Icon Design for Korean Mental Models

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Abstract: Recent studies have shown that cultural characteristics exert a strong influence on icon preference and recognition. Nevertheless, no study has been done to investigate the Korean cultural context in icon design. This study selected the most preferred icon among newly designed cultural icons based on Korean mental schemas for this study and two prevalent word processing software icons (one from a global brand and the other from a local brand) for the ten most popular word processing functions. The results showed that culturalization or localization were necessary to help enhance icon recognition because four new Korean cultural contexts based on Korean mental schemas were collected in this study. However, the newly designed icons with the most prevalent Korean mental schemas were not necessarily selected as the most preferred icons because of the training effect from long-term usage or the repetitive usage effect. When recognizing icons, subjects seemed to prefer a familiar icon, even in preference to a new one with a better representation of their mental model.

Key-Words: Mental model, culturalization, icon design

1 Introduction

The underlying universal meaning of icons based on such office metaphors increased the computer effectiveness for users around the world. Even as icons became ubiquitous, recent studies showed that cultural properties exerted strong effects on understanding and communication through icons due to different perspectives arising from various cultural backgrounds. However, no research in the literature has investigated Korean cultural characteristics in icon design.

This study was conducted firstly to design Korean cultural icons based on Korean mental models in order to enhance icon recognition for Koreans and secondly to investigate what cultural characteristics were identified in Korean cultural icon design.

2 Metaphors and mental models

Metaphors, according to Neale and Carroll (1997), were defined as the transference or mapping of knowledge from a source domain (familiar area of knowledge) to a target domain (unfamiliar area or situation), thereby enabling humans to use specific prior knowledge and experience for understanding and behaving in situations that are novel or unfamiliar [1]. In order to easily understand the meaning of the transference of knowledge from the source domain to the target domain, as Bewley et al. (1983) mentioned, traditional icons adopted from familiar objects such as document, file-folders, file-drawers, etc. were based on the "office metaphor" for users' effective computer use [2]. Therefore, the metaphors used in computer systems help establish user expectations and encourage predictions about system behaviors by using icons.

A mental model is the combination of representation and the mechanisms associated with those representations [3]. A mental model is a user's conceptual and dynamic representation of a system that is used to understand and to predict future states of the system based on the user's previous experience, as well as current observation [4]. Briefly, Toffler (1970) reported that "every person carries within his/her head a mental model of the world which is a subjective representation of external reality" [5]. A mental model is related to experience, training and instruction, which are themselves based on the culture, language, and individual social systems of the users [6]. Specifically, metaphors are needed for the cognitive activity related to semantic association and are related to cultural impact [7]. Therefore the mental model related to cultural properties plays an important role in understanding and interpreting icons.

3   Cultural differences in icon design

Choong and Salvendy (1998) well summarized the cultural differences in cognitive styles, cognitive abilities, digit span, color association, personality and cultural patterns between Americans and Chinese [8]. Based on the language difference of alphabetical language (English) versus pictorial language (Chinese), cultural differences caused by different languages affect the performance time and error rates in icon recognition.

Ito and Nakakoji (1996) studied different user interface designs as affected by the different cultural backgrounds between Japanese and North Americans. According to their cultural model, different colors and shapes (a little cultural dependence) altered the perception of the representations [9].

Piamonte et al. (2001) have performed an international project to evaluate telecommunication symbols. Three sets of icons and pictograms representing seven referents or functions of the video-telephone were designed and tested in Western Europe using different subject groups from Sweden and the United States [10].

Duncker (2002) studied the library metaphors of digital libraries based on the cultural context of the Maori, the indigenous population of New Zealand [11].

The literature review described herein has detailed the cultural differences in icon recognition that are found between different languages, colors, shapes, functions and cultural context.

Due to the need for icon culturalization, this study was designed to investigate what cultural characteristics should be considered in designing Korean cultural icons based on preferences as a measure of cognitive characteristics.

4   Experiment: Designing cultural icons

4.1 Subjects

This experiment consisted of two sessions: collecting mental schemas and choosing the most preferred icon. For the collection of mental schemas, eighteen paid undergraduate or graduate students (23.6 ± 2.2 years old) participated in the survey. After designing icons based on the collected mental schemas, another 80 paid subjects (23.1 ± 2.39 years old) participated in the survey through the Internet to choose the most preferred icons. All subjects had more than 2 years of experience in using word processing programs.

4.2 Procedure

Prior to the survey to collect mental schemas, ten most frequently used functions were determined from different twenty subjects (25.3±2.8 years old): new document, preview, search, font setting, spelling check, style, table, zoom in or out, cut, and paste. Then, the mental schemas of the above ten functions were gathered via the survey. In the survey, subjects were asked to describe and sketch the associated objects, activities, or expected results (feedback) for each function.

After designing the icons based on the mental schemas, a survey was conducted through the Internet to ask "which icon is the best fit for each function based on your cultural background?" Multiple icons could be selected for each function because icons with cumulative votes totaling more than 50% were selected. In order to determine the most preferred icon for each function, icons from two competitive word processing programs in Korea, the global brand (Microsoft Word 2000) and the local brand (Hangul 97), were selected for comparison with the newly designed icons. From these three icon categorizations, subjects were then asked to choose the most preferred icon for each of the ten functions.

4.3 Results

4.3.1 Mental schemas for each function

The mental schemas for each function were collected and materialized into the icon design. Table 1 presents the mental schemas for each function. Based on the descriptions and sketches, icons were designed and selected in table 2. As mentioned earlier, icons with cumulative votes of more than 50% were selected, with the exception of spelling check. In the case of spelling check, although the cumulative vote for the most popular (48.8%) and second most popular (17.5%) icons was already greater than 50%, the third placed icon was also included as a selected icon because it was also designed with the main schema of a red pencil (table 1).

Function	Descriptions			Sketches
	Object	Activity	Expected Results (Feedback)	
New Document	A new white paper	Turing over the pages	Ready for writing on the paper	
	A shining paper	Shining around the paper	Appearance of a paper to write	
	A pencil	A pencil moving on a paper	A letter written on a paper	
Spelling Check	A red pencil	Marking with red pencil	Wrong words checked with red pencil	
	A red pencil and paper	Marking with red pencil	O or V marked on the paper	
Zoom in/out	+/–, a monitor	Blinking the + or – on the monitor	A monitor zoomed	
	A magnifier	Adjusting the rate of zoom	A paper zoomed	
Paste	Some glue	Putting a piece of paper on a piece of paper	A paper put on a piece a paper	
	A yellow post-it	Post-it attached on a paper	A paper attached post-it	

Table 1 Mental schemas for each function

In the case of new document, there were various representations ranging from simple sketches to complex expressions (table 1). The Korean way of flipping pages was reflected with the dog-eared part being located in the bottom-right corner and this arrangement was selected with equal popularity to that of the global brand icon of the dog-eared part in the top-right corner. An icon with shining rays emitting from a new paper was also a popular schema. Some other schemas featuring a page being flipped and a pencil with a combination of the first consonant and vowel in the Korean alphabet on a new paper were also collected. For the preview icon, about two-third of subjects chose the monitor as the representative mental schema and no other competing schemas were collected. However, subjects wanted to put more information on the original schema such as scrolling bars on the monitor. For search, a magnifier was considered the most popular mental schema, although there was some variation of handle locations and syllables in the magnifying lens. The binoculars were also considered a popular mental schema for search.

Functions	Current Icons		New Icons		
	Word 2000	Hangul 97	Top Icons (% of total votes)		
New document			(21.3)	(20.0)	(18.8)
Preview			(67.5)		
Search			(26.3)	(17.5)	(15.5)
Font Setting			(31.3)	(21.23)	
Spelling Check			(48.8)	(17.5)	(13.8)
Style			(26.3)	(12.5)	(11.3)
Table			(35.0)	(18.8)	
Zoom in/out			(43.8)	(40.0)	
Cut			(33.8)	(27.5)	
Paste			(33.8)	(27.5)	

Table 2 Current icons and newly selected icons

In the case of font setting, subjects illustrated various activities for setting the font such as decorating, coloring, or reshaping the letter. However, the selected icons in table 2 confirm that the mental schemas selected for font setting were the same as the current icons: the local brand icon of different colored syllables of the combination of the first consonant with the first vowel and the schema of a syllable of the first consonant with the first vowel in the global brand icon. For spelling check, a red pencil was the main schema to express checking or correcting, either without the paper or on the paper. The local brand icon featuring a red-colored check mark above three Korean syllables was also collected as one of the mental schemas for spelling check. For style, the subjects presented various schemas. The main mental schema seemed to be different files piled up together. Another mental schema was a hanger which is the same as the local brand icon. The word 'style' reminds Korean subjects of the word 'stylish' and the stylish person reminds of a nice pair of suits, which in turn reminds Koreans of hangars. There was not a single mental schema of a brush, as used in the global brand icon, collected among the Korean subjects.

In the case of table, the subjects described the motion of drawing the table with a ruler and pencil as shown in the current icons. The shape of a table alone

was also collected as a popular mental schema of table. For zoom in/out, a magnifier and the symbols of '+' and '−' were combined into the main schema, compared to the monitor with a magnifier lens for the local brand icon, and alternating '+' and '−' signs in the magnifier lens for the global brand icon. For cut, the main schema remained a pair of scissors with different shape of the edges: either blunt or sharp. In the case of paste, the mental schemas for glues and yellow post-its were well removed from the current icons of a clipboard with a written document on it. Although this might be a surprising result for Westerners, it is not for Koreans because the clipboard has never been popular in Korea.

4.3.2 Most preferred icons

From the current and selected icons, the most preferred icons were determined for each function. To rank the preference voting, analysis of variance (ANOVA) and post-hoc test (the Student-Newman-Keul multiple comparison test) were used for each function as shown in table 3.

Functions		Most preferred icons (% of votes)
New document	Factor Level	(76.2)
	ANOVA	$F(2, 82) = 29.08, p = .0001$
	SNK Groups	A
Preview	Factor Level	(88.1)
	ANOVA	$F(1, 41) = 56.74, p = .0001$
	SNK Groups	A
Font Setting	Factor Level	(85.7)
	ANOVA	$F(1, 41) = 42.71, p = .0001$
	SNK Groups	A
Spelling Check	Factor Level	(50)
	ANOVA	$F(3, 123) = 7.43, p = .0001$
	SNK Groups	A
Table	Factor Level	(61.9)
	ANOVA	$F(2, 82) = 9.65, p = .0002$
	SNK Groups	A
Zoom in/out	Factor Level	(69.0)
	ANOVA	$F(2, 82) = 16.54, p = .0001$
	SNK Groups	A
Paste	Factor Level	(76.2)
	ANOVA	$F(1, 41) = 15.50, p = .0003$
	SNK Groups	A

Table 3 ANOVA and Student-Newman-Keul (SNK) multiple comparison test for preference voting

Based on the ANOVA results in table 3, three functions showed no significant difference among the current and selected icons, with the level of significance set at 0.05. No significant difference meant that there were no differences in preference between the newly designed icons with culturally selected mental schemas and the current global and local brand icons. Culturally favored mental schemas of files in the function of style showed no significant difference compared to the mental schema of a brush for the global brand icon and of a hanger for the local brand icon. In the case of search, the mental schema of magnifying lens for the local brand icon and the newly designed icon were dominantly favored (73.8%) over the mental schema of the binoculars for the global brand icon. No significant difference was expected in the case of cut because the global recognition of the overall shape of scissors may predominate over the local recognition of the detailed shape of edges in scissors.

The most preferred icons for the remaining seven functions could be categorized into three groups. When the most preferred icon was identical with that of the global brand of MS Word 2000, the global mental schema was the best fit to characterize the functionality of the icon. However, only one global mental schema was selected as the most preferred icon: new document. When compared to table 2, the preference voting in table 3 is quite different from the voting of cultural schemas. Not much cultural schema difference is shown in table 2 regarding the location of the dog-eared part between the upper-right and lower-right corners but there is a significant preference difference in the locations of the dog-eared part in table 3. The icon which featured the Western way of page flipping (the dog-eared part in the upper-right corner) was determined as the most preferred icon. The new mental schema of emitting rays was least preferred.

When matched with the local brand icons of Hangul 97, the functionality of the icons was well designed to reflect the Korean cultural mental schemas such as preview, font setting, spelling check, and table. In the case of preview, the main schema of the monitor in table 1 was selected as the only representative schema in table 2, resulting in the preferred icon because the magnifying lens in the global brand icon apparently reminds Koreans of the search activity. When the global brand icon and the local brand icon were designed with the same mental schemas and with similar shape, the local brand icon was preferred to the global brand icon except for the case of spelling check.

The possible reason for preferring the local brand icon was the training effect because the Korean subjects had experienced greater exposure to the local brand of Hangul 97 than to the global brand of MS Word 2000.

The newly selected mental schemas, the magnifying lens and yellow post-it, were determined to be the most preferred for zoom in/out and paste, respectively. For the former, the main schema of the magnifying lens was used simultaneously in the global brand and local brand icons. The only difference was the degree of complexity: more detailed information was added in the newly designed icon by adding the '±' sign on the written document. In the case of paste, the yellow post-it on the written document was expected to be the most preferred icon from table 1 because of the lack of popularity of the clipboard in Korea.

4.4. Discussion

When designing the local icons for the Korean Hangul word processing software in the late 1980's, universal recognition was considered to be the most important issue, which relegated the consideration for cultural properties on icon design. However, when adopting the original (global) icons to the Korean product, Hangul word processing developers did not copy the original icons as they were. Instead, icons were modified from the original icons (table 2) if the original icons were not culturally comprehensible and more details were added to the original icons to increase the specificity, even at the expense of losing the advantage of simplicity, if the original icons were somewhat comprehensible. This method of localization or culturalization affected the cultural preference in selecting four local brand icons (preview, font setting, spelling check, and table) as the most culturally preferred icons. Another reason to explain the cultural preference for the local brand icon might be the result of the training effect which arises due to repetitive use of the local brand word processing software in Korea. This training effect by repetitive use in recognizing icons was also the reason that the competitive cultural mental schema of emitting rays for new document in tables 1 and 2 became the least preferred in table 3.

This study also demonstrated that the above cultural characteristics were important factors in the culturalization or localization of Korean cultural icon design. Among the above cultural characteristics, colors, shapes and cultural contexts played important roles in the selection of culturally preferred icons based on Korean mental schemas. The red pencil and yellow post-it were examples of color-related mental schemas. For shapes, Korean mental schemas, such as font setting and zoom in/out, developed with more detailed information added to the global mental schemas compared to the global icons were selected as the preferred. Unique Korean cultural contexts that were also found in this study included the top-right corner location of the dog-eared part, the red pencil with an 'O' for the correct answer and a '√' for the wrong answer, and the use of a magnifier. The magnifier was found to be a very versatile object in Korean mental schemas of search and zoom in/out. In order to minimize the confusion caused by the double use of the magnifier either in the case of search or in the case of zoom in/out, different items were embedded in the magnifier: a Korean character for search and a '±' sign for zoom in/out. Therefore, in order to achieve localization or culturalization, these Korean cultural characteristics should be used to help expedite icon recognition. Otherwise, these cultural characteristics would be lost due to the training effect arising from repetitive use of less culturally fitted icons.

Then, since this process of localization or culturalization has already been progressing in Korea, what has caused the observed localization or culturalization? As reviewed so far, the mental schemas representing cultural characteristics, whether they were the colors, shapes or context, should be culturally acceptable to the target culture in order to facilitate localization and culturalization. The iconic images representing unfamiliar or obscure objects or activities, even though they had been repetitively used for a long time in the case of the clipboard icon in this study, could not be perceived for what they truly meant, but rather were only processed without full appreciation for the meaning of the iconic images. This indicates that the duration of the repetitive usage is not necessarily the only factor contributing to localization or culturalization. Rather, the degree of cultural familiarity of the images, i.e., whether the iconic images were culturally original or culturally accepted global objects or activities, such as the post-it, is another important factor in enhancing icon recognition.

5 Conclusions

In conclusion, the significant findings are as follows:

(1) Although the process of localization or culturalization has been progressing in Korea, several new and prominent Korean cultural mental schemas were collected: shining rays emitting from a blank document for new document, a red pencil with a check mark (√) for spelling check, different colored files for style, and a yellow post-it on the written document for paste.

(2) Icons with prominent Korean mental schemas were not necessarily identical with the most preferred icons because of the training effect resulting from repetitive icon use. Another factor was found to be the utilization of culturally accepted, familiar objects and activities in enhancing icon recognition.

ACKNOWLEDGMENTS

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