

Time Limits, Information Search and the Use of Search Assistance

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ABSTRACT

In this paper, we analyze the impact of task time limits as described by 24 participants in an experimental study investigating the use of a search assistance tool, the Search Guide (SG), during four search tasks with varying levels of cognitive complexity. Participants were given a 12 minute task time limit and a warning notification when 3 minutes remained. In post-experiment interviews, participants reported two different impacts of the time limit on use of the SG: ten described using the SG as a way to save time given the time limit while five reported less SG use due to uncertainty whether it would contain useful information. Participants also described skimming and reading pages more shallowly, selecting easier to read search results, and bookmarking pages more freely because of the limited time they had to complete the task.

Keywords

time limit; time pressure; information search;

1. INTRODUCTION

Researchers often impose task time limits in interactive information retrieval studies as an experimental manipulation (i.e., to examine its impact on search) or for pragmatic reasons relating to the experimental design (e.g., to allow time to complete multiple tasks within an experimental session or minimize fatigue).

In recent studies, researchers have imposed different task time limits and found significant differences in search behaviors and outcomes [5, 13, 16] and searchers' post-task perceptions of their performance [6, 12, 16]. Research has also found significantly higher levels of perceived time pressure with shorter time limits [5, 6] as well as variability in reported time pressure even when participants were given the same time limit [4]. In addition, time pressure has been found to be higher as participants near the end of their allowed time [6].

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CHIIR '17, March 07 - 11, 2017, Oslo, Norway

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ISBN 978-1-4503-4677-1/17/03...\$15.00

DOI: <http://dx.doi.org/10.1145/3020165.3022150>

Understanding how and why time constraints influence users' interactions with search systems provides insight into how an important contextual factor [15] impacts search processes and outcomes. There are also important implications for research design and analysis when researchers impose time limits.

Our work extends prior research by examining participants' perceptions of how and why a time limit impacts search behaviors when all participants are given the same time limit. This research was part of a broader lab-based experimental study [2] on the use of a novel search assistance feature, the Search Guide, that provides searchers with access to the search trails followed by previous searchers. In post-experiment interviews with 24 participants, we asked participants if the researcher-imposed 12 minute task time limit and three minute warning notification impacted their use of the Search Guide or their search behaviors during any of the tasks they completed.

In this short paper, we present our results of the influences of the time limit and warning notification on (1) use of the Search Guide and (2) search behaviors and strategies. We also analyze (3) the relationship between task time and perceived time pressure.

2. BACKGROUND

Research has found differences in information search behaviors and outcomes across varying task time limits including less time spent, shallower results inspection [3, 5], faster document inspection [5], and less information collected [13]. Time limits have also been found to influence the viewing of features within documents [14, 16], and the strategies used to allocate attention across a set of documents [18].

Time constraints can also impact participants' perceptions and reflections about their searches and outcomes; time constrained searchers report lower levels of confidence [3, 12] and less satisfaction with search outcomes [6, 16]. Participants with (shorter) time limits have reported higher levels of post-task difficulty and higher levels of reported stress or time pressure while searching [6, 12, 16]. Researchers have found interaction effects of time limits with search results presentation on participants' satisfaction with a selected search result [3], with task type on self-reported knowledge gain [13], and with task completion time on time pressure, task difficulty, search satisfaction, and task time and progress monitoring [6].

Researchers have noted potential effects of time constraints or time pressure as explanations for unanticipated information seeking behaviors including the selection of more con-

venient and less credible sources [17, 19], not verifying information found [10], and copying and pasting information rather than writing [11].

Time limits may also play a role in the use of novel interface tools or features. In previous studies of novel search assistance features [2, 7], researchers found several reasons for non-use including that participants preferred to search by themselves or they forgot the feature was there. Limited time may present a barrier to use: engaging with a new feature requires time to learn and may involve uncertainty about the benefits. For example, in a study of a search system with novel overview and filtering features, Kules & Shneiderman [9] noted, “the time available was substantial for each session, but not long enough for searchers to completely adapt their tactics” [p. 477].

In the work presented here, we focus on the ways in which participants describe the impact of time limits on their use of a novel search interface feature and their search process and outcomes.

3. METHOD

The research presented here was conducted as part of a broader study to investigate use of a novel search assistance tool called the SearchGuide (SG) [2]. The SG provides users with access to the search trails followed by previous users who searched for information on the same topic. The broader study involved 48 participants; the analysis presented here is from the 24 participants who had the SG available. Participants were all undergraduate students.

Each participant completed four search tasks of different levels of cognitive complexity. The tasks were adapted from Kelly et al. [8] and were based on Anderson and Krathwohl’s Taxonomy of Learning [1]. The four task types were: (1) *remember* tasks that involved finding a fact, (2) *understand* tasks that required compiling a list of items, (3) *analyze* tasks that required compiling a list of items and understanding their differences, and (4) *evaluate* tasks that involved compiling a list of items, understanding their differences, and making a recommendation. Task complexity was rotated across participants using a Latin square.

Participants used a search system that was similar to standard web search engines (Figure 1). Participants could see the current task (A), enter queries (B), and click and view results on the search results page (SERP) (C). Web search results were returned using the Bing Search API. A bookmarking feature was added to the web browser toolbar to allow participants to save relevant pages (D). The SG was shown to the right of the web search results (E) and displayed three search trails (“paths”) taken by different users who completed the same search task. Each path included the queries that were issued by the other user and for each query, the sequence of search results that the other user clicked and bookmarked. A SG relevant to the current task was shown on every SERP (i.e., after the first query was issued). Participants were shown a brief video introducing the SG features at the start of the study, but they were not instructed to use the SG.

During an experimental session, participants completed four search tasks with pre- and post-task questionnaires and were asked to think-aloud while they conducted their searches. Participants were given up to 12 minutes to work on each task so that all components could be completed within the 1.5 hour experimental session time limit. A pop-up message

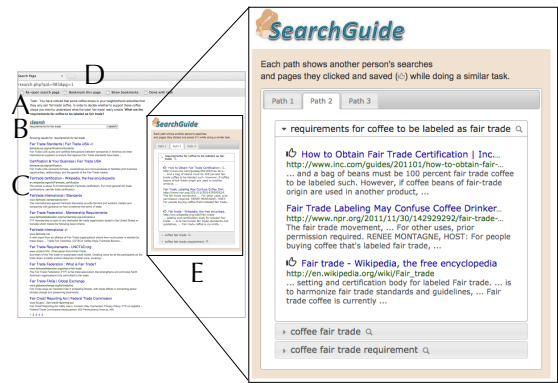


Figure 1: Search Interface and Search Guide

notified participants when three minutes were remaining.

After completing all four tasks, the moderator conducted a retrospective stimulated recall interview about each task and a semi-structured post-experiment interview in which three questions about the tasks (as a group) were asked: Do you think the 12 minute time limit influenced...

- ...how you completed any of the search tasks?
- ...the pages you bookmarked for any of the search tasks?
- ...your use of the SG in any way?¹

If the participant saw the three minute warning message, the moderator asked similar questions about its effects.

The entire session was recorded using TechSmith Morae screen recording software. We used qualitative analysis techniques with four rounds of coding to analyze participants’ mentions of the impact of time limits on SG use and task process. Round 1 involved two researchers independently open coding the data and resolving codes to form a set of closed codes. In Round 2 these codes were refined, and in Round 3, two researchers independently coded half the interviews and reviewed the other researchers codes. All disagreements were discussed and resolved by both researchers. One researcher coded the direction of the impact of time limit on SG use in Round 4.

4. RESULTS

4.1 Time Limit and SG Use

We were interested in how the time limit might have influenced participants’ decisions to use or not use the SG (i.e., click on it). In post-experiment interviews, a majority of participants ($n=15$, 63%) said the 12 minute time limit or 3 minute warning influenced their use of the SG.

Positive impact. As shown in Fig. 2, ten participants (42%) said their use of the SG was due in part to the short time limit. All ten clicked on the SG for at least one task (median=3). Participants said they used the SG more because of the time limit or because it was more efficient to use it.

When I thought that I might not have enough time to finish, I definitely used the Search Guide a little more than I would have if I didn’t feel pressured for time. (p25)

¹Inadvertently, one participant was only asked about their use of the SG.

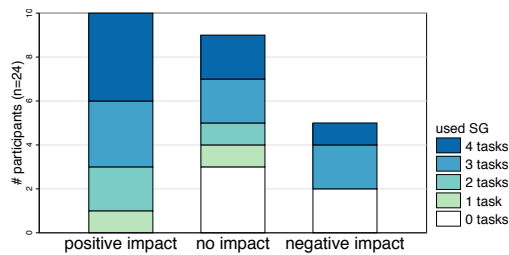


Figure 2: Described time limit impact on SG use

One participant described turning to the SG for a difficult task so that they didn't run out of time.

When it was the easy questions, the time was like whatever. But when it came time to do like the first one with the farmer, it was like 'go to the Search Guide to find information' because if you don't then you might run out of time. (p11)

One participant noted that the 3 minute warning may have triggered them to use the SG to verify what they found.

it may have...encouraged me to look at the Search Guide just to see what other people searched for as well to see if I was on the same track as they were or if they found something more interesting or more informative. (p27)

Negative impact. Five participants (21%) attributed their non-use or low level of use of the SG to the time limit; however, three of the five used the SG for at least three tasks. One described feeling uncertain that they would find useful information in the SG.

I think the 12 minute made me less likely to use it because if I was rushed and I wasn't sure what I would find in the Search Guide, I might as well just search it myself. (p13)

Another participant mentioned that they didn't have time to verify its usefulness during the time allowed.

Maybe this would be useful but I don't have time to verify that it would be useful in the 12 minutes. (p19)

Two participants said they would have used the SG more if they had more time: one who never used the SG and one who used the SG for each task.

It was kind of a new feature...the search bar looks exactly like Google which I use all the time so I was just more comfortable with that...once I had gotten into the topic, I felt a little more comfortable using a new method-the Search Guide. (p215)

4.2 Time Limit and Task Process

In the post-experiment interviews, we asked participants if they thought the time limit influenced how they completed any of the tasks or the pages they bookmarked. Twenty participants (83%) said the time limit influenced how they completed their tasks including when they stopped searching, how they selected and read pages, which pages they bookmarked and changes in their strategy.

Stopping. Several participants described abandoning the task or part of the task early ($n=10$). Specifically, they said they would have continued working on the task if they had more time ($n=6$), searched more ($n=3$), examined more pages ($n=2$), or bookmarked more pages ($n=4$).

Selecting and reading pages. Participants described an impact of the time limit on their selection and reading of pages. Twelve participants reported skimming or reading pages shallowly, and two participants described looking for pages that were easy to skim or that would provide background information (e.g., Wikipedia).

I didn't want to spend a lot of time reading specific details, I was looking for main points. (p39)

Two participants described avoiding pages with scholarly or scientific information.

I only had 12 minutes...I didn't want to spend it trying to decipher this scholarly article. (p17)

One participant described deciding to avoid information that was difficult to understand due to the time limit.

Bookmarking. Ten participants described being less selective in their bookmarking as a result of the time limit such as bookmarking with "more leniency" (p19) or being more "bookmark friendly" (p39). One described trying to find "a larger number of lower quality pages instead of that one page that really hit the mark" (p9). Another described less selectivity near the end of the task.

I bookmarked something like the last minute because you don't have time to go back. It seems like it's alright so you'll be ok. (p11)

Strategy. Several participants said the 3 minute warning triggered metacognitive reflection and task strategy shifts.

When the 3 minute timer came up, I was like what information do I have, what do I need, what can I get in 3 minutes (p33)

After the 3 minute warning, participants described verifying that they had nearly completed the task ($n=3$) and evaluating the information they had already found to determine if there were any gaps ($n=5$).

I was using the 'you have 3 minutes left' as a point where like, ok, evaluate all the information gathered, and I used the time before that to gather as much information as possible (p17)

No impact. Four participants said that the time limit had no impact on their search process or bookmarking. Of these, three finished the task in under 9 minutes (before the 3 minute warning).

4.3 Time and Time Pressure

As part of our analysis, we looked at task completion time and self-reported time pressure to see how they varied across the 96 search tasks completed by the 24 participants.

Mean task completion time was 7.3 minutes ($SD=3.4$) with participant means ranging from 4.6-11.5 min. Nineteen participants (79%) received a 3 minute warning on at least one task, and ten participants (42%) received a warning on 2 or more tasks. The 3 minute warning was displayed in 38% of tasks (36 of 96) and it was displayed in significantly fewer of the least cognitively complex tasks ($\chi^2(3)=8.53, p<.05$): only 3 (of 24) *remember* tasks compared to 11 each (of 24) of *understand*, *analyse* and *evaluate* tasks.

Overall, participants reported low post-task time pressure ($M=1.9, SD=1.2$; "How much time pressure did you feel while completing this task?" 1=none, 5=a great deal). Time pressure (>1) was reported in 49 out of 96 tasks by 18 of 24 participants. Time pressure was reported more frequently for cognitively complex tasks: 8 (of 24) *remember*, 9

analyze, 14 understand, and 18 evaluate tasks ($\chi^2(3)=12.10$, $p<.01$). Six participants described the influence of task complexity (i.e., the number of task components and the clarity of the outcome needed) on time pressure in interviews.

Task completion time was moderately correlated with reported time pressure ($r_s=.465$, $p<.001$, $n=95$). In our interviews, several participants specifically described feeling more time pressure when it took them longer to complete the task.

...for the ones where I didn't get the information right away, I was like oh my gosh I'm not learning anything and my time is slowly ticking away ... So I felt pressured then when the information wasn't popping up...when it was just right there, I didn't feel any time pressure. (p11)

5. DISCUSSION

We have three main findings from our research. First, the task time limit influenced our participants' decisions to engage and avoid engaging with a novel search assistance feature. Second, participants reported and described adapting their search behaviors due to the task time limit. Finally, time pressure was subjectively experienced even with a consistent time limit and it was correlated with the time spent on the task. Our findings are in line with other research that has found time to be an important situational factor of information search [15].

A majority of our participants said the time limit influenced their use of the SG: ten said they used the SG more and five less or not at all. Novel interface features take cognitive effort and time to learn [9] and may involve uncertainty about the benefits. Several previous studies of novel search assistance features have reported reasons for nonuse including a preference to search on ones' own and the novelty of the interface feature [2, 7, 9]. Our work suggests that time limits may be another reason for nonuse with implications for future research: If a researcher is testing a novel interface feature, a task time limit might impact its use.

Nearly all participants described one or more adaptations to their search process to meet the task goal due to time limits: searchers described stopping their task earlier, skimming or reading pages more shallowly, selecting easier to read pages and information, less selective bookmarking, and changes in their strategy. This is line with previous work on skimming in time-constrained document triage [14] and provides some evidence for an impact of time pressure on source selection criteria as previously suggested [17, 19].

We found time spent on the task and time pressure to be correlated. The variability of reported time pressure across tasks suggests that task characteristics (e.g., cognitive complexity) influence the impact of time limits on time pressure.

Finally, researchers should directly consider the potential impact of task time limits during experimental design and analysis. Task time limits may influence not only the time the participant spends on the task but also the use of novel features, search behavior and searcher perceptions.

6. ACKNOWLEDGEMENTS

The authors thank Emily Vardell, our participants and our reviewers. This work was supported in part by NSF grant IIS-1552587. Any opinions, findings, conclusions, and recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the NSF.

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