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Designing for Effective Information Presentation: The Effects of Cultural Differences on Speed, Accuracy, and Perceptions on Usability and Aesthetics

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ABSTRACT

Despite the increasing popularity of animated on-line banner advertising on Web pages, Web users report difficulty in acquiring information on such Web pages. On-line banner can increase brand awareness and generate a "click-through" rate. However, little is known about the effect of animated on-line banner advertising on on-line human information processing. Moreover, as realizing the growth of current interests in cultural interface design, the study will be conducted in a culturally comparative basis. The major purpose of this study is to answer how color, a basic but powerful feature of graphic design, affects user performance and preference in seeking information on a Web page containing an animated banner advertising between American and Thai subjects.

1. INTRODUCTION

Among various types of on-line advertising media (e.g., banners, buttons, and text links), Web banners have become the most widely used on-line advertising media (Meland, 2000). Researchers and practitioners have responded enthusiastically to on-line banner advertising. However, empirical evidence, in terms of cognitive perspectives in human information processing on Web pages containing animated banner advertisements, are remarkably scarce. Still, on-line information seeking has quickly become a daily activity for humans and a number of Web publishers have quickly increased to provide current on-line information and archives for their customers through the Internet. Understanding strategies in acquiring desired information is essential and guides research and practice in Web page design. Among a variety of graphic components on screen, color is one of the powerful components of design.

More importantly, the Internet, the global communication channel, allows buyers and sellers who have different cultural backgrounds and speak different languages to interact with each other. The success of e-commerce could depend on the effectiveness of managing cultural differences of users from different parts of the world. To localize an interface by taking cultural factors into account must be considered with care. Similar to meanings of music, language, and image, perceptions of color differ from culture to culture. As cultural backgrounds could influence the learned responses and reactions to color (Eiseman, 2000), color preferences might be considered culturally dependent. Indeed, real-world evidence in differences of color preferences across cultures in various areas such as fashion and packaging designs could be found daily. Interface designers need to understand color appreciation and color response of people in different cultures and regions, since effective use of color can create several benefits, and these benefits must be given to all people throughout the world. This study attempts to explore effects of combinations of text and background colors of Web animated banner graphics on performance and preference in seeking information on Web pages containing animated banner graphics between American and Thai subjects.

2. RELATED STUDIES

Attention generally refers to a selectivity of processing (Eysenck & Keane, 1995), concentration effort on a stimulus, or the limited resources available to the cognitive system (Ashcraft, 1998). Humans always encounter many information sources simultaneously, but they cannot easily attend to more than one source of information at a time because of the limitation on attentional resource. When attempting to concentrate on one stimulus, a person ignores the surrounding stimuli or distractions. This process is called as filtering or selecting (Ashcraft, 1998). However, a study shows that objects in a visual peripheral system can draw human attention (Driver & Baylis, 1989). In the cognitive psychology arena, visual attention is categorized into various types. The number of attention categories varies. For instance, Wickens and Hollands (2000) categorize attention into three types: selective attention, focused attention, and divided attention. From a theoretical point of view, this study considers divided attention as the framework. Within this framework, it is assumed that attentional resource is limited in nature, and therefore, attention is a human capacity that can control human response. The purpose of divided attention in this

study is to distribute limited resources between two tasks, including seeking target words among non-target words and attending also to the animated banner advertisements. Wickens & Hollands (2000) emphasize that two tasks can interfere with each other when they have the same stimulus modality either visual or auditory. In other words, tasks can be performed more easily when each of them is using a different modality.

A recent study by Zhang (1999) reports significant differences in different conditions of animated graphics in on-line information seeking. The study investigates the impact of animated graphics in searching target words on Web pages containing animated graphics in relationship to task difficulty, animated graphic color, animated graphic content, and instruction to ignore such animated graphics (Zhang, 1999). The results show that the animated graphics worsen user performance in searching for the target words. For example, an animated graphic that is similar but irrelevant to a task distracts a user's attention more than an animated graphic that is dissimilar to a task does. Such results become more negative when users are instructed not to ignore the animated graphics. Nevertheless, in terms of advertising banners, animated ones tend to be more effective in increasing a click-through rate than static ones.

Noiwan & Emurian (2001) investigate the effects of target word density (i.e., high, medium, and low) and Web page presentation styles (i.e., no graphics, static graphics, and animated graphics) on search time and user preferences. The results show a significant effect of target density on search time. Search time on low-density pages is significantly briefer than on high-density pages, an outcome that validated the experimental protocol. However, no significant effect is found for page presentation style, and the interaction between target density and presentation style is not significant. Self-report data showed that static graphics pages and animated graphics pages are sometimes perceived differently in terms of usability and aesthetics, and both styles are perceived as visually appealing to users. Several studies show the effects of color in human information processing. (Hoadley, 1989), for example, states that color, one of the attributes of a visual stimulus, can attract human attention. Moreover, Marcus (1992) expresses that color is the most complicated visual component. Furthermore, extensive studies of color in visual attention, particularly in visual search, show that color is one of the best ways to distinguish a stimulus from the surroundings (e.g., D'Zmura, 1991). To date, only one study has been investigated in this context (Zhang, 1999). In that study, bright color is the vital attribute of animated banner, which can greatly distract user attention. The brightness attribute is explored in two levels: bright color and dull color. The result shows that an animated graphic with bright color distracts a user's attention more than an animated graphic with dull color.

As cultural backgrounds could influence the learned responses and reactions to color (Eiseman, 2000), color preferences in usability perspectives might be considered culturally dependent. Several factors influencing human preferences of unique colors or color combinations have been investigated such as age, gender, emotion, personality, and nationality by rating separately or by comparing between each pair of colors on a subjective scale (Kreitler & Kreitler, 1972). In the investigation between age and color preference, for instance, Terwogt and Hoeksma (1995) state that preferences tend to change as a result of social and cultural influences. Kreitler and Kreitler (1972) suggest that an answer to color preferences depends on a context of a question. Grieve (1991) suggests that color preference must be assessed in regard to the objects or the contexts of the perceived colors. Therefore, like or dislike in unique colors or color combinations should be identified into specific aspects in regard to a specific task that a user performs. In interface design, such aspects might include the usability of an interface. For example, in interacting with an interface, one might think that yellow graphics could increase an interface's pleasantness, whereas gray menus could increase an interface's usefulness.

Usability might differ from one culture to the next. Cultural backgrounds could affect designers' ideas in designing interfaces. Designers develop systems based on their assumptions, while users perceive those systems with the users' assumptions (Kaplan, 2000). Due to different thinking styles, attitudes, feelings, and behaviors of users influenced by their cultures, users from different cultures might perceive usable elements or concepts differently. For instance, in Web design, most Web usability guidelines are developed with an American perspective. What Americans perceive as usable might not be usable in other countries or cultures, and vice versa. Differences between Thai and American cultures affect Web design (Noiwan & Norcio, 2000). The major differences between Thai and American Web sites are visual designs and designs of structure of information. However, no evidence has been reported that these so-called undesirable interface elements as mentioned above are also unusable among Thai users.

3. METHODOLOGY

3.1 Research Questions

- a. Are there performance differences in target-word searching on different Web pages containing animated banner graphics with different combinations of text and background colors?
- b. Are there differences in perceived usability on different Web pages containing animated banner graphics with different combinations of text and background colors?

- c. What are the relationships between performance in information searching and perceived usability on different Web pages containing animated banner graphics with different combinations of text and background colors?
- d. Does culture affect performance in information searching and perceived usability on different Web pages containing animated banner graphics with different combinations of text and background color?

3.2 Experimental Design

The experiment in this study uses 2 X 6, within-subjects, full-factorial design for both cultural groups: Thai and American. With respect to cross-cultural comparison, 2 x 6 x 2 mixed factorial design is utilized whereby cultural group (Thai and American) is the between-subjects factor. Each subject performs all 13 experimental tasks. Both Thai and American groups are presented with the same sequences of tasks. In each cultural group, the two independent variables include background color of an animated banner (red, yellow, blue, orange, violet, and green) and text color of an animated banner (black and white). Moreover, extensive studies on color preferences for hues utilize these six basic colors (i.e., Eysenck, 1981; Saito, 1994). With regard to the between-subjects design, cultural group, including Thai and American, is used as another independent variable. It is important to clarify that the study does not aim at exploring superiority of subjects between cultures. Rather, the study attempts to explore some possible cultural differences in interacting with a computer interface. The ultimate goal is to design an interface that could facilitate cognition and perception of users from different cultural groups. The dependent variables for the experiment include (1) total target-word search time, (2) total target-word accuracy, (3) banner-word selection accuracy, and (4) self-reports of usability.

Automatic recording of search time in seconds and target-word search accuracy in numbers of errors begins when a Web page is displayed to a subject, and it ends when a subject finishes the searching task. Banner-word selecting accuracy is assessed after a subject finishes searching a Web page by asking him or her to identify the word that is not shown in three animated banners. Four multiple choices are provided; one is the wrong answer, and the others are the right ones. Perceived usability of banner-color use is assessed using a self-report series of brief questions immediately after a subject finishes each task. Five statements are evaluated, namely, (1) a color use of banner draws my attention from seeking target words, (2) a color use of banner facilitates readability of the banners' words, (3) a color use of banner increases visual appeal of the Web page, (4) a color use of banner makes the Web page seems interesting, and (5) a color use of banner makes the Web page seems enjoyable. A subject rates each factor varied in seven scales, namely, extremely disagree, quite disagree, slightly disagree, neither agree nor disagree, slightly agree, quite agree, and extremely agree.

Two groups of participants join in this study: American subject group and Thai subject group. Each cultural group consists of 30 female and 30 male volunteers. To reduce undesired variations among subjects other than cultural differences, factors such as Internet experience, age, and gender are controlled. Winning monetary rewards is used as an incentive to motivate subjects to join the experiment and to perform the experimental tasks as fast and accurate as possible. The first prize costs \$100.00 and the second prize costs \$50.00.

3.3 Procedures

Each subject is seated in front of the laptop computer and is informed about the brief instructions by the experimenter. The subject uses a mouse to select target words from a task page and choices on a questionnaire page. The subject first signs the consent form after being informed about their rights. Then, the subject fills out the pre-experiment questionnaire page about demographic, Internet usage information, and color preferences. The subject is instructed to scan a Web page "as in reading", that is to read line by line and from left to right within a line, as fast and accurate as possible. The subject is also instructed not to ignore the words on animated banners. Then, the subject performs a practice session with an actual test program. For the actual experiment, each subject is presented with 13 different Web pages containing different animated graphics. A pre-task page is shown to present the subject with the target words. Then, a subject is required to search for 16 target words in a task Web page. When a target word is found, a subject must click on it one time. Time and error in word searching task is automatically recorded. When all target words are clicked, the subject is automatically taken to a post-task page, to rate usability of the corresponding experimental Web page and select the word that is not appeared on three animated banners. Then, the subject must take a break for 5 seconds by closing their eyes for relaxation. Afterward, the subject has to click a button on a screen to begin the next experiment.

3.4 Experimental Material

a. Target Words and Non-Target Words

With respect to words utilized in a target-word searching task, an early study by Zhang (1999) was conducted by using non-word strings as random combinations of one to four letters in her first experiment and words not controlled for numbers of letters in her second experiment. Extending on this early work, for American subjects in this study, all words are five-letter, which can be read with a single eye fixation. This experiment is controlled for word familiarity by taken from a corpus of American-English words. Allowing uncontrolled word familiarity might

cause difficulty in interpretation of measures (Kreuz, 1987). For experimenting with Thai subjects, five-letter words, controlling for word familiarity, taken from a corpus of Thai words are used.

In Zhang's study, target words in each Web page were 8% of the total words displayed on a page (Zhang, 1999). Moreover, in the pilot study of this study, 16 target words (8% of the total words) were randomly distributed all across a Web page containing 200 total words. In each experimental Web page, 200 words, including 184 non-target words and 16 target words are randomly listed by not attempting to make sentences. Each word is separated by a space. No period is used. A target word is varied in each experimental Web page. Locations of non-target and target words are randomized by a computer program; however, target words are not allowed to be placed next to each other. Words shown in each Web page are selectable; when a subject clicks on a word, which is originally black, is changed to gray and then information of the word is recorded into a database.

b. Animated Banner Graphics

Extending from the early study by Zhang (1999), this study utilizes animated banner graphics. Each as with a word inside, which is considered as a task-similar graphic. The effects of varying combinations of text and background colors of animated banner graphics are investigated. Since the purpose of the study is to investigate how users share attention to two stimuli simultaneously, three animated banner graphics are used in each Web page in order to investigate how users perceive words on banner graphics while they are also searching for target words from textual information. Such three animated graphics are located at the right side of textual information across text lines, as commonly shown in current American and Thai Web sites. Relevant to this matter, for English text which is read from left to right, empirical evidence shows that the effective field of view or the perceptual span or the visual area that eyes can cover in each fixation includes about 3 or 4 characters to the left of fixation and about 14 to 15 to the right of fixation, because more informative text is lying to the right of fixation (Rayner & Pollatsek, 1989).

With regard to a banner graphic size, a common size of banners on the right side of screen is 125 by 125 pixel is used. Even though, a 468 by 60 pixel size has been the most widely used currently, a 125 by 125 pixel size is now more frequently used. Zhang (1999) also utilize the graphic that has almost the same size as 125 X 125 pixels, namely, the 110 X 110 pixel graphic. Words on banners are drawn from the non-target word database used for searching task. Such words are designed to change in size as used in Zhang (1999). With the purpose of readability, a San Serif font is used. The background colors are red, orange, yellow, green, blue, and violet. The text colors are white and black. All colors are commonly used in Web banner graphics. Moreover, such colors have also been used to investigate color preferences and color meanings across cultural groups. In particular, a moderate level of color brightness and saturation are chosen to minimize overly distracted effects.

c. Experimental Web Pages

In this study, 13 experimental Web pages are developed: 12 pages are the experimental conditions of cross-products from the two levels of text color of a banner and the six levels of background color of a banner, and one page is a based-line page with no banner graphic. With the objective of eliminating the potential role of practice effects in the interpretation of the results, the study utilizes a Latin Square design variation to distribute the order of page presentation events over subjects. An example of experimental Web pages for American subjects is shown in the figure 1.

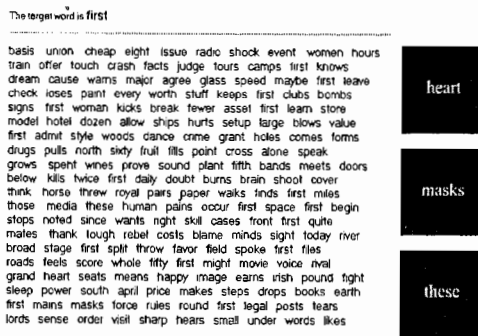


Figure 1. An example of experimental Web pages for American subjects

4. CONCLUSION

The paper presents the ongoing experimental study exploring the effects of combinations of text and background colors of Web animated banner graphics on performance and preference in seeking information on Web pages

containing animated banner graphics between American and Thai subjects. The study will utilize a target-word searching task and explores variations in text and background color combinations of animated banners. Within-subjects, full-factorial design is utilized for each cultural group. Within-subjects factors include banner-text color and banner-background color and a between-subjects factor includes a cultural group. The dependent variables include total search time for the target words, target-word search accuracy, banner-word selection accuracy, and self-reports of usability. Currently, the study is under the subject recruitment process.

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