Indonesian elderly in the single-touch interaction feature.

**Table 8.** Interface features ratings (Two-way ANOVA)

Interface feature	Korean	Indonesian	Sig. (2-tailed)
Large amount of contents	3.95	4.181	0.417
Secondary information about contents	4	3.923	0.770
Meaningful classification of contents	3.85	4.363	0.089
Friendly and informative error messages	4.1	4.220	0.646
Icon or image-based style	3.3	3.181	0.761
Colorful interface	3.45	3.368	0.830
Large and clear font style	4.45	4.368	0.780
Aesthetical interface	3.5	2.918	0.092
Clear menu labeling	4.2	4.258	0.780
Minimal steps	4.1	4.368	0.373
Large and clearly distinguished targets	4.25	4.231	0.945
Single touch-based interaction	3.8	4.555	0.032 <sup>a</sup>
Interface feature	50–59 years	60 years and older	Sig. (2-tailed)
Large amount of contents	4.143	3.988	0.587
Secondary information about contents	4.050	3.873	0.503
Meaningful classification of contents	4.386	3.827	0.065
Friendly and informative error messages	4.193	4.127	0.8
Icon or image-based style	3.093	3.388	0.45
Colorful interface	3.464	3.354	0.773
Large and clear font style	4.364	4.454	0.760
Aesthetical interface	3.171	3.246	0.825
Clear menu labeling	4.293	4.165	0.542
Minimal steps	4.264	4.204	0.84
Large and clearly distinguished targets	4.2	4.281	0.773
Single touch-based interaction	4.286	4.069	0.527

<sup>a</sup>Significant at 0.05 level.

## 5 Discussion and Conclusion

The results show that there are significant differences in all cultural dimensions scores between Korean and Indonesian elderly. The differences in cultural dimensions scores are influenced by nationality culture.

Regarding the efficiency and learnability test results, it was found that the older adults group completed all tasks significantly faster than the elderly group. Based on the errors test results, it was found that the elderly group had significantly fewer errors on the task zooming a photo than the older adults group. There is no significant difference found in the satisfaction test results. It can be concluded that the differences in time and errors measurement are driven by the age groups culture.

Furthermore, there is a significant difference in the interface features ratings between Korean and Indonesian elderly. It was found that Indonesian elderly had a higher preference for single touch-based interaction feature than Korean elderly. The difference in this feature preference is influenced by nationality culture.

This study compared the elderly's preferences on touch-based interface design based on nationality and age groups cultures. The results found significant differences in the cultural dimensions scores and interface features ratings between Korean and Indonesian elderly, as well as usability testing criteria between the older adults and elderly groups. The interface design embedded with culturally preferred design elements reflecting users' culture can be more effective in the communication for the users [4]. This finding also can help designers in designing and developing the touch-based interface design that is culturally appropriate for the elderly.

There was a possibility of selection bias due to convenient sampling. Therefore, if a completely random sampling method were used, the significance level of the results would be increased. Furthermore, background variables such as the education level and occupation could not be matched perfectly which therefore may affect the results.

For the future work related to the cross-cultural studies, it is suggested to consider the influence of the cultural dimensions on the responses of rating questionnaire, if applicable, as Johnson [6] has found that the cultural dimensions are associated with the response style of the respondents. By adopting certain methods to reduce the effects of response bias, the results of the research can truly reflect the cultural differences and lead to a higher reliability and validity.

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