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Iconic hyperlinks on e-commerce websites

Hong-In Cheng[a,*], Patrick E. Patterson[b]

[a]*Kyungsung University, Busan, Republic of Korea*
[b]*Iowa State University, Ames, Iowa, USA*

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Abstract

The proper use of iconic interfaces reduces system complexity and helps users interact with systems more easily. However, due to carelessness, inadequate research, and the web's relatively short history, the icons used on web sites often are ambiguous. Because non-identifiable icons may convey meanings other than those intended, designers must consider whether icons are easily identifiable when creating web sites. In this study, visual icons used on e-business web sites were examined by population stereotypy and categorized into three groups: identifiable, medium, and vague. Representative icons from each group were tested by comparing selection performance in groups of student volunteers, with identifiable and medium icons improving performance. We found that only easily identifiable icons can reduce complexity and increase system usability.

1. Introduction

Pictographic interfaces are believed to reduce system complexity and decrease mental load (Howell and Fuchs, 1968; Lodding, 1983; Rohr, 1984; Rohr and Keppel, 1984). In many cases, icons can represent command functions and the general state of a system (Rogers, 1986). Iconic interfaces are sets of images that convey meaning nonverbally, with particular icons characterized by type, form, and color. Individual icons typically are chosen by virtue of resemblance (pictograph), analogy (symbol), or social custom (sign). Standing et al. (1970) reported that pictures are easily recognized over long periods of time and usually support recall better than text. Aversano et al. (2002) employed iconic interfaces to help novice users understand complicated relational database models, and pictorial navigation aids were shown to make labels less ambiguous in related research involving search tasks (Egido and Patterson 1988). Typically, the most effective icon type is a concrete object that maps its referent directly, while the least effective is one that functions analogically (Rogers 1986). "Articulated distance" (i.e., the perceived difference between a picture and its meaning) was shown to influence reaction time in design (Blankenberger and Hahn, 1991).

Howell and Fuchs (1968) suggested a simple stereotype measure which represents correct recognition of the simbols to generate military signs. Most modern software applications use icons to provide users with a pictorial interface that acts as a physical metaphor, making the software more user-friendly. However, as noted by Rogers (1986), not all icons necessarily convey to users of an application the meaning intended by its designers.

E-commerce websites also use iconic interfaces to help customers link to appropriate web pages, order products or services, or retrieve information. For example, the shopping cart icon commonly found on e-commerce websites is used to facilitate checkout after products are selected. When designing web sites that allow quick, accurate, and easy interactions, designers must decide whether to use an iconic interface, a command-based interface, or a combination of the two.

Caron et al. (1980) conducted thorough studies of pictographic symbols in places such as airports, roadways, and public buildings. However, the use of pictographs for iconic web interfaces has not been widely studied. It is generally acknowledged in the field of semiotics that, in order to communicate effectively, the use of symbols

*Corresponding author.
E-mail addresses: hicheng@ks.ac.kr (H.-I. Cheng), ppatters@iastate.edu (P.E. Patterson).

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should be consistent. Yet, because of the web's relatively brief history and a corresponding lack of research on the subject, such consistency generally is not the case with e-commerce web sites.

Web designers currently do not have iconic interface reference sets from which to choose the most appropriate pictograph for a given function. In this study, (1) visual icons used on e-business web sites were categorized and investigated based on population stereotypy, (2) representative icons from each group were evaluated by testing selection performance, and (3) a methodology for selecting and using appropriate website interfaces was developed.

2. Experiment 1

The objective of the first experiment was to determine the quality of icons by studying the ability of test subjects to easily identify their functions. E-business sites, identified primarily by Napier et al. (2001), were chosen and 25 icons were selected from these web sites. Subjects were shown the icons and asked to identify the function of each icon. Subjects were informed that the icons were collected from e-business web sites.

2.1. Methodology

Thirty-eight Iowa State University students (25 male, 13 female) participated in the study to receive extra credit in their introductory ergonomics class. The subjects' ages ranged from 19 to 27 (mean = 21.13, SD = 1.58). Eighty-nine percent of the subjects indicated that they had previously purchased goods on e-commerce websites.

Each subject was given a brief overview of the experiment and informed consent was obtained. A questionnaire was given to each subject to evaluate exactly how users identified the function of each icon. Subjects were then asked to recall or guess the intended function of each icon and freely offer their written observations.

2.2. Results

Following the stereotypy devised by Howell and Fuchs (1968), icons were grouped into three categories: "identifiable" (60–100% identifiable), "medium" (30–60%), and "vague" (0–30%). Icon classification results are shown in Table 1. Responses were considered correct if keywords or similar descriptions were embedded in the answers. A Cronbach's α of .9712 was obtained, indicating that the included items were measuring a single uni-dimensional latent construct.

Typically used icons such as question mark (92.1%), shopping cart (81.6%), and envelope (86.6%) transferred the intended meanings well and a "padlock" security symbol (76.3%) and a shopping bag (60.5%) were categorized as identifiable icons. A palm tree (57.9%) for purchasing a vacation package, "I" pictogram (55.26%) often used for tourist information, the letter "H" coupled with a door (42.1%) to represent hotel reservations, and shopping cart with arrow (34.2%) were medium category icons. However, a telephone icon (7.8%) for customer support, a heart (5.3%) and a shooting star (0%) symbolizing "wish list," a pencil (0%) for checking account, a "plug" (0%) for login, and a "document" (0%) for reviewing order history were not well understood by subjects. Although selected from actual e-business web sites, certain icons did not appear to make any sense at all to the subjects.

Interestingly, some icons were used for different functions on different web sites. A checkmark represented product checkout on one site, but was used to check a user's account on another (Table 1). Also, different icons were used across various web sites to activate the same hyperlink (e.g., a shopping bag on one site, a cart for the same purpose on another).

3. Experiment 2

Based on results from the previous experiment, an empirical study was designed and performed to explore the actual effects on functional performance time of using specific icons, and to provide website designers with suggestions for improvement.

3.1. Methodology

Three different formats were employed over three categories to build nine e-commerce web pages, using "identifiable" (), "medium" (), and "vague" () icons from the prior study. Iconic, textual, and mixed formats (i.e., icon + text) were employed to examine optimal hyperlinks on e-commerce web sites. Generic commercial website style was used to design the simulated sites (Fig. 1). Company names and logos were located at the top of the web page, hyperlink menus were displayed immediately under the title, and other information was placed in the rest of screen using a grid structure.

A between-subject design was used to reduce learning effects. Twenty-one Iowa State University students (14 male and 7 female) participated in the experiment, with each subject randomly placed in one of three format groups. Appropriate situations and tasks were given to the subjects before they were asked to select hyperlinks. For example, a subject was told (1) that a product had previously been ordered and (2) that the subject was to determine the product's current delivery status. The subject would then (3) select the appropriate hyperlink to determine if the product was still in the warehouse, en route to the customer, or already delivered and in storage.

The experiment utilized two-stage hierarchical design with the levels of category (i.e., identifiable, medium, and vague) nested under the levels of formats (i.e., icon, text, and icon + text). Category and format were independent variables; target selection time was a dependent variable.

Table 1
Classification of icons by the stereotypy

Icon	Function	Color F/B	Stereotype (%)
Identifiable			
	Transfer to "help" web page	White/red	92.1
	Initiate "e-mail" web page	Black/white	86.6
	Check out products	White/red	81.6
	Prove site's security	Blue/white	76.3
	Check out products	Green/white	71.1
	Check out products	White/orange	60.5
	Prove site's security	Blue/white	60.5
Medium			
	Purchase vacation package	Green, blue/white	57.9
	Purchase airline ticket	Blue/white	55.3
	Load "information" web page	Blue/white	55.26
	Transfer to hotel reservation web page	Blue, brown/White	42.1
	Check out products	Gray/light brown	34.2
Vague			
	Check out products	Orange/gray	2.63
	Check order status	White/orange	15.8
	Transfer to customer support web page	Blue/white	7.8
	View wish list	Gray/white	5.3
	Transfer to register web page	Blue/white	5.3
	Transfer to free catalog web page	Blue/white	2.63
	View wish list	White/orange	
	Show a list of favorite products	Red/white	0
	Check account and order status	Gray/white	0
	Check account	White/orange	0
	Check account	White/black	0
	Log in	White/red, gray	0
	Show a list of previous order	Gray/white	0

Note: F (foreground color)/B(background color).

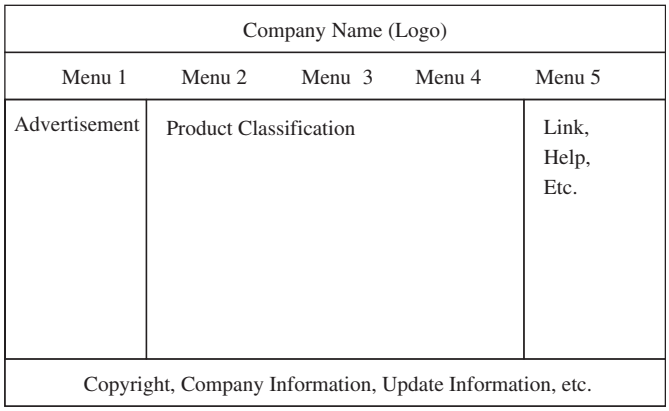

Fig. 1. Basic format of simulation web page.

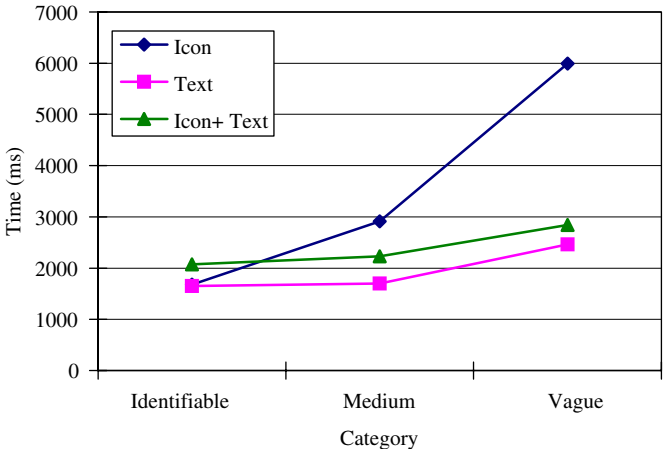

Fig. 2. Performance time vs. icon category.

A Java Script program was developed to measure the time between the final loading of a web page to the subject clicking a icon.

3.2. Results

Performance times were measured in ms, but they were found to be non-normally distributed and so were transformed into log(performance time) for ANOVAs. After analysis, all data have been transformed back to times in ms for presentation. Significant difference in performance time were detected among formats ($F = 5.77$, $p < .012$) and post hoc analysis showed text to be more efficient than the icon format ($\alpha = .05$).

Significant effects were found for category ($F = 34.91$, $p < .001$) with an interaction detected between category and format ($F = 4.09$, $p < .008$). Tuckey's multiple comparison method showed both identifiable ($p < .001$) and medium ($p < .001$) icons were better than vague icons. Even though there were no significant differences found between identifiable and medium icons, identifiable icons were observed to require less performance time than those in the medium icon category.

Fig. 2 illustrates original experimental data clearly. Where an icon was identifiable, the icon format could be effectively employed. Otherwise, text only showed the best performance for all situations.

Because users needed to encode both text and icon when mixed links were used, the icon + text hyperlink required slightly more time than the text only interface. For all kinds of formats, identifiable icons guaranteed better results.

4. Discussion

The iconic interfaces used on web sites are critical for the proper functioning of the site, and doubtless even more will be used on web sites in the future. Many icons currently being used on e-commerce web sites are not meaningful, however, with some even conveying incorrect associations along with their intended meaning. Our results support and expand on the work of Rogers (1986) and that of Blankenberger and Hahn (1991). Identifiable icons were those which, in the subject's experience, mapped most directly to the referent, and whose perceived difference between the icon and its intended meaning were smallest.

When designers use icons on their web sites, they must consider whether or not these icons are readily identifiable. We recommend the use of a pilot study rather than a self-test for icons used to represent new functions, and the development of an icon reference set for use in representing existing functions. If icons are not identifiable and brief textual descriptors are added to clarify an icon's intended function, then text alone may offer a better approach to designing hyperlinks. Certainly the combination of icon and text offers an alternative interface, but this has the disadvantage of requiring more space on the web page, and takes more time on the part of the site visitor to encode and cognitively process.

Significantly, not all icons reduce complexity and mental load. When icons are easily identifiable, the positive results seen in previous studies may be obtained. However, if the quality of icons is poor, they may actually increase ambiguity for the user. Icons should be selected, designed, and employed cautiously.

Further research should explore which characteristics make an icon identifiable, and how that information may be used to improve icon design. Subjective evaluation and the effect of experience on recognition is also an important next step in understanding and evaluating icon usage. A better understanding of how perception, experience, and identification characteristics combine will be important in developing icon reference sets that will increase web site functionality.

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