Time Pressure, User Satisfaction and Task Difficulty

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ABSTRACT
In this paper, we explore the question of whether or not perceived time pressure and task difficulty are predictors of users' satisfaction with their search strategies. We conducted a crowd-sourced user study in which 269 participants completed a total of 600 information-seeking tasks. Based on self-reported data gathered from post-task questionnaires, we found that both perceived time pressure and task difficulty were significant predictors of satisfaction with search strategy. No interaction effect was found. This exploratory analysis suggests that time pressure can influence search processes and is a dimension that should be investigated in more depth. We propose future research to investigate the impact of time pressure on other contextual factors and search outcome measures.

Keywords
Time pressure, information-seeking, satisfaction, task difficulty

INTRODUCTION

Information science research has studied many contextual factors that can influence search processes and outcomes – e.g., task complexity, task difficulty, domain expertise (Byström & Järvelin, 1995; Liu, Liu, Cole, Belkin & Zhang, 2012). However, the effects of *time constraints and time pressure* on searching have been studied less and are not as well understood. The amount of time available to conduct a search or the feeling of time pressure could impact a searcher's information-seeking and searching behaviors. For example, searchers might choose to use more accessible information sources or make relevance decisions more quickly. In addition, time pressure and time constraints pose a recurring dilemma for information science researchers when designing laboratory studies – Will the search process and search outcomes be affected by imposing time limits on participants' searches?

Disciplines such as decision science, psychology, and computer-supported cooperative work have explored the impacts of time pressure in a variety of settings. Findings from these works suggest that time pressure can cause faster performance and lower performance quality (Ben Zur & Breznitz, 1981; Karau & Kelly, 1992; Maule et al, 2000). Time pressure has also been shown in group-work settings to reduce collaborators' satisfaction with group processes and outcomes as compared to low-time pressure conditions (van der Kleij et al., 2009).

Information science research has focused less on time pressure but has explored the influence of other factors – such as task difficulty – on search processes and outcomes. As searchers may vary in their perception of the difficulty of a given task, task difficulty is often pre-tested and then confirmed through self-reported ratings. Task difficulty has been shown to affect search behaviors and outcomes, including more queries issued and longer time spend on search results pages (Liu et al., 2012; Wu, Kelly, Edwards & Arguello, 2012).

As prior research in decision-making and psychology found effects of time pressure on performance and satisfaction, we sought to determine if there was an effect of time pressure on information seeking outcomes. Because task difficulty could also play a role in relation to time pressure, we included it in our analysis. Specifically, we address the following research questions:

RQ1: Does perceived time pressure predict user satisfaction with their search process?

RQ2: Does perceived task difficulty mediate the relationship between perceived time pressure and satisfaction with the search process?

RELATED WORK

While time pressure has not been studied extensively in information science, other fields such as decision science and psychology have examined it in a variety of contexts. Prior work has distinguished the concepts of *time constraints* and *time pressure* (Ordoñez & Benson, 1997). Time and time constraints are subjectively experienced (McKenzie & Davies, 2002; Savolainen, 2006, p. 123); given the same time constraint, there is variability in the amount of time pressure reported by different individuals (Francis-Smythe & Robertson, 1999). Time constraints are one method to induce time pressure, but other methods such as displaying a constantly visible timer have also been used to manipulate feelings of time pressure (Karau & Kelly,

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1992; Olson & Olson, 2013). Some studies imposing time constraints have assumed time pressure is felt (Padovani & Lansdale, 2003), and others have asked questions about perceived time pressure as a manipulation check (Ordoñez & Benson, 1997; Maule, Hockey, & Bdzola, 2000).

Studies in decision science have found that people under time pressure process information more quickly (Ben Zur & Breznitz, 1981; Maule, Hockey & Bzola, 2000), produce lower quality work (Karau & Kelly, 1992; van der Kleij et al, 2009), selectively filter information including more reliance on negative information (Ben Zur & Breznitz, 1981), and are less satisfied with process and outcomes (Haynes, 2009, van der Kleij, 2009).

In studies of information seeking, time constraints are often imposed as part of the experimental design (for a thorough review, see Kelly & Sugimoto, 2013), but few studies have manipulated time constraints as an experimental variable of interest. Tombros, Ruthven & Jose (2005) conducted a study that compared the information seeking behaviors of participants who were given 15 minutes versus those given 30 minutes to complete search tasks. They found evidence that the group with less time relied on more "obvious" features such as query terms and link quality versus "in-depth examination of content and structure" (p. 337). They also found that the 15-minute group reported the tasks as being more stressful, and they were less satisfied with their search outcomes. In their study of face-to-face and remote team processes, van der Kleij et al. (2009) found significant effects of increased time pressure: lower quality work, less satisfaction with performance, and less information exchange. Padovani & Lansdale (2003) found a significant effect of time constraints in their study of how users navigate different hypertext structures. In a condition with no time constraints, participants spent more time finding and refinding information, viewed more screens, and took more steps when refinding information (p. 136).

Others have looked at the connection between time pressure and affective measures in information behavior. In a study of search behavior, Chen & Rieh (2009) found a connection between frustration and time pressure based on an analysis of exit interviews.

METHOD

We conducted a crowd-sourced user study by recruiting participants using the Amazon Mechanical Turk (MTurk) and asking them to complete an information-seeking task and to fill out pre- and post-task questionnaires. Since we were interested in the effects of task difficulty and time pressure, we used a set of 20 tasks that were found to vary in participant-reported task difficulty in a previous study (Wu et al., 2012). An example task is shown below, along with the instructions that we provided.

> *Your goal in this HIT will be to search for and bookmark webpages that would help you in completing the information-seeking task shown below.*
>
> *You will not be required to create an actual response. However, in the end, your bookmarks should contain all the necessary information needed to complete the task.*
>
> *Task: You recently became involved with a conservation group that picks-up trash from local waterways. One of the group members told you that your work was important because it helps keep pollution out of the ocean. What are some of the different types of ocean pollutants? What environmental risks and associated with each pollutant?*

Only MTurk workers with a reputation score of 95% or above were eligible to participate. Participants were allowed to complete up to 8 tasks, assigned randomly with no duplication. We collected data for 30 redundant trials of each of the 20 tasks, for a total of 600 total searches that were posted as Human Information Tasks (HITs) on the MTurk. Participants were paid USD $0.50 for each task. The 600 HITs were completed by 269 MTurk workers.

Participants worked on the tasks using a custom-designed search interface (hosted on our server) that used the Bing Search API to provide web search results. The search system provided mechanisms for participants to search, view, and bookmark pages and asked that they provide an explanatory note for each page bookmarked.

In the post-task questionnaire, participants were asked a number of questions. We focus on three in this analysis:

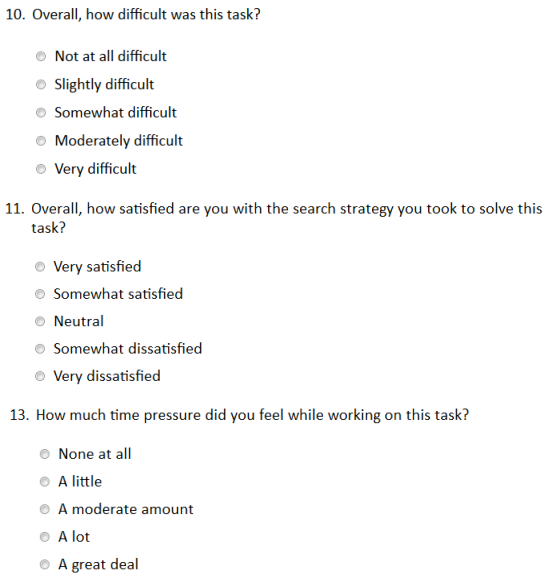

Figure 1. Post-Task Questions

We did not explicitly manipulate the time constraint in this study. All participants had 15 minutes to work on the task. This limit was configured in the MTurk HIT and was shown in the HIT description, but was not emphasized or repeated in the task instructions or task interface.

ANALYSIS & RESULTS

We grouped the responses to the items on the questionnaire as follows. For time pressure, participants reported "none at all" for 279 of the tasks (46.7%). We put these into the *no pressure* group, and then placed all the remaining tasks for which participants reported time pressure (from "a little" to "a great deal") into the *pressure* group. For the questions about task difficulty and strategy satisfaction, we converted the responses to numeric values from 1 (low) to 5 (high).

Experiencing *some* time pressure ("a little" to "a great deal") was reported by slightly more than half of the participants (*n*=321, 53.5%) although all participants were given the same 15-minute time constraint in the HIT description. This variability supports our assertion that the level of perceived time pressure varies among individuals given the same time constraint.

	No Time Pressure (n=279, 46.5%)	Time Pressure (n=321, 53.5%)	Overall (n=600)
Satisfaction with search strategy	4.57 (.69)	3.89 (1.06)	4.21 (.97)
Difficulty	1.37 (.69)	2.14 (1.03)	1.78 (.97)

Table 1: Satisfaction and Task Difficulty (mean, SD)

Table 1 reports participant perceptions of time pressure and task difficulty. Participants who reported feeling no time pressure reported a higher satisfaction with search strategy (mean=4.57, SD=.69) than if they reported feeling no time pressure (mean=3.89, SD=1.06). Participants under no time pressure also reported feeling that the task was less difficult (mean=1.37, SD=.69) than those under time pressure (mean=2.14, SD=1.03).[1] Within each level of task difficulty, mean satisfaction was lower when the participant felt time pressure, see Figure 2.

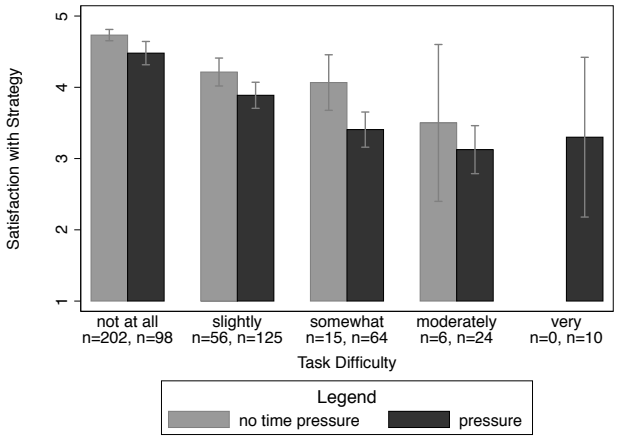

Figure 2. Satisfaction, Task Difficulty & Time Pressure

We ran a regression analysis to try to isolate the effect of time pressure on satisfaction by controlling for task difficulty. Table 2 displays the regression coefficients (β) and intercept (constant). The binary measure of perceived time pressure was a significant predictor of satisfaction with search strategy. In Model 1 in Table 2, the predicted satisfaction score was .669 lower for those reporting time pressure than those who did not (β=-.669, p<.001). We added task difficulty in Model 2. Perceived time pressure remained significant, predicting a satisfaction score .350 lower for a participant who reported time pressure (β=-.350, p<.001) as compared to one who did not. Also in Model 2, task difficulty significantly predicted satisfaction (β=-.417, p<.001). In other words, for each additional unit of task difficulty, the model predicted that satisfaction would decrease by .417. No interaction effect between task difficulty and time pressure were found. Time pressure and task difficulty explained a sizeable proportion of the variance in satisfaction with search strategy, R^2=.2667, F(2, 597) = 85.56, p<.001.

Variables	Model 1	Model 2
Time Pressure	-0.669***	-0.350***
Task Difficulty		-0.417***
Constant	5.235***	5.489***
Observations	600	600
R-squared	0.120	0.267

*** $p < 0.001$

Table 2: Regression Models for Satisfaction with Strategy

DISCUSSION AND CONCLUSION

Previous research has suggested that time constraints have effects on searching behavior and search satisfaction. The results of our analysis suggest that perceived time pressure can negatively impact user satisfaction, even when searchers are given the same time limit and after taking into account the perceived difficulty of the task. This suggests

[1] Using the same tasks in a separate study, Wu et al. (2012) found similar levels of perceived task difficulty.

that perceived time pressure may be an important, independent construct that influences information seeking behaviors and outcomes.

We note that in our study, participants were recruited via the Amazon Mechanical Turk, and worked in their own locations. Thus, even though all participants had the same time constraint, there may have been environmental factors that differed which could have contributed to the differences in perceived time pressure. We also note that another limitation of our method is that we did not control and manipulate the time constraint, but instead measured users' perception of the time pressure.

This exploratory study considers the analysis of three post-task survey questions, and further research is needed to provide a more nuanced understanding of time pressure in information-seeking and interactive information retrieval. A logical next step is to conduct a more controlled study in which time constraints are manipulated. The relationship between time pressure and other contextual variables is an important areas to study, as well as investigating the impact of time pressure on other search outcome metrics (e.g., time to complete task, number of queries issued, number of pages reviewed). Nonetheless, our current findings suggest that time pressure may be an important situational factor to consider in studying information seeking behaviors.

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