

# Culturally Adapted Mobile Phone Interface Design: Correlation between Categorization Style and Menu Structure

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## ABSTRACT

This paper presents the results of experiments conducted to understand the correlation between culturally different cognitive styles and issues of information architecture and flow, specifically in a mobile phone interface. 30 Korean participants and 30 Dutch participants participated in an on-screen prototype test as well as a cognitive style test. Different preferences were found for each cultural group regarding function/theme-related menus. In addition, individual categorization styles were found to be correlated to individual preferences. Overall, the findings indicated that performance and preferences in a certain menu structure are associated with cognitive styles, which may eventually help design culturally adapted interfaces. The correlation between prior experience and preference was not found to be significant in any of the tests.

## Categories and Subject Descriptors

H.5.2 [Information Interface and Presentation]: User Interfaces  
– Interaction styles, User-centered design

## General Terms

Design

## Keywords

Interface design, Cognitive styles, Cultural difference

## 1. INTRODUCTION

Interest in the influence of culture on the design of user interfaces has grown as the world market has become more globalized. Products and services have been localized at a superficial level related to text, numbers, date/time formats, images, symbols and functionalities but without any reflection of unconscious cultural effects. Interface studies with cognitive and implicit viewpoints are rare, and mostly involve interaction in a desktop environment. These studies provide theoretical knowledge, but applying this knowledge directly to small-sized mobile devices remains a challenge, as a mobile interface is much more limited in terms of its information structure and sequence compared with a desktop interface. In particular, mobile phones among all mobile devices

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are being rapidly disseminated through diverse cultural areas. For this reason, cultural accommodations need to be taken into consideration. Moreover, the content associated with mobile phones has increased dramatically in terms of the types and quantity of content; hence, additional opportunities now exist for the creation of interfaces that are culturally adapted. However, mobile phones have thus far appeared to retain universal interfaces independent of culture.

It is, therefore, essential that we understand the cultural impact on the mobile interface independently, considering the characteristics of mobile environment and examine how the mobile interface can be culturally adapted. This study aims to illustrate how culturally different cognitive styles influence information structure and sequence in the mobile phone interface by examining users' performance and attitude toward the interface.

## 2. THEORETICAL BACKGROUND

Cognitive style is an individual's preferred and habitual approach to organizing and representing information [4]. Cognitive style has been studied in association with diverse concepts such as personality, creativity, problem solving, and corporate culture, among others. Different researchers have been studying it from different point of views; thus, it has been identified under many different dimensions.

Anthropological and psychological studies continue to suggest that cognitive style is culturally different. Particularly, Nisbett reports plausible evidence of such cultural difference, empirically supporting what has been extensively asserted in other disciplines by explaining where the culturally adapted cognitive difference comes from [3]. A central idea to his research is 'holistic versus analytic thought'. Holistic thought engages in context-dependent and holistic perceptual processes by attending to the relationship between a focal object and the field, and through a tendency of explaining and predicting events based on such relationships. On the other hand, analytic thought engages in context-independent and analytic processes by focusing on a salient object independently from the context in which it is embedded. It has a tendency to focus on attributes of the object and assign it to categories, using rules about the categories.

This distinction has a thread of connection with distinctions made by other psychologists. Witkin and his colleagues made a distinction between field dependence and field independence [6]. They describe field-dependent people as those who tend to experience surroundings in a relatively global fashion, passively conforming to the influence of the prevailing field or context. Conversely, field-independent people tend to experience their surrounding with objects as being discrete from their background.

These distinctions are also similar to Riding's distinction between Holists, who see the global picture and approach a task more holistically, and Serialists, who focus on details and are more serialistic in their approach to learning.

Nisbett and his colleagues have found cognitive differences between East Asians (Chinese, Koreans, and Japanese) and westerners (mainly American) in such characteristics as perception, attention, categorization, and inference. According to his investigation on perception and attention, East Asians attend more to the field and relationship between an object and the field than do westerners [2] and East Asians are inclined to explain events with reference to interactions between the object and the field, while westerners are more inclined to explain the same events with reference to properties of the object. Concerning methods of organizing the world, East Asians tend to group objects on the basis of similarities and on the relationship among the objects, whereas westerners tend to group the objects on the basis of categories and rules [1][5]. These studies indicate that thinking styles of East Asians are different from those of westerners. In other word, East Asians engage relatively more in holistic thoughts while westerners have more analytic thought patterns and approaches.

### 3. HYPOTHESIS

As the related studies indicate, user performances and favorable attitudes are predicted to be enhanced when an interface is compatible with their cognitive style. To grasp which cognitive style has a correlation with which element in mobile phone interface, interface elements of a mobile phone were conceptually divided into three different layers; representation, menu structure and interaction flow. The corresponding cognitive process in each interface layer and analytic/holistic characteristics in the cognitive process are listed in Table 1.

**Table 1. Interface Layers and Related Cognitive Styles**

Interface layer	Cognitive process	Analytic	Holistic
Representation (component and template)	Perception	Field-independent Verbal	Field-dependent Visual
Menu structure	Categorization	Taxonomic Inferential Rule-based	Relational Contextual Family resemblance
Interaction flow	Task handling	Planned Organized Sequential Linear	Flexible Spontaneous Random Parallel

This paper focuses on the 'menu structure' layer as well as the cognitive styles related to the layer. Thus, it was hypothesized that taxonomic or relational tendency in the categorization would have a correlation with a type of menu structure in a mobile phone interface. Therefore, specific situations were set by considering the structural characteristics of a mobile phone interface in order to give shape to the hypotheses.

An option (menu) for setting certain contents in a mobile phone is classified as a 'setting' due to its function. It can be also contextually attached to a menu containing the content itself as it is one of the operations conducted with the content. For instance,

to perform a task of setting (changing) a ringtone, a user may go through a 'setting' menu in the main screen and find an option for ringtone. Alternatively, the user may find the same option under a 'sound' menu in the main screen. A structure having the option under the 'setting' menu is a menu structure which is functionally grouped by the common function of a setting, whereas a structure having the option under the 'sound' menu is a menu structure which is thematically grouped by the shared context (or theme) of a sound. Considering that East Asians and westerners categorize things differently, it was predicted that they would show different behavior and attitudes toward certain menu structures due to their cognitive difference. Specifically, the prediction was:

East Asians would associate the task of 'setting contents' more with a thematically grouped menu than a functionally grouped menu and show a more favorable attitude toward a thematic grouping. On the other hand, westerners would associate the same task more with a functionally grouped menu and prefer a functional grouping.

## 4. EXPERIMENT

For comparative experiments between the East Asian and the Western culture, Korea and the Netherlands were chosen as the representative cultures. Given that the hypothesis was built under the assumption that Korean participants are more relational and parallel thinkers compared to Dutch participants, clarifying their cognitive styles was necessary. It was considered that their cognitive styles may not be reconciled with their culturally-different cognitive styles, as was assumed. In other words, individual cognitive styles may be more salient compared to collective cognitive styles due to the small sample size. For this reason, each participant was asked to perform the two tests (the prototype test and the cognitive style test) together in order that the correlation between individual cognitive styles and individual performances may be revealed. 30 Korean(20 males and 10 females) and 30 Dutch(16 males and 14 females) were randomly involved in the experiment through the Internet. The entire experiment took approximately 20 minutes.

### 4.1 Method

#### 4.1.1 Prototype Test

In the mobile phone prototype, the main screen of the mobile phone consisted of six menus (Call history, Messaging, Phonebook, Sound, Display, and Settings). Setting contents was possible through not only thematic menus such as 'Sound' and 'Display' and but by using a 'Setting' menu. For example (Fig.1), to set or change the wallpaper on the mobile phone, participants were able to start from the 'Display' menu, select a certain picture from 'My pictures' and then click 'Set as wallpaper' from among the options in a context menu that popped up from the right side at the bottom. Participants were also able to change the wallpaper by accessing the 'Setting' menu, entering 'Wallpaper' in 'Display', and finally selecting one picture from among a list of pictures.

Participants were asked to change the ring tone (Task 1) and the wallpaper (Task 2) to a specific example for each task by entering a menu from among six menus. The menu that they chose to use for the tasks was examined. After completing the two tasks, they were asked to perform the same tasks again using the other way (for a total of four tasks). For example, if a participant changed

the ring tone using the 'Sound' menu during the first trial, that participant would need to do the same task using the 'Setting' menu during the second trial. This was done to allow the subjects to experience and compare two different ways (thematic approach vs. functional approach) so that a preferred approach could be ascertained at the end of the test.



**Figure 1. Two Approaches for Setting the Wallpaper**  
(Top: from 'Display', Bottom: from 'Settings')

#### 4.1.2 Cognitive Style Test

The cognitive style test was intended to discover whether an individual's cognitive style is taxonomic or relational using a methodology similar to the experiments by Unsworth [5]. Among the 39 sets of images used in Unsworth's study, 26 sets were selected as stimuli. 13 sets were excluded that were judged to have relatively low image quality and clarity. One target picture and two alternative pictures were presented together and participants were asked to select the one alternative that best matches the given target picture as quickly as possible. The two alternatives were one that belonged to the same taxonomy as the target picture and one that shared a relationship with the target picture. For example, a picture of a mouse (or a rat) was presented as a target picture, and a squirrel and a piece of cheese were presented as alternatives. A mouse and a squirrel are both animals and so were considered to be in the same taxonomic category. A mouse eats cheese, thus the mouse and cheese were considered to share a relationship. The pictures remained on the screen until participants made their choices. Three sets were given as warm-ups prior to the actual trials in order to help participants understand how to respond. The other 23 sets were presented in sequence.

## 4.2 Results

The collected data were analyzed using the software package SPSS (SPSS 11.0 for Windows). The significance level was set to be  $p < .05$ .

#### 4.2.1 Menus Which They Selected

Fisher's exact test was conducted with a 2 x 2 crosstable of cultural factors (Korean, Dutch) and a selected menu (Setting/Sound, Display). Over 70% of both cultural groups set the ringtone by using a 'Sound' menu. The results indicated that there were no significant difference in the choice of selected menus between the two groups ( $p=1.00$ ). For the task of setting the wallpaper, most of the participants changed the wallpaper by

using a 'Display' menu; thus, no significant differences were found between the groups ( $p=.52$ ). These results show that there were no cultural differences inherent in the menus that they started with as they performed the tasks.

#### 4.2.2 Menus Which They Preferred

53% of Dutch participants ( $n=16$ ) preferred the 'Setting' menu and 77% of the Korean participants ( $n=23$ ) preferred the 'Sound' menu. Preferred menus while changing the ringtone differed between the groups ( $p=.03$ ). When changing the wallpaper, 53% of the Dutch participants ( $n=16$ ) preferred the 'Setting' menu and 73% of the Korean participants ( $n=22$ ) preferred the 'Display' menu. The cultural difference did not appear statistically significant ( $p=.06$ ); however, this was closely related to the national tendencies found in the former task.

#### 4.2.3 Categorization Style of Each Cultural Group

Data taking longer than the mean value for completion time (2.39s) were excluded as this data set was not considered unconscious and instant responses. After excluding this data, the percentage of each response type (relational grouping or taxonomical grouping) was counted to yield an individual categorization tendency in a relative index ([100]: strong taxonomic ~ [1]: strong relational tendency). To determine if any differences in the categorization tendency between cultural groups or selected menus existed, a two-way ANOVA was conducted. An interaction effect between national groups and selected menus was not found. The Korean group ( $M=35.73$ ,  $SD=26.45$ ) had a greater relational tendency than the Dutch group ( $M=42.32$ ,  $SD=30.70$ ), but the difference was not significant [ $F(1,56)=.74$ ,  $p=.39$ ].

#### 4.2.4 Correlation between Categorization Style and Selected/Preferred Menu

A categorization tendency was found to be different according to the selected menus. The categorization tendency was different [ $F(1,56)=5.05$ ,  $p=.03$ ] between a group selecting the 'Setting' menu ( $M=53.35$ ,  $SD=34.46$ ) and a group selecting the 'Sound' menu ( $M=34.26$ ,  $SD=25.02$ ) while changing the ringtone. Such tendentious differences were also found for the changing of the wallpaper [ $F(1,56)=7.87$ ,  $p=.01$ ] between a group selecting 'Setting' menu ( $M=57.59$ ,  $SD=31.50$ ) and a group selecting 'Display' menu ( $M=32.84$ ,  $SD=24.99$ ). Categorization tendency was also found to be different according to the preferred menus. Categorization tendencies differed [ $F(1,56)=16.86$ ,  $p=.00$ ] between a group preferring the 'Setting' menu while changing the ringtone ( $M=56.78$ ,  $SD=32.90$ ) and a group preferring the 'Sound' menu ( $M=27.99$ ,  $SD=18.78$ ). Such tendentious differences were also found for the changing of the wallpaper [ $F(1,56)=9.27$ ,  $p=.00$ ] between a group preferring the 'Setting' menu ( $M=53.01$ ,  $SD=34.46$ ) and a group preferring the 'Display' menu ( $M=29.70$ ,  $SD=19.38$ ). In other words, the group that selected/preferred the 'Setting' menu had a tendency to be more taxonomic than the group that selected/preferred the 'Sound' or 'Display' menu in both tasks.

As stated above, the categorization tendency was found to be different between groups selecting/prefering different menus. Thus, if individuals' categorization tendencies are known, it was considered that menus that individuals will select/prefer could be predicted. A logistic regression analysis revealed that the higher a taxonomic person a participant is, the greater the possibility of

that participant to select a 'Setting' menu when changing the ringtone or the wallpaper. Regression models with the preferred menus and categorization tendency were likewise obtained. Consequently, the higher a taxonomic person a participant is, the greater the possibility of preferring a 'Setting' menu when changing the ringtone or the wallpaper.

#### 4.2.5 Impact of Prior Experience

It was considered that the performance with and preference for a certain interface were possibly affected by the interface types participants experienced previously. For this reason, the impact of pre-experience (or familiarity) was examined by inspecting the correlation between the interface type on the mobile phones that participants were using at the time of the study, and the interface types with which their performance or preference was enhanced during the prototype test (The information regarding their current mobile phones was collected as part of the cultural background questionnaire). As a result of Fisher's exact test, no correlation was found between the ways for changing the ringtone in their current mobile phones and their selected menu during the test ( $p=1.00$ ). Additionally, there was no difference between the ways for setting the wallpaper in their current mobile phones and the ways they performed on the test ( $p=.73$ ).

### 5. DISCUSSION & IMPLICATION

Korean participants preferred a thematically grouped menu and Dutch participants preferred a functionally grouped menu. The categorization tendency of the Korean group was found to be more relational compared to the Dutch group, but the tendentious difference was not statistically significant. The sample size was not large enough to be generalized down to a collective cognitive style; for this reason, individual cognitive styles appear more highlighted than collective cognitive styles. However, such collective cognitive styles have been shown by a number of cultural psychological studies. Thus, the correlation between individual cognitive style and menu structure found in this research can feasibly apply to a cultural level under the assumption that East Asians tend to make more relational groupings compared to westerners.

This study shows the possibility of a cognitively adapted interface that uses the connection between a cognition model and the interface architecture. Current structure and flow of the interface appears universal across cultural areas. However, the findings in this research may be helpful if designing an interface suitable to each cultural area on the basis of the fact that the cognitive styles of East Asians and westerners differ from one another. Given that mobile phones have a limited number of menus due to their small screen size, it is necessary to organize the limited number of main menus appropriately in order to offer logical and quick access to any command or option. The findings in this study suggest that menus can be organized in a different way depending on users' cognitive styles; hence, suggestions regarding structuring items in mobile phone are made available by this study.

The participants having a relational categorization style performed the tasks using a thematic approach and preferred this approach in a situation where both approaches were available. Therefore, for East Asian users who are known to be more relational, it may be better to organize menus thematically so that

they make more natural and efficient use of their devices. In the thematic structure, options are usually shown in the form of a context menu to offer contextual accessibility, an approach that suits the attributes of a holistic thinker. For example, it is possible to organize main menus with thematically grouped menus such as 'Sound' and 'Display' and put all tasks related to the theme together.

Participants with a taxonomic categorization style performed the tasks using a functional approach and preferred this approach in a situation where both approaches were available. Therefore, for western users who are known to be more goal-oriented, it may be better to organize menus according to goals or functions so that they feel certain of goal achievement. For example, it is possible to organize main menus with functionally grouped menus such as 'Setting' and 'Download'.

### 6. CONCLUSION

This study set a hypothesis regarding a correlation between cognitive style and menu structure in a mobile phone interface. Individual styles in categorization were significantly correlated with type of menu structure. In other words, participants selected and preferred the interface adapted to their cognitive style. Thus, the hypothesis was supported; it has substantial implications in designing a culturally adapted interface.

However, there were limitations inherent in the experiments. The experimental environment was desktop-based and was considered possibly not realistic enough to demonstrate a mobile phone interface. In addition, the subject groups were mostly students in their early twenties who likely find it easier to adjust themselves to change. Thus, it might be difficult to discover clear differences between cultures or individuals. For this reason, it is necessary to use a large enough sample with diverse generations to ensure the validity of the data. Other issues apart from menu structure and flow in the interface also need to be considered, as do other products.

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