Show-all-Links: Identifying Hyperlinks in Websites that use Non-Standard Formatting

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Many websites adhere to their own custom style guides and no longer follow traditional usability standards such as the once ubiquitous, blue, underlined text link. Users may miss important information by not knowing which elements are clickable and which are not. The objective of this study was to determine whether or not an option to highlight all the hyperlinks (links) on a website would help users locate all of the page's available image and text-based links. All participants were shown two different websites and asked to click on all design elements that they thought were links. In the experimental condition, participants had the option of using a keyboard shortcut key that, when pressed, would highlight all the links on the website. In the control condition, this option was not available. Significantly more participants in the experimental condition found all of the links compared to the participants without the highlight option. If the design of a website prevents developers from implementing easily-discoverable links, developers should consider adding an option that can highlight all of the links on a website.

INTRODUCTION

The more confusing a website is perceived to be, the more likely it is for visitors to leave the website without clicking on some links of potential interest or benefit to them. This can result in a higher bounce rate (Edmonds, White, Morris, & Drucker, 2007) which is defined as the percentage of people who visit a website and leave without further engaging with the page. A high bounce rate is oftentimes a result of poor user interface design (Edmunds et. al., 2007). The bounce rate can be reduced by identifying the type of information the website's audience will be seeking and then tailoring the navigational system to fit those needs (Perkowitz & Etzioni, 2000). Designing a user-centered navigational structure can help users build a mental model of how a website is structured, and therefore help them make decisions on which parts of a website they wish to view (Chaomei & Rada, 1996). The various visual treatments applied to links can make link localization difficult for certain users (Gill, 2000).

This study was conducted to determine whether giving Internet users the option to highlight all the hyperlinks (links) on a website would help them locate all the available links on that page. The number of incorrectly identified links was also used to measure the usefulness of being able to highlight all the links on a website. The problem that this study addresses is a common one among Internet users since most websites are designed around custom style sheets which do not adhere to traditional usability standards. This is exacerbated by the heavy use of Cascading Style Sheets, Adobe Flash, and other Internet design technologies that have given web developers the ability to fully customize the look and feel of their websites. Though customization in-and-of-itself does not lead to usability issues, it does open the door for poor design practices.

Section 2.4.4 of the World Wide Web Consortium's (W3C) Web Content Accessibility Guidelines (2007) states that the purpose of a link should be determinable from just the link's text, or from its "programmatically determined link context." In other words, whether or not a visual element in a website is a link should be obvious without requiring the user to interact with it. Traditionally alerting a user to the presence of a link was achieved by underlining blue text (Preece, Rogers, & Sharp, 2002). Many current websites do not follow this traditional standard of identifying a text link. Additionally, the use of images and photographs as links has further reduced a users' ability to identify which elements are links and which are not.

Our first hypothesis is that users seeking to find links on websites will fail to locate some of the links. Our second hypothesis is that providing users with a function to reveal all the links on a website will increase link-locating accuracy by both increasing the number of links found and decreasing the number of incorrect clicks (clicks on visual elements that were not actual

links) for each website. Our third hypothesis is that providing a show-all-links function will significantly decrease the time it will take to accurately locate all the links on a website.

METHOD

Participants

A total of 88 university undergraduate and graduate students participated. Six participants produced data that were greater than three standard deviations from the mean. Their data were removed from the analysis because they did not appear to make legitimate attempts to find the links on the websites. Of the remaining 82 participants, 50 were male and 32 were female (mean age = 20.5, *SD* = 4.4).

Apparatus

The experiment was conducted through a website maintained by the first author. The website uses a MySQL database and a PHP server-side scripting language to provide the storage for participant responses. The experiment could be accessed from any computer with Internet access. All participants met the minimum computer requirements including a computer monitor resolution (1024 x 768 or greater) and an installed version of the Adobe Flash player (version nine or greater).

Procedure

Once individuals signed up to participate, they were emailed a link with the experiment's web address. Using their Internet browser, they were asked to agree to the terms of the consent form. Once they clicked on the 'I accept' button, they were randomly placed into either the *conventional-view* condition (control) or the *show-all-links* (experimental) condition.

In the conventional-view condition, participants were asked to view two websites, displayed in **Figures 1** and **2**. Both figures show the show-all-links function activated as indicated by rectangular borders surrounding some of the objects.

The viewing order of the websites was randomized. Participants were told that the goal of the study was to investigate how people interact with certain types of websites. For each website, participants were asked to click on as many elements on the page that they visually determined to be links. They were told the links could be text, graphics or photographs. Participants were also advised that clicking on the links would not load new websites, and all interactive indications of active links were disabled. For example, hovering the pointer over a link would not change the appearance of the link, and the mouse pointer would not change to a hand icon. Every time the participant clicked on an element that was a link, it would become highlighted with a thin, green border. Every time participants clicked on anything other than a link, a red, .5 cm, semi-transparent circle would appear to indicate an incorrect click.

Figure 1. Website 1 with Show-all-Links Function Activated

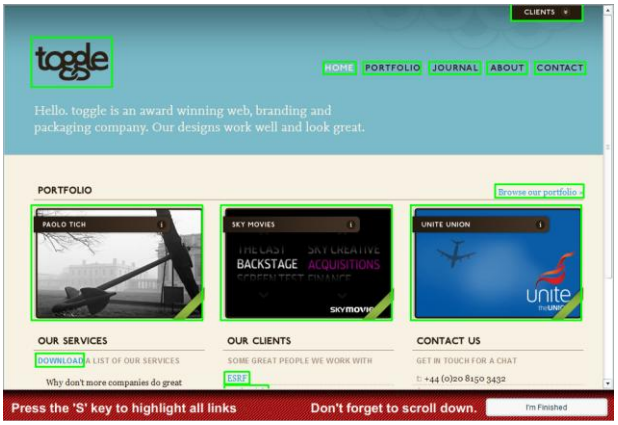

Figure 2. Website 2 with Show-all-Links Function Activated

The show-all-links condition was identical to the conventional-view condition except participants were also told that they could use a keyboard shortcut to instantly highlight all available links of the website. Pressing the 'S' key (for Show link) would highlight the links, and pressing the 'H' key (for Hide link) would remove the highlights.

Questionnaire

After participants in both conditions completed viewing the two websites, they were asked complete a short, demographic questionnaire. Participants were asked to rate their level of expertise using the Internet on a five-point scale ranging from 'novice' to 'expert.' They were also asked to estimate how many hours they used a computer for Internet use, where they primarily used a computer, and for what reason.

RESULTS

A series of one-way ANOVAs were conducted to examine whether participants in the show-all-links group were significantly different in both task time and link-location accuracy than those in the conventional-view group. **Table 1** displays the means and standard deviations.

Table 1. Means (and Standard Deviations) of the Response Measures as a Function of the Conventional and Show-All-Links Views (n=82).

	View			
	Conventional		Show-All-Links	
	M	*SD*	*M*	*SD*
Website 1				
Click Accuracy	82.00	17.67	89.41	19.00
Correct Clicks	23.05	4.46	24.15	4.39
Incorrect Clicks	1.71	2.21	.88	1.18
Percent Correct	88.60	17.12	92.78	16.97
Task time (s)	49.68	16.14	48.77	25.47
Website 2				
Click Accuracy	58.62	22.03	80.29	25.93
Correct Clicks	18.45	5.12	20.98	5.34
Incorrect Clicks	4.40	3.74	1.73	1.92
Percent Correct	76.98	21.35	87.48	22.17
Task time (s)	51.78	23.23	44.07	23.26

Click Accuracy was calculated by subtracting the number of incorrect clicks from the number of correct clicks and dividing by the total number of available links on the website. *Correct Clicks* was calculated by adding the total number of correctly identified links. *Incorrect Clicks* was calculated by adding the total number of clicks on non-link areas of the website. *Percent Correct* was calculated by dividing the number of correct clicks by the total links available on the website. *Task Time* was recorded in seconds and began once the participant was presented with the website.

An analysis of participant responses when viewing Website 1 revealed a significance difference between conditions only in the number of incorrect clicks, $F(1, 81) = 4.53$, $p = .04$, $\eta^2 = .05$. Those in the show-all-links group clicked on significantly fewer incorrect visual elements. An analysis of Website 1 also revealed that click accuracy just misses the conventional level of significance, $F(1, 81) = 3.35$, $p = .07$, $\eta^2 = .04$ but showing a trend in the direction of making more accurate clicks.

An analysis of Website 2 revealed significant differences for both the number of correct clicks, $F(1, 81) = 4.79$, $p = .03$, $\eta^2 = .06$ and the number of incorrect clicks, $F(1, 81) = 16.39$, $p < .001$, $\eta^2 = .17$ with those in the show-all-links group clicking on significantly fewer incorrect visual elements, and finding significantly more links.

An analysis of Website 2 also revealed significant differences in the percentage correct of links located, ($F(1, 81) = 4.77$, $p = .03$, $\eta^2 = .06$) and the overall click accuracy, $F(1, 81) = 16.68$, $p < .001$, $\eta^2 = .17$. Participants in the show-all-links group found significantly more of the available links, and were significantly more accurate than those in the conventional-view group.

None of the time measures showed a difference between conditions ($p > .05$).

DISCUSSION

The results indicate that users can miss a number of links on a website if the links are not obvious to the user. According to Information Foraging Theory (Pirolli & Card, 1999), users favor websites that reduce the amount of time it takes them to locate information. The more time and effort a user is required to spend on a website, the more likely they are to leave without fully discovering the potential benefit of the website. This can lead to a reduction in page views which can adversely affect ad revenue and potential sales for the website owner.

Participants who viewed Website 2 in the conventional-view group were less able to locate a number of links; even when they were specifically looking for all of the links on the page. The results from the analysis of Website 2 also revealed that users with the show-all-links functionality are significantly more likely to locate all the links on the website without making incorrect clicks. The results from Website 1 show that those in the show-all-links group were

significantly less likely to make incorrect clicks, although there were no significant differences in locating links. One explanation for this non significant result is that, as **Table 1** indicates, both groups found a high percentage of links yielding a probable ceiling effect.

Though it was expected that those in the show-all-links group would find all the links quicker than those in the conventional-view group, the time to locate all the links on both websites was not significantly affected by the view conditions. This may have been due to some additional time that was needed to adjust to the added functionality in the show-all-links group. Future research should be conducted to examine how users in both groups allocate their time.

The results also indicate that the lack of web design standards can play an important role in the user's ability to correctly locate links on a website. Molich and Nielsen (1990) found that guidelines are oftentimes not followed due to how lengthy and complicated they have become. They suggested the use of easy-to-follow heuristics which could be better-suited for referencing during the active design process.

Both of the websites in this study did not follow conventional standards which is what may have caused users to miss locating some of the links. For example Website 2 contained images that were also links and users may have been unaware that they could click on them. Both websites also did not include descriptive text links; shorter text links can cause users to overlook potentially beneficial information (Nuehring & Foltz, 2006).

In addition to following a set of heuristics, the results indicate that web designers could also decrease the amount of missed links by including a keyboard shortcut that allows users to instantly highlight all the available links on the website.

This study only used two websites to investigate the usefulness of the show-all-links option. Future research should be conducted with a larger number of websites that includes a systematic manipulation of differences between sites. For example, it would be useful to compare user behavior between standards compliant websites and non-standards compliant websites. Eye tracking behavior would also help to determine if users scan non-standards compliant and standards compliant websites differently.

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