THE APPROPRIATENESS OF ICON REPRESENTATIONS FOR TAIWANESE COMPUTER USERS

Hsiu-Feng Wang

Asia University (Taiwan)

Wang, 305–330
Visible Language 44.3

Rhode Island School of Design
Providence, Rhode Island 02903

Abstract

This experiment investigated how two factors which relate to icon representations affected Taiwanese computer users. These were: alphabetic or non alphabetic representations and cultural or standard imagery. Alphabetic representations are representations which show Chinese characters or English words/letters. Non alphabetic representations are representations which show either concrete or abstract objects. Cultural imagery is imagery that uses ethnic depictions, often shown in a traditional manner. Standard imagery is imagery used in icons found in present software packages used internationally.

Fifty-two Taiwanese citizens with a similar ability in English were shown a series of twenty-six icons on a computer screen along with a list of labels, and asked to match the labels with the icons. The results indicated that cultural elements, especially alphabetical cultural elements aided the recognition of icons by participants not familiar with computers.

Introduction

Many present computer interfaces use icons. Horton (1994) described icons as being "the small pictorial symbols used on computer menus, windows and screens. They present certain capabilities of the system and can be animated to bring forth these capabilities for use by the operator." By using icons to present information to users productivity can be improved. Programs that predominately use icons allow software companies to export their products with little modification. The important question is whether this practice actually obstructs user understanding for certain groups. Fernandes (1995) suggested that iconic representations are problematic between different cultures.

The Iceberg model introduced by Hoft (1996) shows three metaphorical layers of culture: surface, unspoken rules and unconscious rules. The surface layer consists of cultural characteristics that are visible and obvious. They include: currency, date format and language. The two other layers of culture lie below the water level and are thus more difficult to study. They consist of cultural characteristics that exist out of conscious awareness, such as non verbal communication. It is imperative however that a designer does not ignore these two lower layers, for they form the basis for what is on the surface.

INTERFACES AND CULTURE

Most software deemed appropriate by their manufacturers for a particular nation, have their help files and menus translated into the language of that nation. However language is only one way in which nations differ. Nakakoji (1994) reported that software designed and launched successfully in one country does not necessarily suit people in another country because differences in culture can cause misunderstanding. It is thus essential to consider other factors, such as cultural symbolism, metaphors, imagery and color usage (Sears et al., 2001).

Po and Chuan (1999) compared two teams of designers who worked, independently, for Motorola on the design of pager products for the Chinese market. One design team was based in the USA and the other in Singapore. The results from the two teams were significantly different and reflected the cultural backgrounds found in each country. Another experimental study conducted by Fang and Rau (2003) examined the effects of cultural differences between Chinese and US users on the perceived usability of World Wide Web (WWW) portal sites. They found significant differences in satisfaction between each group, and in the number of steps each group used to perform the same task. The study indicated that

cultural differences affect usability and task performance and that there is a need to investigate the effectiveness of icons on specific populations.

Onibere et al. (2001) carried out research in Botswana, a multi-cultural country which has two official languages (Setswana and English). One area of investigation was to find out whether Batswana (Botswanian citizens) users would prefer a localized interface. The survey results indicated that Batswana overwhelmingly desired such an interface. It is not known, however, whether this is true for the Taiwanese. This research investigates whether icons with local features are more appropriate for Taiwanese computer users than current standard icons.

REPRESENTATIONS AND APPROPRIATENESS

Signs can communicate their meanings in different ways. The road sign 'falling rocks' depicts rocks falling; the packaging symbol 'fragile' uses a picture of a glass. Generally both signs are effective even though their methods of communication are very different. The road sign uses imagery directly associated with an underlying concept (rocks falling) whereas the 'fragile' sign uses imagery indirectly associated with the underlying concept (a glass is fragile). The falling rocks sign, being more representational, is said to be more 'concrete' (Preece et al., 1994).

It has been reported that concrete icons are the easiest icons to identify because they use visual metaphors of the real world (Nolan, 1989; Ray, 1994; Stammers, 1990). Stammers (1988) also suggested, however, that concrete icons only help inexperienced computer users when they come to perform tasks. His research suggested that once experience is gained, concrete icons are no more effective than other icon types. These findings are supported by other research studies (Blankenberger and Hahn, 1991; Moyes and Jordan, 1993; McDougall et al., 1998).

A number of experiments have looked at the appropriateness of icon representations with regards to culture. Choong and Salvendy (1998) investigated how three different icon presentation modes affected performance in terms of recognition time and errors. Their experiment employed Mainland Chinese and American participants. The three icon presentation modes used in their experiment were pictures only, text only and pictures with text. The icons shown to both nationalities were the same except for the text which was written in Chinese for Chinese participants and English for the American participants. The results of the experiment showed that the icons that depicted text only were the least beneficial to Chinese participants and icons that depicted pictures only were the least beneficial to American participants. The results also showed that the pictures with text icons were not always more advantageous than text only or picture only icons.

In a similar study, Kurniawan et al. (2001) also investigated the effects of icon presentation modes on an icon's appropriateness and meaningfulness. However unlike Choong and Salvendy (1998), their study concentrated on Hong Kong Chinese computer users bi-lingual in Chinese and English. The icon presentation modes used in their study were the same as those used in Choong and Savendy's (1998) study: pictures only, text only and pictures with text only. Furthermore the same languages, Chinese and English, were used for the text elements. However unlike Choong and Savendy's (1998) study all participants were exposed to both languages. The research found that the Chinese participants rated text only icons, both Chinese and English, more appropriate and meaningful than picture only icons. When these findings are taken together with the findings of Choong and Salvendy's (1998) study, they seem to suggest that the Hong Kong Chinese differ from the Mainland Chinese with regard to the icon presentation mode they find most beneficial.

Some authors have provided guidelines regarding the use of text in iconic interfaces. Galdo (1990) suggested that designers should avoid using text with images when designing for an international market as word lengths differ from language to language. Galdo explained that these length differences can lead to practical problems getting translated text to fit in space allocated. Bradley (2001) also recommended restraint in the use of text, suggesting that interface designers should limit the use of alphabetic characters which have little or no meaning to the target user group.

AIMS OF THIS EXPERIMENT

Although American culture is not universal, standard icons generally use imagery that is based on American culture (Choong and Salvendy, 1998). In a study by Bourges-Waldegg and Scrivener (1998), the researchers commented that if a computer user does not understand an icon's imagery this can make the icon's function harder to learn. The researchers further suggested that a lack of understanding of an icon's imagery can even lead to a computer user deciding not to interact with an icon for fear of what might occur. This experiment investigated the appropriateness of Taiwanese cultural imagery in icon design, and compared it to standard imagery. In the experiment, the term *imagery* is used to describe pictures that are figurative or abstract; it is not used to describe text in any form.

The experiment was performed with Taiwanese participants and addressed the following question: *Do Taiwanese computer users find icons that use cultural imagery more appropriate than icons that use standard imagery?*

In the aforementioned study by Kurniawan et al. (2001), two varieties of text only icons were shown to Hong Kong Chinese participants. One icon variety showed

English text and another showed Chinese characters. The study found that there was no significant difference, in terms of appropriateness, between the two icon varieties. However it cannot be assumed that this finding would be reflected in Taiwan as, unlike in Hong Kong, English is not in widespread use. In addition to addressing the question above, this experiment also addressed the following question: *Do Taiwanese computer users find icons that use Chinese characters more appropriate than icons that use English letters/words?*

Method

Fifty-two Taiwanese citizens participated in this experiment. Communication with the participants was in Mandarin Chinese. The age of participants ranged from 21 to 35 years. The experiment took the form of a recognition test (Zwaga and Easterby, 1984) using icons on a computer screen. Participants were asked to match the icons shown to referents written on a list. The term *referent* is used in this paper to describe the name given to an icon by its program designer.

Prior to the commencement of the experiment, all participants completed a questionnaire written in Chinese. The questionnaire collected personal details and data relating to English ability and computer experience.

ENGLISH ABILITY

A previous study showed that English ability affects icon recognition (Wang, 2005). It was therefore decided that in this experiment, this factor would be controlled in such a way that all participants had a similar level of English ability.

Potential participants were asked to translate 12 English sentences (taken from Taiwanese junior and senior high school English textbooks) into Chinese. The sentences were arranged in order of increasing difficulty to translate. Each sentence was awarded points according to its position in the test and thus its difficulty. It was determined that the test would be used to find the largest group of individuals with a similar level of English ability. This group was made up of members that had a basic command of English; these individuals were asked to participate in the experiment.

COMPUTER EXPERIENCE

Results from other research (e.g., Wang, 2005; Gillan et al., 1995) showed that computer experience affects the identification of icons. Therefore, participants were divided into two groups according to their computer experience. The questionnaire

asked participants whether they were computer literate and if so, how often they used a computer and what they used it for. This information was used to create two groups labelled: Group A, participants familiar with computers, and Group B, participants not familiar with computers.

Participants who said that they were not computer literate were placed in Group B. The remainder of the participants were placed into either Group A or Group B according to the responses they gave with respect to how often they used a computer and what they used it for. The latter was asked because it was thought that some participants who only played computer games might state that they were computer literate. This would have placed them in the wrong group for this experiment which investigated computer icons. In practice, however, this did not occur.

The questionnaire used a scale from 1 to 5, where 1 was 'rarely' and 5 was 'often,' to enable participants to indicate how often they used a computer. Participants who returned a value of 4 or more were placed in Group A, the rest were placed in Group B. Both groups had 26 participants.

Constructing the recognition test

MATERIALS

The recognition test used 26 icons shown in an environment that emulated the widely used word processing package Microsoft Word. This method of icon presentation was done by drawing the icons to be used in a computer graphics program and then importing them into Microsoft PowerPoint for presentation on a computer screen. 31 labels were also provided on a sheet of paper.

ICONS

The icons employed in the experiment are shown in Table 1. In the table they are shown categorized according to whether they are *non alphabetic* or *alphabetic* icons. A non alphabetic icon is an icon that either depicts an abstract object (a symbol) or a concrete object (an object that exists in the real world). An alphabetic icon is any icon that shows Chinese characters or English words/letters. The icons were additionally categorized according to whether they were *standard* icons or *cultural* icons. A standard icon is an icon that is found in international versions of software. A cultural icon is an icon that has cultural, national or local features.

The standard icons employed in the experiment were taken from frequently used software packages such as Microsoft Word and CorelDraw. The majority of the

cultural icons were obtained from the Internet (www.gutesbo.se/icons) and (http://members.tripod.com/iconweaver/downt.htm) as well as a journal article (Ito and Nakakoji, 1996); the author designed the remainder.

When designing a cultural icon the author employed, as closely as possible, the principles used in the corresponding standard icon. For example the standard (Microsoft) icon for *bold* is the letter 'B,' an abbreviation of the word 'bold.' Additionally the icon shows the letter 'B' in a bold typeface. The author thus abbreviated the equivalent Chinese word for bold from 粗體 (bold body) to 粗 (bold) and wrote it in a bold typeface. It should be noted that the icon *spelling & grammar*

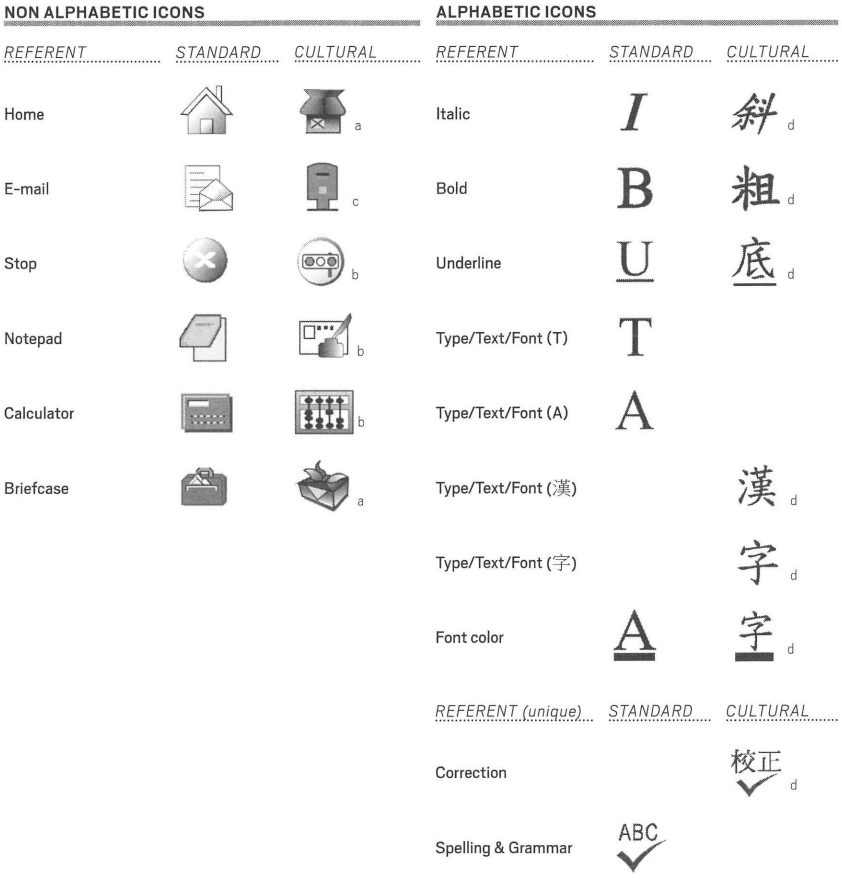

Table 1: The icons shown in this experiment

NOTES: **a** Icons taken from Ito and Nakakoji, 1996, p.111. **b** Icons taken from www.gutesbo.se/icons (The cultural *notepad* icon was adapted for the experiment. The original icon showed the icon's referent written in Chinese in addition to the image elements). **c** Icons taken from http://members.tripod.com/iconweaver/downt.htm. **d** Icons designed by the author of this experiment

did not have a cultural equivalent as spelling does not exist in Chinese. The closest function to spelling and grammar in Chinese is called 'correction,' and therefore an icon called *correction* was used in the experiment.

LABELS

This experiment uses the term label to refer to a possible name for an icon. A label can be either a referent (the name given to an icon by its program designer) or a dummy label. In this experiment, the term dummy label refers to a label which is not an icon's referent. Dummy labels were used in the experiment to increase the number of alternative answers a participant could pick from. The labels used in this experiment were written as a list in Chinese (all referents in the list were the names of icons as used in the Chinese language versions of the software packages). The order of the labels on the list was randomized for each participant. In total 31 labels were shown in the experiment, of which 14 were referents and 17 were dummy labels.

PROCEDURE

Prior to the tests, the participants who had never used a computer before were shown Microsoft Word and were given a brief but succinct explanation of what the program was for and how it worked. This was done not to introduce the participant to Microsoft Word *per se* but to give an overview of how computer interface tools enable computer users to carry out tasks.

All the participants taking part in the experiment were then individually shown a mix of cultural and standard icons; this mix consisted of both non alphabetic and alphabetic representations. The icons were shown on a computer screen one after the other in a random order. Participants were asked to match each icon shown with a label from a list of 31 on a sheet of paper. Participants were told that there was no restriction on how often a label could be used and that they should take as much time as they needed to respond to each icon shown. The author recorded the participants' decisions.

Results

RECOGNITION OF STANDARD AND CULTURAL ICONS

Table 2 shows the number of correct labels chosen by each group with respect to standard and cultural icons. A total of 676 icon viewings were performed in the recognition test to each group (26 different icon designs were shown to all of the 26 participants in each group).

STANDARD ICONS	GROUP A Familiar with computers	GROUP B Not familiar with computers
Home	16	7
E-mail	9	7
Stop	20	10
Notepad	19	9
Calculator	7	8
Briefcase	24	9
Italic	24	5
Bold	23	5
Underline	24	5
Type/Text/Font (T)	11	5
Type/Text/Font (A)	14	4
Font color	14	3
Spelling & Grammar	17	4
Total correct for each group	222	81
Total across Groups A and B	*303*	

CULTURAL ICONS	GROUP A Familiar with computers	GROUP B Not familiar with computers
Home	9	6
E-mail	22	12
Stop	5	7
Notepad	5	7
Calculator	21	15
Briefcase	6	5
Italic	24	20
Bold	24	20
Underline	24	18
Type/Text/Font (漢)	17	15
Type/Text/Font (字)	24	18
Font color	7	11
Correction	22	19
Total correct for each group	210	173
Total across Groups A and B	*383*	

Table 2: The number of correct labels chosen for each icon. Each group consisted of 26 participants.

Combining the results of both participant groups, the total number of correct labels chosen for the standard icons shown in the icon recognition test was 303, compared with 383 for the cultural icons (*see table 2*). In other words, Taiwanese computer users recognized cultural icons better than standard icons ($\chi^2 = 9.33$, 1df, $p < 0.05$).

	GROUP A Familiar with computers	GROUP B Not familiar with computers
Standard icons	222	81
Cultural icons	210	173
All icons	432	254

Table 3: The number of correct labels chosen with respect to icon taxonomy and group.

Comparing the number of correct labels chosen for standard icons with cultural icons across the two groups shows that there is a different pattern ($\chi^2 = 24.66$, 1df, $p < 0.05$; *see table 3*).

When Groups A and B are looked at separately, the results show that participants familiar with computers (Group A) selected a similar number of correct labels

for standard and cultural icons (222 and 210 in *table 3*). The reason for this was probably that the participants in Group A based their decisions on their knowledge of word processing packages and/or other computer packages and knowing what sorts of commands are found in programs, could figure out what the cultural icons represented even though they had most likely never seen most, if any, of the cultural icons before.

This result differed from those participants not familiar with computers (Group B) who found cultural icons easier to recognize than standard icons ($\chi^2 = 33.32$, 1df, $p < 0.05$; *see table 3*). In their case, the participants not having much computer experience almost certainly did not know what the majority of the icons shown were for and thus based their decisions on what they saw and on what tasks they thought computers might be able to perform. Thus it seems that a cultural representation gave Group B a better indication what an icon was for, the probable reason being that the representations were closer portrayals of the participant's world and thus conveyed their meaning more effectively.

To summarize, the results seem to indicate that cultural icons assisted Group B in the task of icon recognition. The same icons however, did not seem to further assist nor hinder Group A.

RECOGNITION OF NON ALPHABETIC AND ALPHABETIC ICONS

Table 4 shows the number of correct labels chosen by each group for an icon type. It should be noted that the table does not include data that relates to the *correction* and *spelling & grammar* icons as, due to the language differences that exist between Chinese and English, neither icon can have a cultural/standard equivalent as previously noted.

	GROUP A Familiar with computers	**GROUP B** Not familiar with computers
NON ALPHABETIC ICONS		
Standard icons	95	50
Cultural icons	68	52
Total	163	102
ALPHABETIC ICONS		
Standard icons	110	27
Cultural icons	120	102
Total	230	129

Table 4: The number of correct labels chosen for each icon type (excluding the number of correct labels chosen for the *correction* and *spelling & grammar* icons).

Excluding the *correction* and *spelling & grammar* icons, both groups were shown 6 non alphabetic *standard* icons, 6 non alphabetic *cultural* icons, 6 alphabetic *standard* icons, and 6 alphabetic *cultural* icons. Each group consisted of 26 participants. Thus the subtotals shown in Table 4 are all out of 156 (6 icons × 26 participants = 156) and the totals are all out of 312 (6 icons × 2 icon types, i.e., standard and cultural × 26 participants = 312).

The following section looks at Groups A and B separately. The results in Table 4 show that Group A recognized non alphabetic *standard* icons better than non alphabetic *cultural* icons ($\chi^2 = 4.47$, 1df, $p < 0.05$). The group recognized alphabetic *standard* icons and alphabetic *cultural* icons with equal ease ($\chi^2 = 0.43$, 1df, $p > 0.05$; *see table 4*).

The reason that Group A recognized non alphabetic *standard* icons better than non alphabetic *cultural* icons was probably because they had used the former but not the latter. However, although Group A had probably used alphabetic *standard* icons before, but not alphabetic *cultural* icons, it is likely that participants could read the Chinese characters shown on the latter and thus understand their functions.

There was no difference in the ability of Group B to recognize non alphabetic *standard* icons compared to non alphabetic *cultural* icons. ($\chi^2 = 0.04$, 1df, $p > 0.05$; *see table 4*). However, a difference in the ability to recognize icons was found when the same participants were shown the alphabetic icons. It was found that the participants were much more likely to recognize alphabetic *cultural* icons than alphabetic *standard* icons ($\chi^2 = 43.6$, 1df, $p < 0.05$; *see table 4*). The reasons for this could be that Group B, due to a lack of computer experience and only a basic command of English, could only make guesses as to what each alphabetic *standard* icon was for. In contrast, when shown an alphabetic *cultural* icon, participants in Group B could, in most cases, understand the Chinese abbreviation shown on the icon and hence simply pick out the icon's referent from the list of labels.

To summarize, the results seem to indicate that participants familiar with computers (Group A) recognized non alphabetic *standard* icons better than non alphabetic *cultural* icons, and alphabetic *standard* icons and alphabetic *cultural* icons with equal ease. However, a different pattern was found with participants not familiar with computers (Group B). They recognized non alphabetic *standard* icons and non alphabetic *cultural* icons with equal ease, and alphabetic *cultural* icons better than alphabetic *standard* icons.

INCORRECT LABELS

In this section, incorrect labels chosen are analyzed to ascertain why they were chosen by participants and to gain an understanding of what types of icon representations invite confusion.

Full records of the correct and incorrect labels chosen by participants with respect to the icons shown in this experiment are given later.

CONFUSION ANALYSIS

Table 5 shows for each group (Group A and B) and icon type (non alphabetic *standard*, non alphabetic *cultural*, alphabetic *standard*, and alphabetic *cultural*) the icons most frequently given an incorrect label and the number of participants who gave these icons an incorrect label.

	GROUP A Familiar with computers			GROUP B Not familiar with computers		
	ICON & REFERENT		*# OF ERRORS*	*ICON & REFERENT*		*# OF ERRORS*
STANDARD ICONS						
Non alphabetic icons		Calculator	19		Home	19
					E-mail	19
Alphabetic icons		Type/Text/Font (T)	15		Font Color	23
CULTURAL ICONS						
Non alphabetic icons		Stop	21		Briefcase	21
		Notepad	21			
Alphabetic icons		Font Color	19		Font color	15

Table 5: The icons most frequently given an incorrect label and the number of participants who chose an incorrect label for these icons according to icon type and group. The total number of responses given by each group to each icon was 26.

Standard icons

NON ALPHABETIC ICONS IN GROUP A

The non alphabetic *standard* icon that was given the most number of incorrect labels was the *calculator* icon; it was given an incorrect label by 19 participants. Interestingly it was also the standard icon given the most number of different labels by Group A (*see tables 7.1–7.4*). The icon was repeatedly given the incorrect label

'mathematics.' In fact more participants of Group A gave the icon the incorrect label 'mathematics' than the correct label 'calculator.' It seems likely that these participants saw that the icon's imagery was that of a calculator but interpreted the image too indirectly. Some participants however did seem to have been confused by the icon's imagery. A number of participants offered the label 'address book,' which suggests that they may have mistaken the image of the calculator for that of an electronic personal organizer.

NON ALPHABETIC IN GROUP B

The non alphabetic *standard* icons that were given the most number of incorrect labels by Group B were the *home* icon and the *e-mail* icon; both icons were given an incorrect label by 19 participants. The *home* icon was often given the label 'address book.' This confusion probably happened because the participants, having little (or no) computer experience, were unaware of the existence or the concept of the *home* icon and thus linked the image of the house to something associated with places of residence, such as an address book.

The *e-mail* icon seems to have brought confusion to participants not familiar with computers, perhaps because its imagery was not direct enough. Participants generally recognized the images for what they were (a letter and an envelope), but failed to make the link between the images and e-mail. The most frequent label given by participants not familiar with computers to the e-mail icon was 'write a letter.'

ALPHABETIC ICONS IN GROUP A

The alphabetic *standard* icon most frequently given an incorrect label was the *type/text/font (T)* icon; it was given an incorrect label by 15 participants. It was also the alphabetic *standard* icon that was given the same incorrect label the most number of times by participants familiar with computers; 'a letter T' was given by 9 participants. The *type/text/font (A)* icon was also given an incorrect label a similar amount of times by participants familiar with computers; 8 participants gave the icon the incorrect label 'a letter A.' The reason for this mislabelling was probably due to the icons being less direct. Unlike the other alphabetic *standard* icons shown in the tests, the two *type/text/font* icons did not indicate what would occur if used. The *bold* icon, for example, illustrated what would occur by showing a letter in a bold typeface and the *italic* icon illustrated what would occur by showing a letter in an italic typeface.

Another alphabetic *standard* icon that was mislabelled repeatedly was the *font color* icon (*see table 7.1*). The icon was given the incorrect label 'underline' by 7 participants. The most likely reason for the confusion is that the *font color* icon,

like the *underline* icon, showed a line under an English letter (the *underline* icon did however show a thinner line). It is possible however that less confusion may have occurred if the line shown in the *font* icon had been multicolored in the tests.

ALPHABETIC ICONS IN GROUP B

Font color was the alphabetic *standard* icon that was most frequently given an incorrect label by participants not familiar with computers in the recognition test; 23 participants gave the icon an incorrect label. The fact that the *font color* icon used the same, or similar, image elements as other alphabetic icons (an English letter and an underline), although typically employed for a different purpose, seemed to invite confusion. Nearly eight times as many participants not familiar with computers returned an incorrect label for the standard *font color* icon, as those that returned the correct label. The label 'a letter A' was the most frequent incorrect label given to the icon by the group (*see table 7.2*).

A technique frequently used by Group B in the recognition test was to choose the label that described, in literal terms, what the alphabetic *standard* icon being displayed showed. For example the label 'a letter I' was given to the *italic* icon by over a third of the participants of Group B and the labels a 'capital letter' and 'an English letter' were given by the group to each alphabetic *standard* icon shown in the tests (*see table 7.2*).

Cultural icons

NON ALPHABETIC ICONS IN GROUP A

The two non alphabetic *cultural* icons most frequently given incorrect labels by participants familiar with computers were the *stop* icon and the *notepad* icon; both icons were given incorrect labels by 21 participants.

Most participants gave the *stop* icon, which displayed a picture of a traffic light, the label *font color*. One possible reason for this might be that the three colors used to depict the lights of the traffic light (red, amber and green) caused participants to believe that the icon had something to do with color. This belief may have been supported by the fact that the traffic light was portrayed with all three lights illuminated equally and thus led participants to reason that the image was not trying to communicate any of the conventional messages that a traffic light conveys (such as stop). Furthermore the fact that a traffic light performs its function by changing color might have led participants to believe that the icon had something

to do with color change. It could also be possible that some participants did not recognize the image of the traffic light as a traffic light but instead saw it as an artist's palette, a box of watercolor paints or simply as a depiction of several colors.

The *notepad* icon, which depicts a fountain pen, a pot of ink and an envelope seemed to cause confusion due to the fact that the icon used imagery that was too indirect. It is likely, due to the fact that the most frequently given incorrect label to the icon was 'write a letter,' that participants familiar with computers recognized the image elements for what they were, but failed to make the link between the images and the intended communication.

The non alphabetic *cultural* icon *home*, which depicted a traditional Taiwanese/Chinese thatched house, was given the incorrect label 'history' by participants of Group A nearly as many times as it was given its correct label (*see table 7.3*). This probably occurred because participants focused on the age of the house depicted rather than the house itself. The majority of houses in Taiwan are modern tiled buildings as depicted in the standard *home* icon; interestingly the standard icon for *home* was never incorrectly given this label. This suggests that the icon's antiquated imagery misled participants in Group A rather than aided understanding.

NON ALPHABETIC ICONS IN GROUP B

The *briefcase* icon was the most mislabelled non alphabetic *cultural* icon by participants not familiar with computers; 21 participants gave the icon an incorrect label (*see table 5*). (In fact the icon was also the third most mislabelled non alphabetic *cultural* icon by participants familiar with computers.) The most frequent incorrect label given to the icon by participants not familiar with computers was 'document,' 8 participants gave the icon this label (*see table 7.4*). Perhaps the reason for the scale of the mislabelling was because the imagery used for *briefcase* was not very clear. The imagery showed a traditional Taiwanese/Chinese package, which was probably too ambiguous to carry the intended message. Consequently, the icon received an array of incorrect labels as participants guessed what the intended communication was.

The concept behind the *briefcase* icon however is that of a method of conveniently managing and packaging files for travel that are usually held on a desktop computer. Files needed on a journey are placed in a folder called a 'briefcase' and copied on to a portable data storage device. This 'briefcase' is then transferred usually to a laptop. On return the updated files in the briefcase folder are then used to update the original desktop files. It could therefore be considered that the metaphor, and hence the correct label, a 'briefcase' was overly suggestive of the sort of image that should be portrayed by the icon. For example if the 'briefcase' icon had been called 'my travel bag' or 'my

package of files' perhaps the icon depicting a Taiwanese/Chinese package would have been given more correct labels than it did in the recognition test.

ALPHABETIC ICONS IN GROUPS A AND B

The *font color* icon was the alphabetic *cultural* icon given the most number of incorrect labels by both Group A and Group B; 19 participants in Group A and 15 participants in Group B gave the icon an incorrect label (*see table 5*). The icon was also given the highest number of different incorrect labels. A third of participants of Group A and nearly a third of participants of Group B mislabelled the *font color* icon as *type/text/font (字)*. It is likely that this occurred because the *font color* icon showed the Chinese character '字' and on the list of labels given to each participant both the 'font color' label and the 'text/type/font' label showed the Chinese character '字'. The label for *font color* was '字型色彩' (which means 'font color' in English) and the label for *type/text/font* was '字型' (which means 'font' in English).

In contrast to the above, the alphabetic *cultural* icons for *bold, underline, italic* and *type/text/font (字)* were rarely given an incorrect label by Group A (*see table 7.3*). Interestingly, no participants in the tests gave the label 'italic' to any other cultural icon apart from the cultural *italic* icon. This most probably occurred because none of the cultural icons shown, except the cultural *italic* icon, showed an italic letter. The label was however given to other standard icons possibly because participants were unfamiliar with what italic English letters look like.

Looking at the results for the alphabetic icons as a whole (i.e., the results for Group A and B combined) alphabetic *standard* icons were mislabelled almost twice as many times as alphabetic *cultural* icons (*see table 6*).

	GROUP A Familiar with computers	**GROUP B** Not familiar with computers	**TOTAL**
Alphabetic standard icons	46	129	175
Alphabetic cultural icons	36	54	90

Table 6: The number of incorrect labels chosen with respect to alphabetic standard icons and alphabetic cultural icons in both groups.

Discussion and conclusion

The purpose of this experiment was to investigate whether Taiwanese computer users better understand cultural or standard imagery and whether they better understand cultural or standard text representations.

Participants were divided into two groups (Group A and Group B) according to their computer experience. This was done as previous research findings suggest that computer experience affects the identification of icons (Wang, 2005; Gillan et al., 1995). The results of this experiment support these research findings.

The results reveal that overall Taiwanese computer users recognized cultural icons more accurately than standard icons. However when participants familiar with computers (Group A) and participants not familiar with computers (Group B) are looked at separately, a difference exists. Group A recognized standard and cultural icons with equal ease, whereas Group B recognized cultural icons more easily than standard icons.

Looking at the imagery shown in the icons used in this experiment, the results reveal that in general Taiwanese computer users recognized standard imagery more easily than cultural imagery. However when participants familiar with computers (Group A) and participants not familiar with computers (Group B) are looked at separately, a difference exists. Group A recognized standard imagery more easily than cultural imagery, most likely because they were familiar with the images used, whereas Group B recognized standard and cultural imagery with equal ease. The results also show that some non alphabetic *cultural* icons were significantly easier to recognize than their standard counterparts. For example the cultural *calculator* icon was given three times as many correct labels than its standard counterpart by Group A, and nearly twice as many correct labels than its standard counterpart by Group B.

Therefore in answer to the question: "Do Taiwanese computer users find icons that use cultural imagery more appropriate than icons that use standard imagery?" the results suggest that only certain cultural images bring benefits.

Looking at the text shown in the icons used in this experiment, the results show that among participants familiar with computers there was no significant difference in their ability to recognize alphabetic *standard* icons compared to alphabetic *cultural* icons. However, this was not the situation for participants not familiar with computers. They recognized alphabetic *cultural* icons more easily than alphabetic *standard* icons.

Therefore in answer to the question: "Do Taiwanese computer users find icons that use Chinese characters more appropriate than icons that use English letters/words?" the results show that overall Taiwanese computer users find icons that use Chinese characters more appropriate than icons that use English letters/words.

The results suggest that Group B (participants not familiar with computers) often mislabeled icons because they were unaware of commands used in computer programs. Participants of Group B in general linked the images portrayed by non alphabetic icons with real-life activities/objects and the letters shown by alphabetic *standard* icons with letters from the English alphabet.

These results point to a number of design considerations:

- → When designing interfaces for Taiwanese computer users, designers should not only address issues that relate to language, but also those that relate to the cultural interpretation of images. This suggestion is supported by Lin (1999).
- → Where possible, alphabetic icons for Taiwanese computer users should use both typographic cues and Chinese characters.
- → Objects that have a distinctive shape, especially those defined by their function, should be used in preference to objects that have an indistinct shape. (In the experiment the cultural *calculator* icon, which showed an abacus, fared extremely well. Conversely the standard *calculator* icon, which showed the less distinct form of an electronic calculator, fared badly.)

Many research studies look at culture and interface design. In many of these studies Taiwanese computer users are often grouped with other nationalities under the title 'Asian' (e.g., Evers and Day, 1997; Rau and Liang, 2003). However this approach can be potentially misleading as the findings are general and can have little bearing on what would be found if nations were looked at separately. Furthermore, it should not be assumed that guidelines and design considerations developed for one nation are relevant to another just because their cultures have similarities.

The final Tables 7.1–7.4 contain a full record of the recognition test for this experiment. These tables are arranged according to participant group (Group A and Group B) and icon type (standard and cultural). The tables show the labels provided, the labels chosen and the number of times they were chosen.

For each table, the labels provided for participants are listed in the left column. Labels 1 to 6 are non alphabetic icon labels, labels 7 to 12 are alphabetic icon labels and labels 13 and 14 are unique icon labels (either *spelling & grammar* or *correction*). Labels above the horizontal thick black line (i.e., labels 1 to 13) are referent labels. Labels below the horizontal thick black line (i.e., labels 14 to 31) are dummy labels.

The icons shown to participants form the headings of each column. The number of correct matches for an icon is the value in the cell which corresponds to the icon and its referent. For clarity this cell is shown in grey. All other entries in the icon column, except for the total at the bottom, are confusions.

For example, Table 7.3 shows that the cultural *calculator* icon (column 5) was given the correct label by 21 participants (indicated by grey), one participant chose the incorrect label 'briefcase' for this icon, and two participants chose the label 'calculator' for the cultural *briefcase* icon.

REFERENT							T	A	B	*I*	A	U	ABC
1. Home	16												
2. Stop		20											
3. Briefcase			24										
4. E-mail	1			9									
5. Calculator					7								
6. Notepad					2	19							
7. Type/Text/Font (T)							11						
8. Type/Text/Font (A)								14			4		
9. Bold									23				
10. Italic										24	1		
11. Font color							2	1			14		1
12. Underline										1	7	24	
13. Spelling & Grammar													17
14. Correction													
15. Mathematics					9								
16. Document				1	2	2							
17. A letter A								8					
18. A letter T							9						
19. A letter U													3
20. A letter B									2				3
21. A letter I													
22. A letter X													
23. A number 1													
24. Change case									1				2
25. Delete		6					1						
26. History			1	1		2				1		1	
27. Translate English to Chinese													
28. An English letter													
29. Address book	7		1	1	5	3							
30. Write a letter	2			14	1								
31. Capital letter							3	3				1	
Total number of incorrect labels	10	6	2	17	19	7	15	12	3	2	12	2	9

Table 7.1: The number of correct and incorrect labels chosen by Group A relating to standard icons.

REFERENT							T	A	B	*I*	A	U	ABC
1. Home	7												
2. Stop		10											
3. Briefcase	1		9			1							
4. E-mail	3			7		1							
5. Calculator			10		8								
6. Notepad	1				6	9							
7. Type/Text/Font (T)							5					2	2
8. Type/Text/Font (A)								4			4	2	2
9. Bold									5				
10. Italic										5			1
11. Font color							1	3			3	2	
12. Underline											4	5	
13. Spelling & Grammar								1					4
14. Correction													4
15. Mathematics			2	2	5	3							
16. Document			2	2	3	6							
17. A letter A								11			9		3
18. A letter T							12						
19. A letter U												9	
20. A letter B									13				
21. A letter I										12			
22. A letter X		5											
23. A number 1										3			
24. Change case							2	1	2		1	2	4
25. Delete		11											
26. History			1										
27. Translate English to Chinese									2	1	2		3
28. An English letter							2	2	2	2	1	2	1
29. Address book	12		2	3	4	5		1	1	1			
30. Write a letter	2			12									
31. Capital letter						1	4	3	1	2	2	2	2
Total number of incorrect labels	19	16	17	19	18	17	21	22	21	21	23	21	22

Table 7.2: The number of correct and incorrect labels chosen by Group B relating to standard icons.

REFERENT							漢	字	粗	斜	字	底	校正
1. Home	9												
2. Stop		5											
3. Briefcase	1		6		1	1							
4. E-mail			4	22		3							
5. Calculator			2		21								
6. Notepad			1			5	1						
7. Type/Text/Font (T)						1	17		1	1	2	1	
8. Type/Text/Font (A)								24	1		10		
9. Bold							2		24				
10. Italic										24			
11. Font color	1	14	1			1					7		
12. Underline											5	24	
13. Spelling & Grammar		2	1										22
14. Correction		2	2				1						3
15. Mathematics		1	2		4								
16. Document			3			1							
17. A letter A													
18. A letter T													
19. A letter U													
20. A letter B													
21. A letter I													
22. A letter X													
23. A number 1													
24. Change case													1
25. Delete													
26. History	8	2	3			1							
27. Translate English to Chinese				1			5	1			1		
28. An English letter													
29. Address book	6		1	1		2							
30. Write a letter	1			2		11		1		1	1		
31. Capital letter												1	
Total number of incorrect labels	17	21	20	4	5	21	9	2	2	2	19	2	4

Table 7.3: The number of correct and incorrect labels chosen by Group A relating to cultural icons.

REFERENT							漢	字	粗	斜	字	底	校正
1. Home	6					2							
2. Stop		7											
3. Briefcase	2		5		2								
4. E-mail			4	12		4							
5. Calculator					15								
6. Notepad			2			7	1						
7. Type/Text/Font (T)	1	3					15		2			2	1
8. Type/Text/Font (A)								18	3	2	8	4	
9. Bold									20				
10. Italic										20			
11. Font color		12					1				11		
12. Underline										2	1	18	
13. Spelling & Grammar							1	3			2		19
14. Correction		3											1
15. Mathematics					7								
16. Document	2		8			1	1						
17. A letter A													
18. A letter T													
19. A letter U													
20. A letter B													
21. A letter I													
22. A letter X													
23. A number 1													
24. Change case											1		1
25. Delete			1										
26. History			1		2	1							1
27. Translate English to Chinese							6	5		1	1	1	2
28. An English letter													
29. Address book	15		1	7									
30. Write a letter		1	4	7		11					1		
31. Capital letter							1		1	1	1	1	1
Total number of incorrect labels	20	19	21	14	11	19	11	8	6	6	15	8	7

Table 7.4: The number of correct and incorrect labels chosen by Group B relating to cultural icons.

References

Blankenberger, S. and K. Hahn. 1991. Effects of icon design on Human-Computer Interaction. *International Journal of Man-machine Studies*, 35.3, 363–377.

Bourges-Waldegg, P. and S.A. Scrivener. 1998. Meaning, the central issue in cross-cultural HCI design. *Interacting with computers*, 9.3, 287–309.

Bradley, R.K. 2001. Design and the cultural significance in international communication. In Stephanidis, C., editor. Universal access in HCI: towards an information society for all. The 9th International conference on Human-Computer Interaction symposium on human interface. London: Lawrence Erlbaum Associates, 466–470.

Choong, Y.Y. and G. Salvendy. 1998. Design of icons for use by Chinese in mainland China. *Interacting with Computers*, 9.4, 417–430.

Evers, V. and D. Day. 1997. The role of culture in interface acceptance. In Ess, C. and F.S. Udweeks, editors. Proceedings CATA'98, Cultural attitudes towards technology and communication. London: Science Museum, 1–11. Also available from: http://www.swi.psy.uva.nl/usr/evers/publications.html (Accessed April 15, 2005).

Fang, X. and P.L.P. Rau. 2003. Culture differences in design of portal sites. *Ergonomics*, 46.1–3, 242–254.

Fernandes, T. 1995. *Global interface design: A guide to designing international user interfaces*. Boston, MA: Academic Press.

Galdo, E.M. 1990. Internationalisation and translation: some guidelines for the design of Human-Computer Interfaces. In Nielson, J., editor. *Designing user interfaces for international use.* Amsterdam: Elsevier, 1–10.

Gillan, D.J., B.S. Fogas, S. Aberasturi and S. Richard. 1995. Cognitive ability and computer experience influence interpretation of computer metaphors. In Proceedings of the Human Factors Society 39th annual meeting, Santa Monica. *The Human Factors Society*, 243–247.

Hoft, N.L. 1996. Developing a cultural model. In Galdo, E.M. and J. Nielsen, editors. *International User Interfaces*. New York, NY: John Wiley & Sons, 41–73.

Horton, W. 1994. The Icon Book. New York, NY: John Wiley & Sons.

Ito, M. and K. Nakakoji. 1996. Impact of culture on user interface design. In Galdo, E.M. and J. Nielsen, editors. *International User Interfaces.* New York, NY: John Wiley & Sons, 105–126.

Kurniawan, S.H., R.S. Goonetilleke and H.M. Shih. 2001. Involving Chinese users in analyzing the effects of languages and modalities on computer icons. In Stephanidis, C., editor. *Universal access in HCI: Towards an information society for all.* (The 9th International conference on Human-Computer Interaction symposium on human interface). London: Lawrence Erlbaum Associates, 491–494.

Lin, R. 1999. Cultural differences in icon recognition. In Bullinger, H.J. and J. Ziegler, editors. *Human-Computer Interaction: Ergonomics and user interfaces.* London: Lawrence Erlbaum Associates, 725–729.

McDougall, S.J.P., M.B. Curry and O. Bruijn. 1998. Understanding what makes icons effective: how subjective ratings can inform design. In Hanson, M.A., editor. *Contemporary Ergonomics*. 1998. London: Taylor & Francis, 285–289.

Moyes, J. and P.W. Jordan. 1993. Icon design and its effect on guessability, learnability, and experienced user performance. In Alty, J.L., D. Diaper and S. Guest, editors. People & computers VIII: Proceedings of HCI '93. Cambridge: Cambridge University Press, 49–59.

Nakakoji, K., 1994. Crossing the cultural boundary. *BYTE*, 19.6, 107–109.

Nolan, P.R. 1989. Designing screen icons: ranking and matching studies. In Proceedings of the Human Factors Society 33rd annual meeting, Santa Monica. *The Human Factors Society*, 380–384.

Onibere, E.A., S. Morgan, E.M. Busang and D. Mpoeleng. 2001. Human-Computer interface design issues for a multi-cultural and multi-lingual English speaking country-Botswana. *Interacting with Computers*, 13.4, 497–512.

Po, T.M. and T.K. Chuan. 1999. Challenges in designing user interfaces for handheld Human-Computer Interaction. In Bullinger, H.J., editor. Human-computer Interaction. Vol. 1, Ergonomics and User Interfaces: Proceedings of HCI International '99, The 8th International Conference On Human-Computer Interaction. London: Lawrence Erlbaum Associates, 808–812.

Preece, J., Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. 1994. *Human-Computer Interaction*. Harlow, UK: Addison-Wesley.

Rau, P.L.P. and S.F.M. Liang. 2003. Internationalization and localization: evaluating and testing a Website for Asian users. *Ergonomics*, 46.1–3, 255–270.

Ray, E. 1994. *User Interface Design*. Upper Saddle River, NJ: Prentice-Hall International.

Sears, A., J.A. Jacko and E.M. Dubach. 2000. International Aspects of World Wide Web Usability and the Role of High-End Graphical Enhancements. *International Journal of Human-Computer Interaction*, 12.2, 241–261.

Stammers, R.B. 1988. Icon interpretation and degree of abstractness-concreteness. In Adams, A.S., R.R. Hall, B.J. McPhee and M.S. Oxenburgh, editors. *Ergonomics International 88*. London: Taylor and Francis, 505–507.

Stammers, R.B. 1990. Judged appropriateness of icons as a predictor of identification performance. In Lovesey, E.J., editor. *Contemporary Ergonomics*. London: Taylor & Francis, 371–376.

Wang, H.F. 2005. Designing appropriate icons for Taiwanese computer users. Ph.D. Thesis. Reading University, U.K.

Zwaga, H.J.G. and R. Easterby. 1984. Developing effective symbols for public information. *Information Design*, 277–297.

Author note

HSIU-FENG WANG is an assistant professor in the Department of Visual Communication Design at Asia University, Taiwan. She read for her PhD in the Department of Typography and Graphic Communication at Reading University, UK. She has interests in graphic icon design, information design and user-centered design.