

THE IMPACT OF WEB SITE FAMILIARITY ON USER PERFORMANCE WHEN CRITICAL NAVIGATION LINKS CHANGE

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The research in this paper examines the effect of web site familiarity on the impact of small changes in a site's primary navigation structure on user performance. Ninety-two participants performed multiple tasks on a web site, and then returned to the site either immediately or after a three-week delay to perform one of the original tasks again. Half the users had the critical navigation link on the first task, while half did not. On the second visit, the presence or absence of the link either remained consistent, or was the opposite of the condition experienced during their first visit. The addition of multiple tasks during the user's first visit to the website was expected to cause the memory of the path to the target to be less salient during subsequent visits, thus reducing the performance increase observed in prior studies. However, results show that web site familiarity did not have a significant effect on user performance in this task. One likely explanation for this finding is that there is a trade-off between the salience created for the correct information path gained by performing a single-task first visit and the familiarity gained through multiple forays through the site as the result of multiple task completion.

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INTRODUCTION

The web has become a nearly indispensable tool in everyday life for much of the developed world. From entertainment to e-commerce to information gathering, people spend almost 32 hours a month online (comScore MediaMetrix, 2010). Not unlike the physical world, people tend to spend a significant portion of their online time revisiting places that they already know, trust, or with which they already have an established business relationship (Adar, Teevan & Dumais, 2008).

Because people tend to revisit sites, it becomes important to understand how changes in the navigational structures of these revisited sites might affect user performance. Imagine that each time you visited your favorite grocery store they had rearranged all of the aisles. Finding your weekly groceries would become an arduous task. Even if they simply moved a single item that you purchased every week, the effort to find its new location each time would certainly lead to lower satisfaction with the entire experience. Online tasks are no different – if a site's navigation links are

moved, added, or deleted, it may lead to user frustration at best and user abandonment at worst.

Previous work (Scharff & Kortum, 2009, Kortum & Scharff, 2007) has demonstrated that user performance *is* impacted when the navigation structure of a site changes over time. When users visited a site that had a target link on the front page, and then made a subsequent visit when the link had been removed, their performance declined precipitously. They searched nearly three times as many pages in an attempt to find the information, and the likelihood that they were actually able to find it decreased almost 30%.

In contrast, when users first visited a version of the site where the target link was absent, and then made a subsequent visit when the link was then present, performance *increased* for those users who found and used the newly added front page link (about half of this group of users). However, even those users who did not find and use the added link performed better and faster than they did on the first search, even after delays of up to three weeks. It was hypothesized that this increase in performance was due to

the fact that users had experience with the site navigation and retained a clear memory of the path to the information, thus enhancing their second-visit performance.

One criticism of these earlier studies was that the users were only required to perform a single search for the target information during their first visit to the site, and a single search on the second visit. This experimental design might have left the users with a clearer memory of target path information than if they had been required to make other “distracter” searches. Further, it has been noted that this single-search paradigm might not be the most reflective of real-world search behavior, because users tend to visit sites multiple times (Tauscher & Greenberg, 1997; Obendorf, Weinreich, Herder and Mayer, 2007).

The work presented in the current paper addresses these concerns by utilizing a more realistic first-visit search scenario, in which the user performs multiple searches on the site. By having the user perform multiple tasks on the site during the first visit, it is hypothesized that the memory of the direct path to the information will not be as salient, and that second-visit performance will not increase to the same degree as was found in studies when just a single first visit task was performed.

METHOD

Participants. Ninety-two undergraduate students from a private university in southeastern Texas participated in the study. Each participant agreed to an online consent statement and received partial credit towards completion of course requirements for participating. Neither gender nor age information was requested from participants.

Design. The task in this study required participants to search a web site for target information that was located 2-3 clicks from the home page, unless there was a direct short cut link in the left-hand navigation panel. There were five search tasks, the first

and last of which were the target searches of interest, and both involved the same path, although the specific answer was changed to prevent participants from answering by memory. The three intervening “distracter” searches took participants to other pages on the web site.

This study employed a 2 (target search task: first or second) x 2 (target shortcut link presence consistency: yes or no) x 2 (presence of shortcut link on second target search task: yes or no) x 2 (time delay of second target search: no delay, or three-week delay) between-participants design. The three intervening search tasks always immediately followed the initial target search task. Participants were randomly assigned one of the four link consistency x link presence conditions. For ease of discussion, we identify these conditions by the link presence (Yes or No) on the two target trials: NN, NY, YN, YY. Dependent measures included the search time and number of pages accessed for each target search

Materials. This study used the same web site and general procedure outlined in Scharff and Kortum, 2009. When present, the short-cut link to the target information page was sixth from the top of a list of ten links in the left-hand navigation.

Procedure. Potential participants were given a link to the site, which took them to a study overview and IRB approved consent statement. If they agreed to participate, they continued to the instruction page, which gave them the specific target information for the first task and explained the steps for indicating the target had been found (or that they decided the target was not available, although it always was present), and where to type the target information. Each search task started at the home page. Participation took approximately ten minutes to complete all tasks.

RESULTS

Prior to multivariate analyses, we used *t*-tests (for unequal variances) to investigate the impact of link presence on search times and page counts. When a short-cut link was present, search times were significantly faster (mean = 50.5 secs; stdev = 29.2) than when links were not present (mean = 114.4 secs; stdev = 70.5), $t(105) = -7.8$, $p < 0.001$. Likewise, significantly fewer pages were searched for trials when the short-cut link was present (mean = 2.4; stdev = 1.8) than when it was not present (mean = 8.9; stdev = 7.2), $t(91) = -8.1$, $p < 0.001$. These results are consistent with previously reported work (Scharff & Kortum, 2009, Kortum & Scharff, 2007).

For subsequent analyses, we transformed each participant's search time and page count data into a single measure, time per page. This measure allows us to better understand the combined impact of the two variables as a function of condition and delay. A *t*-test showed that participants spent significantly more time per page when the link was present (mean = 28.2; stdev = 25.0) than when it was not (mean = 17.5; stdev = 15.8), $t(171) = 3.73$, $p < 0.001$.

A 2 (target search task) x 2 (consistency) x 2 (link presence on second search) x 2 (delay) mixed ANOVA was then performed. There was a significant main effect for search, with participants spending more time per page on the first target search than the second (means = 22.5 and 13.9 secs/page, respectively), $F(1,84) = 33.7$, $p < .01$.

This main effect was moderated by two significant interactions. The Search x Consistency x Link on 2nd interaction is shown in Figure 1; $F(1,84) = 12.8$, $p < .01$. When the link was present during the first target search, participants took more time than when it was not. The least amount of time per page occurred when the link was removed after being present during the first search.

The Search x Consistency x Delay interaction is shown in Figure 2; $F(1,84) = 5.4$, $p < .05$. The consistent trials (NN and YY) are combined, as are the inconsistent trials (NY and YN). This 3-way interaction is driven by group differences on search one for those two groups that ultimately received consistent versus inconsistent trials. Given our random assignment, we did not expect to see significant differences across the four light bars in this graph. Overall, the effect of delay was not compelling (as in this interaction) or non-existent (all other effects or interactions).

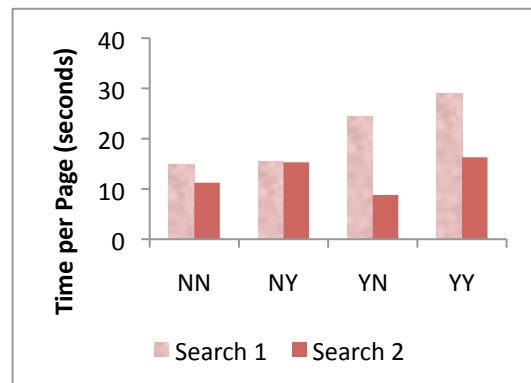


Figure 1. The Search x Consistency x Link on 2nd interaction, showing that, during the first search, participants on average spent more time on pages when the link was present. Removing the link led to more superficial scanning of pages.

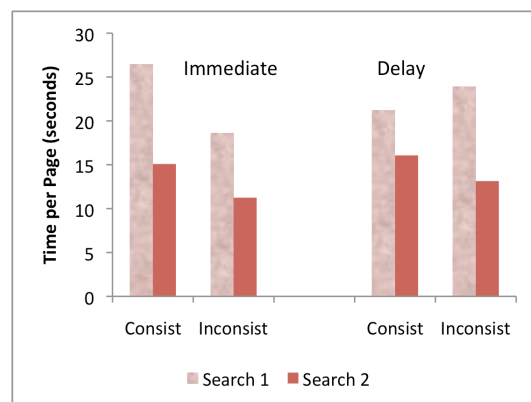


Figure 2. The Search x Consistency x Delay interaction. After experience with the site, participants tended to spend less time per page with inconsistent link presence than when link presence was consistent. Initial group differences during Search 1 drive the interaction.

In order to provide a visual illustration of the results on search times and page counts separately, and allow more direct comparison with our previously published research (time per page was not graphed in those papers), we also include below the means for all conditions collapsed across delay (Figures 3 and 4, respectively).

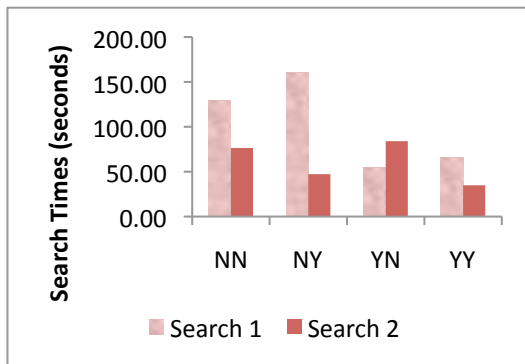


Figure 3. Mean search times for the different link conditions for the first and second searches (collapsed across delay). This is consistent with data reported in our previous studies, where adding the link caused a significant decrease in the NY condition, and decreases in the NN and YY conditions. This suggest a benefit of site familiarity.

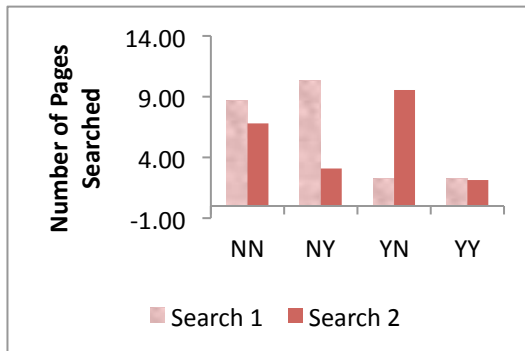


Figure 4. Mean page counts for the different link conditions for the first and second searches. This is consistent with data reported in our previous studies, where removing the link caused a significant increase in the YN condition and adding the link (NY) decreased the page count.

DISCUSSION

The addition of multiple tasks during the user’s first visit to the website was expected to cause the memory of the path to the target to be less salient during subsequent visits, thus reducing the performance increase observed in prior studies. However, the data

presented here indicate that this is not the case. One likely explanation for this finding is that there is a trade-off between the salience created for the correct information path gained by performing a single-task first visit (through procedural memory) and the familiarity gained through multiple forays through the site as the result of multiple task completion (through the creation of a mental map).

Because the users did not know which of the multiple tasks they completed (if any) would be the task that was to be tested on the subsequent visit, no strong memory for “the” path to the target information was formed during the first visit. While this should have decreased second visit performance, the completion of all the additional tasks during the first visit allowed the user to gain more experience with the overall site structure and navigational elements. This experience translated into a better mental model of the information location across the site. These differences between procedural memory and mental map formation have been noted in physical navigations tasks as well (Iaria, Palermo, Committeri & Barton, 2009)

To be certain, changes in the navigational structures of web pages can have large impacts on user performance. When links are absent, user performance is adversely impacted, and in the case of adding important links, user performance is enhanced. However, these changes in performance did not appear dependent on whether or not the users had greater experience with the site through multiple task completion. To more systematically test this assumption, we ran an additional analysis comparing the performance of current participants to those from Scharff and Kortum (2009), where those participants had no intervening search tasks to increase site familiarity. There was no significant effect of familiarity, and no interactions. This suggests that site developers cannot rely on frequent users to be any more

immune to the effects of changing navigational links than the casual user.

The time-per-page data does provide the designer with some important clues about user behavior in situations where the navigational structure is changing. When a critical target link is presented on the main navigational structure, users tend to spend more time on the pages getting to the target (presumably reading them more thoroughly). When a direct target link is not present on the site, users tend to spend less time per page, but peruse more pages. These results suggest that if the direct target link is present, users have more confidence in the path they are on, and spend more time on the subsequent pages because they have a higher confidence that at the information they seek is there. In the case where there is no target link, this confidence is reduced and users return to the typical scan behavior that is seen for browsing, where user spend less than 10s per page (often 1-2 seconds; Cockburn & McKenzie, 2001), scanning for potential productive targets on which to click.

The implications of these findings are important because they force a web site designer to think carefully about the correct and high-value links that should be included in the navigation structure. If the correct links are chosen, then users will spend more time with each page, and allow the site's content to be attended in ways that might be beneficial for the site owner. Poorly chosen navigational links might increase user tendency to simply scan pages in the site, stopping to digest content only when the target is found, or worse, leaving if the target is *not* found soon enough. It also appears that removing a critical navigational link can drive this pattern of behavior. If a user has a memory of a target link which is no longer present, much of their search effort may be spent trying to find that link or the remembered target page. This kind of behavior predisposes the user to ignore large portions of content that are not deemed within the parameters of their target search.

While it was not manipulated in the current study, we suggest that if the organization / appearance of the target page had also been altered, performance would have been even worse than our current data in the conditions where the navigational link had been removed.

Future studies will need to focus on the effect of changing more than a single link on a web page, as might be seen in larger scale changes to web navigation structures. In this case, users may alter their behavior in response to large scale changes in ways that are qualitatively different than their response to the small changes studied here. Another aspect of web page change that is also of interest is whether a change in appearance alone (e.g. colors, fonts, content spacing within pages) might have as deleterious an impact as actual navigation changes on user's performance.

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