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ASSESSING THE EFFECTS OF WEBSITE CONTROL BUTTON DIFFERENTIATION ON USER ATTITUDES AND PERFORMANCE

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Abstract

While much research in HCI has examined control design and layout on keyboards and other user devices such as personal digital assistants (PDA) not much research has been identified that looks at web-page button (control) design used in single-step navigation. This research proposes the development of differentiation characteristics to be used on web page control tools and seeks to test the effects of color and shape on users' attitudes and performance.

Keywords: Human computer interaction, HCI, e-commerce

Introduction

It has been proposed that the World Wide Web has emerged as the most powerful driving force shaping the reality of the Internet and its success (Polak 2002; Laudon and Laudon 2001). One of the negative implications to this incredible technological sprint is that as the person-machine systems become more complex and sophisticated, the knowledge and information necessary to operate and maximize positive outcomes often exceed human capabilities (Rudolph and Corso, 1992). User interface designers and developers need to consider user limitations and user abilities when launching E-commerce web-sites. This is especially true with regards to the navigation tools that are key to a successful interface.

Many design experts, including Nielsen (1999) as well as Smith et al. (1997), specify that user interface design incorporate differentiation in the use of controls, layouts, menus, and links. What this means is that designers need to build into the site distinct features of cues for the controls so that users can easily and readily locate and identify the actual button or link they are searching for. The authors of these studies also address the issue of consistent themes and locations for identical buttons on various pages within the site. Users become accustomed to finding a specific control in a particular spot on the site and when it is moved it becomes a hindrance to site navigation and negatively impacts performance (Nielsen 1999).

A random search on the Internet identified approximately 25 well know and established commercial sites. While there were many ingenious and aesthetically pleasing sites, control differentiation was almost non-existent on the commerce sites identified. Do corporate web-site managers and designers know something that the interface design experts do not? Why would corporate retail sites fail to use control differentiation, instead relying on lists of hypertext links that arrange their product offerings in either alphabetical lists or by functional categories on their sites?

This research-in-progress study will examine different aspects of control differentiation, including color and shape, and their effects on attitudes and performance of users.

Research Question

1. What are the effects of control differentiation (color and shape) on user attitudes and performance?

1. Why do controls differentiated by color and shape allow users to perform better?

Prior Research

Cognitive psychology is one of HCI's fundamental and foundational disciplines. Within the bounds of HCI cognitive psychology is used to help scientist: 1) gather knowledge about what users can and cannot be expected to do, 2) identify and explain the nature and causes of some of the problems that users encounter and 3) supply modeling tools and methods to help build interfaces that are easy to use. One theory developed in cognitive research is cue theory. This theory becomes important to the authors in utilizing a well established theory to offer predictions for performance gains expected through the differentiation of control features (Bjorkman 1969; Bjorkman and Nilsson 1982). Cue theory offers the idea that users will take into account all of the available clues offered by the interface and make judgments or assign meanings to the controls based on these clues. As the user interacts with the site additional clues will become available and the user will make adjustments to their previously assigned meanings. Cue theory allows us to predict that as additional cues are available to the user their understanding of the environment will be enhanced thereby improving performance.

In this research, we look to control differentiation, and two distinct properties, shape and color to answer the above research questions. It is argued that cues will provide the necessary clues for users to more quickly identify and select the controls that will allow them to fulfill their desired task. Cue theory suggests that perception is a consequence of putting together clues from all cues available in an environment. It is compared to the detective in a murder investigation who discovers the identity of the murderer by putting together the various clues found at the scene of the crime (Allard 2000).

Shape

One of the ways in which designers provide users an understanding of the function of the control offered on an interface is shape. Shape is one way that we identify unique places, items or categories so that humans have a better understanding of the item in question. Shape is a very good differentiation tool for humans to recognize, some research has shown that it is just behind color in its impact on search and selection tasks (Jubis 1991; Adelson et al. 1993).

Color

Color and interface design are also integral to cognitive psychology's examination of HCI. Color coding has been shown to aid some cognitive tasks (Christ 1975). One of the studies examined color coding methods and it showed significance levels for search tasks if the division of the display into colored regions was properly and logically accomplished. This was shown to be more helpful to inexperienced users but showed significance for all users. The study also concluded that if too many colors are utilized on numerous items the users get color saturation (pollution) and performance is degraded.

There is considerable HCI research examining color palette and its effect on user trust and user attitudes towards specific web-sites though none have attempted to examine color use as a differentiation tool on a web-site (Lohse and Spiller 1998; Mandel and Johnson 2002).

In previous studies on the significance of color differentiation on human performance (Christ 1975; Hoadley 1990) both found that selection accuracy and speed were improved dramatically when color differentiation was used.

Proposed Study and Model

Control Button Shape Differentiation

Researchers have examined the use of shape to enhance search and selection tasks with positive results (Lucas 1987; Weiner 1988; Jubis 1991; Adelson et al. 1993). Some research has touched on the idea of iconic representation differentiation's possible efficiency enhancement during search or selection tasks (Lucas 1987) but most have not been concerned with examining user performance. With the use of shape as a primary distinguishable trait for control design this study will attempt to determine if user

attitudes and performance are enhanced. In aviation research several studies (MacDonald and Cole 1988; Weiner 1988) have shown that differentiation is critical for accurate and speedy selection of controls especially during critical phases of flight or emergency procedures. In line with this past research and as predicted by ideas from cue theory it is proposed that differentiation in a meaningful way of the control's shape will aid users in making accurate and speedy selections of desired controls. Therefore, providing shape differentiation will result in more favorable outcomes than providing no differentiation through the use of hypertext only.

H1_a: A web site with controls differentiated by shape will result in more favorable user attitudes about the site than will a web site with text links only.

H1_b: A web site with controls differentiated by shape will result in higher user performance than will a web site with text links only.

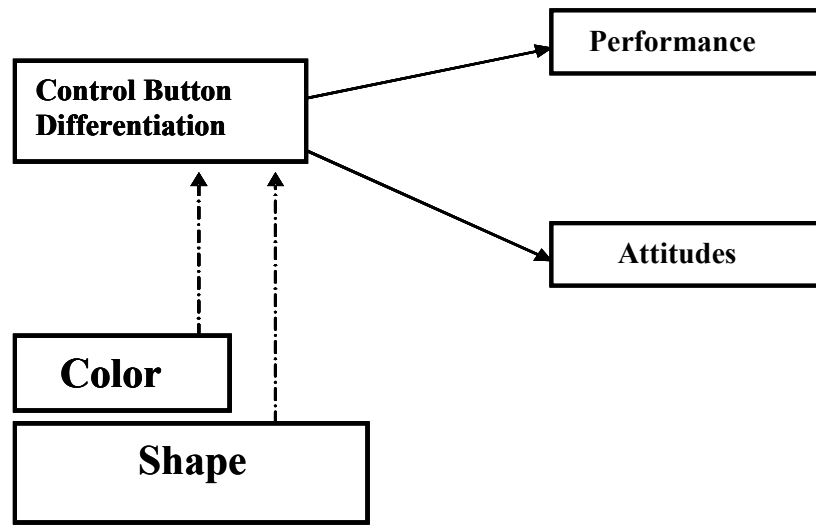


Figure 1. Research Model

Control Button Color Differentiation

Color's role in speed and accuracy during selection tasks is rather definitive. Many studies have been conducted that examined the effects of color differentiation on search and selection tasks (Shontz et al. 1971; Christ 1975; Murch 1984; Hoadley 1990) and most if not all have shown that when controls are differentiated by color selection is made more accurately and more quickly. While these studies cover some of the leading articles in human factor research on color differentiation there is literature in psychology that also investigated color differentiation's effect on information location and selection task outcomes (Smith and Thomas 1964). There is wide support in both the psychology literature and human factors literature for the benefits of color coding on selection speed for information retrieval and selection tasks.

The following hypotheses were operationalized by providing a monochromatic color scheme for one subject site (standard site) and one site that provided buttons of various colors using the standard Microsoft paint scheme. Therefore, variability of color in controls is expected to have a greater positive effect on attitudes and performance than no control color variability.

H2_a: A web site with controls differentiated by color will result in more favorable user attitudes about the site than will a web site with controls not differentiated by color.

H2_b: A web site with controls differentiated by color will result in higher user performance than will a web site with controls not differentiated by color.

Research Method, Analysis and Results

This study utilized an experimental setting to collect the necessary data to test the research model. The study was conducted with 65 undergraduate students from the business school at a well known university in the Northeast. The participants were randomly assigned to groups and then assigned purchasing tasks to complete. The nature of the tasks was online site access with search and information capture requirements.

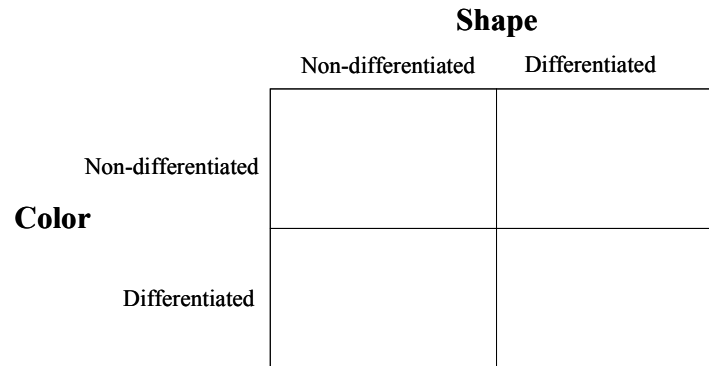


Figure 2. Research Design

A 2×2 between subjects factorial design was employed (See Figure 2.). Each participant was asked to log onto an e-procurement website that had been designed specifically for this research. The first experimental treatment was established using a site that is currently in production and commercially available. It consisted of identical rectangular control buttons with text labels. A second treatment condition consisted of a website that while remaining identical to the first treatment, in basic composition and layout, incorporated control buttons that were differentiated by color. Still another treatment group was assigned to a web site that had buttons differentiated by shape and the remaining condition was a site with control buttons differentiated by both color and shape. The purpose of the task was to determine participant efficiency disparity with the assigned tasks between the four groups thereby identifying whether or not button differentiation affects user attitudes and performance.

The study showed main effects in-line with the predictions developed by applying the theory used to support this paper's propositions for both color and shape differentiation (all hypotheses supported, $p < .05$). There was also an interaction effect between color and shape on performance and attitudes, which is consistent with ideas generated from cue theory, the idea of a diminishing effect when two or more cues are used in conjunction. This diminishing effect would indicate that if a single cue were used to differentiate a control button and then the results were added to the results of another treatment with a single differentiated cue the summative results, compared to a treatment that consisted of two differentiating cues combined, would be greater. Both interactions showed significance at the $p < .05$ level.

Discussion, Conclusion

Much of the HCI research adopted by designers for traditional interfaces has been ignored by web developers. This research-in-progress attempts to use control buttons on web pages to test the effects of color and shape differentiation on user attitudes and performance. The results on both the attitudes and performance elements were encouraging and will be replicated with a larger sample. The combined results of the two studies could influence developers with the establishment of new design standards. This will not only provide a stable framework that has been shown to increase performance but will allow researchers to continue investigation in the area of differentiation and its significance with respect to website control design.

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