

The Design of a Cultural Web Browser for Chinese Users

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Abstract. This study investigates the appropriateness and effectiveness of the design of icons for a Chinese web browser. Web browser developments are outlined, together with the future potential growth of Chinese Internet users. The Maxthon browser, designed in Beijing, has emerged as a strong leader so far with 105 million people having downloaded the browser since its launch in 2003. The findings of the study show that the subjects shown icons and text, had higher recognition rates, and had higher satisfaction ratings than the subjects shown only icons. The most easily recognized icons were the Home (93%), Forward (91%), Backward (88%) and Stop (76%). Furthermore, some evidence points to a gender bias in favour of males in terms of recognition rates of icons and females in terms of satisfaction with the overall look and feel of the operating system. Future work is suggested in terms of refining the web browser icons and exploring the usability of colour and browser 3D effects.

Keywords: Web browser; Icon design; Chinese users; Metaphor; GUI

1 Introduction

With the advent of information technology and global networking, graphical user interfaces (GUIs), which include interactive images and animation, have opened a new dimension for visual language and transformed our whole symbolic system into a much more complex one.

A repertoire of computer-generated graphical symbols is not restricted to the desktop of computers but extensively applied to the interface of IT appliances, e.g. The interface of mobile phones display small iconic buttons, which offer complex function directories such as a personal phone book, settings, text and voice messages (Ben 2006).

On the one hand, that brings a great convenience to individual and global communication; on the other hand, it reflects great cultural and linguistic differences in the degree of comprehensibility of an interface. To avoid iconic ambiguity and misinterpretation it seems that standardisation is the solution; however, this will require learning and adaptation. That is to say, numerous cultural-oriented graphical symbols have to be traded for universal standardisation. Therefore, this has inevitably led to a loss of cultural and individual identity.

1.1 Iconisation trends

Icons have increasingly been used for the communication of information or instructions on labels, packaging, in manuals and interfaces. Many such icons have become standardised and carry a silent authority that is rarely questioned (Evamy 2003). The International Standards Organisation is responsible for the standardisation of icons and signs that are applied to product interfaces (ISO 1997; ISO 1998).

Certain disadvantages of the sole use of icons may include usability problems, metaphor breakdown, direct manipulation, and user difficulties in maintaining a suitable directory system. The major arguments are that standardisation may not be the only permanent solution, and the inconsistent design of visual representations across different media has complicated interface interaction and navigation. On the other hand, the advantages of using icons in interface design over text, is generally accepted.

1.2 Advantages of visual representations

Research exists to show that icons and symbols are more efficient and effective in communications. For example, Walker et al. (1965) stated that symbols and signs are more easily interpreted and learned, because of their greater perceptual simplicity. Rogers and Osborne (1987) found that people tend to crystallise abstract concepts in terms of concrete symbols that can be visually represented. Therefore graphic symbols are often considered as a potential universal means of communication, which can convey certain types of information more directly and immediately than words (Tzeng, Trung et al. 1990).

1.3 Disadvantages of visual representations

Hutchins, Hollan and Norman (1986) proposed the term “articulatory directness”, that is the relationship between the meanings of expressions and their physical form. If the visual representation is more close to the intended meaning, then the articulatory distance becomes shorter.

Choong and Salvendy (1998) examined the impacts of cultural differences in cognitive abilities between American and Chinese users in terms of their performance

time and 'errors' with three different icon displays, i.e. pictorial icons only, text only and combined modes of both pictorial and textual elements. Their results indicated that it is better to design a combined presentation mode for facilitating better initial performance. Furthermore, American subjects had better verbal ability with alpha-numeric icon displays, whereas Chinese subjects had better visual distinction ability with pictorial icon displays, if both subjects are not provided with combined modes.

Shneiderman (1992) pointed out some problems within direct manipulation. Direct manipulation usually requires graphical representations, which are not suitable for all tasks. Limited screen space leaves valuable information off screen and needs scrolling and multiple actions. Users have to learn the meaning of visual representation (icons) and require more learning time than with a word.

User directory problems

A hierarchical management organisation of icons is supposed to help users manage their daily files and easily trace them. Horton (1990) stated that users prefer a hierarchical to a linear organisation of menus. They make fewer errors in a hierarchical structure because it creates a clearer mental map. In fact, people deal with massive information daily and it requires a good arrangement of their personal files in their system to be able to locate the file that they need. Few people actually achieve this goal.

2. The Development of Web Browsers

Web browsers, such as Netscape Navigator, Mozilla, Konqueror, Microsoft Internet Explorer and Apple's Safari, are software applications which enhance the user's experience of interacting with computers.

The first web browser was the generic WWW (later named Nexus) introduced in December 1990 by Tim Berners-Lee (Wikipedia 2006). Since its inception, there have been at least 29 different web browser packages available, most of which have been free. The most popular of these have been Netscape Navigator (c.1994) and Internet Explorer (85% market share worldwide) (c.1995) for the PC, and Safari (c.2003) for the Mac.

The graphical user interface, including the toolbars, menu bars and scrollbars with which the user is familiar, is applied to all Web browsers. By double-clicking on the iconic buttons on the web desktop, users can surf through web pages, which connect to the URL; HTTP supports the transmission between the web server and web browser, and HTML/XML that displays hypermedia links. In terms of the Web metaphor there are aesthetic similarities between all web browsers, which indicate certain functions on the toolbar such as the Back, Forward, Stop, Refresh and Home icons.

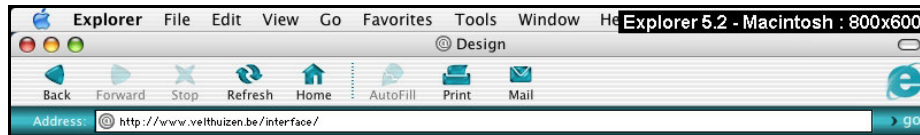


Fig. 1. Internet Explorer web browser interface for the Macintosh Version 5.2.

From the latest Macintosh OS X and Windows XP there appears to be a trend of integrating software and operating system in the evolution of the interface. The *Leopard* interface of the Apple Macintosh operating system and *Vista* interface of the Microsoft Windows XP operating system have some similarities, i.e. the 3D icons which are smooth, translucent, colourful and big, a range of customisation for desktop management and multimedia Internet tools. In particular, the display of the desktop has developed into a browser like-window.

2.1 The Maxthon 2.0 web browser

Frustrated by censorship in search engines, web surfers in China have been turning to a little known company, Maxthon, based in Beijing. So far 105 million people have downloaded the free browser since its launch in 2003. It has been stated that 14% of Chinese users have used the browser and 17% employs it for web searching through Baidu (the largest search engine in China) (Olsen 2006). The reasons for its success are its customizable and innovative features, fast speed and the fact that it is built on top of the IE engine.

The recently published 20th Statistical Survey Report – ‘Internet Development in China’ (July 2007), states that there are 67.10 million computer hosts and 162 million Internet users in China. This only amounts to a penetration rate of 12.3% of the population (CNNIC 2007). Even with this low rate, China is second only to the USA (205 million) in terms of the number of Internet users. The number of Internet users in China has grown by 1720% during the period (2000-2007) (Miniwatts 2007), and if as predicted, China continues to grow at a conservative estimate of 10% per annum, it will overtake the USA in 2010, and approach saturation ($\approx 66\%$ penetration) by 2018. At this point China will have 900 million Internet users.

According to the July 2006 report from the Taiwanese Network Information Centre there was approximately 15 million Internet users (68% penetration) in Taiwan. 81% of the population uses ADSL to access the Internet and the most frequent use was for Web browsing (71%) (TWNIC 2006).

However, most of the existing web browsers have been developed in Europe and the USA, and not all of them could support Chinese text (Simplified and Traditional) (Wikipedia 2006). Brandon (2001) has suggested that a majority of Internet users primarily speak languages other than English, Sun (2001) has suggested that this could be as high as 70%. It has also been reported that 75% of users in China and Korea prefer content in their own languages (Ferranti 1999).

3. What Makes a Good Web Browser Icon?

Over the years there have been many suggestions and design guidelines for what constitutes good usability (Ferranti 1999).

However few researchers have focussed on the subject of what would make a good web icon (Horton 1994; Fernandes 1995).

Howell and Fuchs (1968) were one of the first to put forward the criteria for correct recognition of symbols. These being grouped into categories: *identifiable* (60-100%), *medium* (30-60%) and *vague* (0-30%). According to the International Standards Organisation (ISO) icon recognition rates should be at least 67% to achieve acceptability (Thatcher 2006).

Lindberg and Nasanen (2003) state that processing of visual information involves locating the correct piece of information, recognising the physical object and understanding what it means in the current context of use. According to Barr et al (2002), who used the semiotic approach to compare two sets of icons for the same functions within the Mozilla and IE web browsers:

“...most of the icons utilised by the two browsers are symbolic signs. This is likely because there is no dominant metaphor for the Internet, and thus no real-world phenomenon to create iconic and indexical icon forms.”

Research conducted in Finland by Lindberg, et al. (2006) have investigated the role of aging in icon recognition stating that search performance deteriorates with age and the size of icons. Their results show that search performance slows with age when calculated across all three levels of inter-icon spacing ($\chi^2(4) = 14.904, p < .05$) and icon size ($\chi^2(4) = 15.674, p < .05$). However, individual variability in search performance was very high within all age groups. The study suggests that icons used in graphical user interfaces should be at least about 1 degree in size (about 0.7 cm at a viewing distance of 40 cm) for the majority of users to be able to perform their computerised tasks with relative ease. Also, the inter-icon spacing should be moderate, preferably about the same as the icon size. Ideally user interfaces should be adaptable to individual user needs and preferences.

Sung and Hu (2006) investigated the use of three icon variables. In their research an icon has texture, color, and text attributes. Texture was represented by three statistical textural properties, namely, coarseness, contrast, and directionality. For text, the vector space model was used. For color, a representation based on a modified color histogram method which is less storage-intensive was proposed. Interestingly for our research into natural symbols and icons, they state that the recall-precision measure was almost perfect for a ‘plant’ icon when tested for effectiveness against animals, common objects and other symbols.

The growth and importance of worldwide e-commerce, especially in the far east, is further driving the need for cross-cultural research into iconic interfaces (Fang 2003; De Angeli 2006; Li 2006). The Chinese speaking nations utilize characters originating from symbolic references and so are 'pre-programmed' to interpret iconic representation in place of meaning.

4. Method

The test website consisted of the design of a Chinese Operating System (COS) environment, developed to act as an alternative to the desktop metaphor, involving the 'Garden' as an overarching metaphor. The COS was designed to be culturally rich, and have both visual and aural stimuli in the same way that current computer games are being developed (Shneiderman 2004).

The Culture-Centred Design (CCD) Garden is a simulated and simplified OS environment incorporating a set of culturalised representations and Web browser aimed at facilitating learners' spatial reasoning. The CCD methodology includes four iterative stages i.e. analysis of the target culture, design implementation, iterative testing and evaluation, and re-formulation of design, and was implemented through the findings and experience of the design of a COS (Shen 2006). The aim of designing a COS was not to provide a total solution, but to explore a cohesive alternative to the 'Desktop' metaphor, involving the 'Garden' as an overarching metaphor.

The study investigated the recognition and acceptance of intuitive icons for the web browser element of the Garden COS. The testing involved online evaluation, screen recording and user feedback.

4.1 Participants

The study was conducted in Taiwan during June 2006 and involved 20 voluntary participants (60% male, 40% female) who were recruited from 1st and 2nd year BA Multimedia Design students studying at the National Formosa University. The ages ranged from 18-31 yrs, the mean age being 20.8 years ($SD=2.8$). Participants were not paid or given extra credit for joining this experiment. All students were experienced computer users of PC's with an average user experience of 9.4 years ($SD=3.7$).

4.2 Tasks

The testing was conducted in two phases. Phase I involved a pre-experiment (online) questionnaire to determine the participant's recognition of a series of eight Chinese localised web browser icons in monochrome (see Fig. 2).



Fig. 2. Chinese web browser icons.

The choice of monochrome relates to the work of Horton (1994) who suggests that icons should first be made in B&W, and that colour be added to make them work better.

Phase II consisted of dividing the participants into two groups A and B. Group A consisted of 7 males and 3 females (the imbalance in this group, whereas not desirable, was purely as a result of participant arrival), whereas group B consisted of 5 males and 5 females. Group A were given the task of experiencing the Garden COS (including browser) icons without any text labels, for 3-5 min. Group B were given the task of experiencing the Garden COS (including browser) icons with text labels, for 3-5 min. Both groups were then asked to perform various tasks within the COS and browser 'Favourites' environment, which included creating new folders and files.

Both of these questionnaires are preliminary in nature and will be developed further as and when more robust sample sizes can be utilized.

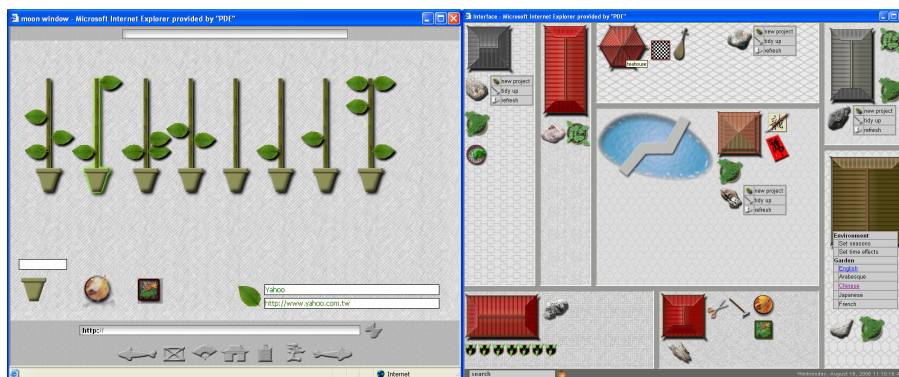


Fig. 3. Views of the File Manager and Chinese Operating System Windows.

4.3 Experiment rationale and hypotheses

The rationale behind the experimental tasks listed in 4.2, were derived from various research hypotheses and findings (Horton 1994; Choong and Salvendy 1998; Hackos and Redish 1998; Goonetilleke 2001).

In brief, the evaluation sought to test out three hypotheses:

- H1 - The new web browser icons are easily recognizable and associated with their functions.
- H2 - There will be a difference in user recognition and satisfaction between groups shown icons and those shown icons with text – the latter group will perform better.
- H3 - There will be no difference between the genders in each of the groups.

5. Results and Discussion

With reference to the results and analysis of the pre-experiment questionnaire it can be stated that four of the new web browser icons were easily recognised and associated with their correct functions (as per Howell’s criteria). The Home icon had the highest recognition rate (93%), followed closely by the Forward icon with 91%, the Backward icon with 88% and the Stop icon with 76% (identifiable).

Two icons were partially recognised (Medium to Low – see Section 3); these were the Search icon with 31%, and the Go/Visit icon with 29%. The last two icons were not well recognised at all (Vague), these being the Refresh icon with 19% and finally the Favourite icon with only 12%.

In general terms, Group B (icons and text) performed better than Group A (icons only) by 8% points, thus partially confirming hypothesis H2. It was also interesting to note that in both groups the male participants outperformed the female participants by 2% points, thus hypothesis H3 was disproved (we note however, the uneven gender balance in Group A and small sample size). In summary, hypothesis H1 was not confirmed, with only 50% of the icons being clearly identified by Group A (icons only).

Table I – Results and analysis of pre-experiment questionnaire (Q1-8).

Group	(%)		Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	Mean
A	60	Male	43%	71%	29%	88%	71%	14%	43%	57%	52%
		Female	33%	100%	0%	100%	100%	0%	0%	67%	50%
		Mean	38%	86%	14%	93%	86%	7%	21%	62%	
B	50	Male	20%	80%	20%	80%	100%	40%	40%	100%	60%
		Female	20%	100%	0%	100%	100%	20%	40%	80%	58%
		Mean	20%	90%	10%	90%	100%	30%	40%	90%	
		Overall Mean	29%	88%	12%	91%	93%	19%	31%	76%	

With reference to the main questionnaire, the first two questions referred to whether the participants were familiar with a famous Chinese fable about a frog in a well (metaphor for knowledge acquisition in Chinese culture), and whether they thought that this visual representation was appropriate for starting the web browser. All the participants were familiar with the fable, however, there was mixed agreement as to whether the use of this visual representation was appropriate.

The answers to the following eight questions were based on the five point Likert Scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree),

and related to whether the participants agreed that the icons were representative of the functions. In this context, overall the participants agreed (mean ≈ 4) with the icons for Back, Forward, Home and Stop. This was consistent with the answers for the pre-experiment questionnaire. The participants were neutral regarding the Go/Visit icon (mean 3.14), and broadly neutral regarding the Search, Refresh and Favourite icons (mean 2.69). It is also interesting to note that overall the male participants from Groups A and B ($SD=0.84$) had much higher mean standard deviations than the female participants from Groups A and B ($SD=0.50$), thus indicating their greater levels of variation between participants. The answers to questions 6 & 8 produced the highest mean standard deviations (0.85 & 0.81).

Overall, both groups could be classified as having a preference between neutral and agree, with the females (mean 3.55) slightly higher than the males (mean 3.37).

Table 2 – Satisfaction of user groups during the main evaluation (Q.1-10).

Grp	Q.1	Q.2	Q.3	SD	Q.4	SD	Q.5	SD	Q.6	SD	Q.7	SD	Q.8	SD	Q.9	SD	Q.10	SD	Mean	Over. Mean
A-M	100%	43%	3.29	1.03	3.71	1.28	3.00	0.53	3.71	1.28	4.14	0.64	2.86	0.64	2.83	0.90	3.71	0.88	0.90	3.41
A-F	100%	67%	3.67	0.47	4.33	0.47	2.00	0.82	4.33	0.47	4.33	0.47	2.67	0.94	2.67	0.47	4.00	0.00	0.67	3.50
B-M	100%	80%	3.00	0.00	4.00	0.63	3.20	0.40	3.20	1.17	3.60	1.36	3.00	0.63	3.00	0.63	3.60	1.36	0.77	3.33
B-F	100%	40%	2.60	0.80	4.60	0.49	1.80	0.75	4.60	0.49	5.00	0.00	2.60	1.02	2.60	0.49	5.00	0.00	0.60	3.60
			Mean	3.14		4.16		2.50		3.96		4.27		2.78		2.78		4.08		
			Σ SD	2.30		2.87		2.50		3.41		2.47		3.23		2.49		2.24		
			Mean	0.58		0.72		0.62		0.85		0.62		0.81		0.62		0.56		
			SD																	

Questions 11 and 12 (multiple parts) related to tasks within the browser favourites section. With regards to Question 11, both groups were able to complete the tasks successfully within a 71-95% range. The result of Question 12 to 12.2 indicated that both groups would prefer to interact with icons and text (89%), followed by icons-only (45%), and then text-only (17%). This supports hypothesis H2, and is in agreement with the results of Choong and Salvendy (1998) and Horton (1994).

The overall satisfaction of the participants was broadly neutral to agree (mean 3.32).

Table 3 – Overall user functionality and satisfaction (Q.11 & Q.12).

Group		Q.11	Q.11.1	Q.11.2	Q.11.3	Q.11.4	Q.12	Q.12.1	Q.12.2	Q.12.3	SD
A	Male	100%	100%	100%	43%	71%	86%	14%	57%	3.29	0.45
	Female	100%	100%	100%	100%	100%	33%	33%	100%	3.00	0.00
	Mean	100%	100%	100%	72%	86%	60%	24%	78%	3.15	
B	Male	80%	80%	80%	80%	100%	20%	20%	100%	3.40	1.02
	Female	100%	100%	100%	60%	60%	40%	0%	100%	3.60	1.36
	Mean	90%	90%	90%	70%	80%	30%	10%	100%	3.5	
	Overall Mean	95%	95%	95%	71%	83%	45%	17%	89%	3.32	0.71

Question 13 and 14 enabled the participants to give written feedback on the overall advantages and disadvantages of the Chinese web browser interface design in terms of usability. The written feedback for Question 13 was very positive with the use of words such as creative and meaningful from Group A and words such as interesting, innovative and fresh from Group B. They also commented on the fact that they liked

the 'computer game' feel of the interface design. The written feedback from Question 14 highlighted the weakness of visual representation using icons-only.

6. Conclusions

At the rate that China's Internet community is expanding, it is likely to overtake the USA to become the largest Internet user base in the world by 2010. By 2018, it is estimated that China will have over 900 million Internet users. Of the currently available web browsers, very few have found favour amongst Chinese users. The leader amongst these is the Maxthon browser developed in Beijing, China.

The success of a Chinese web browser will depend on iconic appropriateness, effectiveness and cultural richness. The GUI should be both intuitive and easy to navigate. With the rapid growth of the use of the Internet, designers need to be culturally-sensitive to the potential of culturally-specific users (Barber and Badre 1998; Bourges-Waldegg and Scrivener 1998; Every 1999; Yeo 2000).

The results of this study support three general conclusions. Firstly, four of the icons were clearly identified by both groups. However, there is a lack of satisfaction with the other four icons, especially the Favourite and Refresh icons. Therefore, it is essential to re-think these icons and reinforce their visual look, perhaps by using colour, shade, outline, 3D, etc. Secondly, most participants ignored the icons of the web browser in the bottom of the screen, when trying to complete their tasks. This indicated that there is a need to improve the layout of the screen for tracking users' eye attention. Thirdly, within the Favourites function, most participants spent time on distinguishing the difference between the Fire icon (Delete) and the Compost Heap icon (Temporary Save) during the testing. This showed that there is a need to rethink these icons.

Furthermore, most participants tend to click the mouse once, rather than twice, in order to evoke the actions of the icons. This suggested that we need to strengthen the icon's functionality. Moreover, the results indicated that the participants had a preference between neutral and agree (3.32) in Q12.3 regarding their overall experience of the COS.

In addition, under the pressure of the limited time (3-5 minutes) for users to complete the task, it might have affected their performance to some extent and created unexpected errors. The use of young subjects also has implications, in terms of their experience of computing and good eyesight.

In their study, Cheng and Patterson (Cheng and Patterson 2007) found that many commercial icons used on e-business websites had extremely low recognition rates ranging from 0% for a pencil or Plug up to 92.1% for a question mark (mean recognition rate of 35%). Although selected from actual websites, certain icons did not appear to make any sense at all to the subjects of their study (e.g. a plug icon to login).

Interestingly, it was found that some icons were used for different functions on different websites.

Using available student populations for a study into icon recognition presents various challenges and problems which in hindsight could be overcome by using a larger and more diverse user group. Our findings are thus limited in their definitive conclusions until larger data samples are presented in the near future.

The results of this small-scale study provide a foundation for future development of the Chinese web browser, based on the methodology of Culture-Centred Design. More extensive experimental settings are currently being developed, such as further questionnaires of icon recognition, consistency of 2D or 3D visual icons, user performance and preference, and 3D navigation orientation (see Fig. 4.).

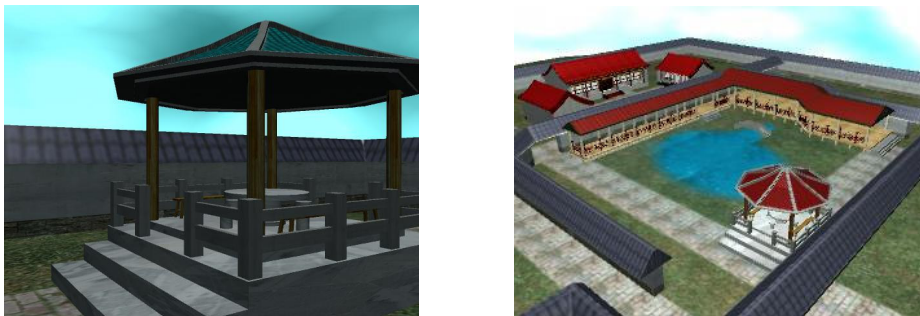


Fig. 4. Developmental Images of the 3D Chinese Web Browser.

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