Interruption and Renewal: How and Why Do People Search Across Sessions?

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ABSTRACT

Cross-session search is ubiquitous in people's daily life and work. People search for a variety of information across multiple sessions to complete a task or solve a problem. Given the challenging characteristics of cross-session search, there are many studies on developing tools to support cross-session search. However, there has been less attention to investigate reasons that cause people to stop and resume searches across sessions for the same task, which is an extremely important aspect of understanding cross-session search. Motivated by research on task factors and users' information behavior, we focus on how and why people search across sessions. Particularly, we propose to 1) identify reasons that cause cross-session searches in everyday life; 2) characterize search stopping and renewal reasons and their relationships during cross-session search; 3) investigate the influence of task factors and user characteristics on stopping and renewal reasons, and to further identify their influences on users' information behavior. Our results will shed light on searchers' cross-session search behavior characteristics and help inform the design of systems to provide better assistance for cross-session search tasks.

KEYWORDS

Cross-session search, interruption, search resumption

1 MOTIVATION AND RELATED WORK

Cross-session search, also known as multi-session search, describes situations in which people conduct a series of information search activities across multiple different sessions (e.g., time periods or days) for the purpose of achieving a single goal [10]. The tasks[1] that motivate people to search across multiple sessions are often more complex than a single-session task for which people can complete by one-sitting [1, 22]. In prior work, researchers have

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[1]Here we refer task as the underlying problem that motivates people to seek information [8].

identified various characteristics that are relevent to understanding cross-session search (e.g., task topic, users' goals, search task types, session numbers, time gaps) [14–16, 21, 22].

Cross-session search involves two important elements: 1) stopping a search session, and at a later point in time, 2) starting a new search session for the same task. However, there is little attention in the literature to characterize these components and to identify their relationships. Experimental tools were developed with the intention to help users when they searched across sessions (e.g., keeping search histories, managing/monitoring task process, helping note-taking) [15–17], but few of them addressed the underlying causes and users' needs for help that spread over time for cross-session tasks. Gaining knowledge about the reasons that cause people to stop and renew multiple search sessions can help us better understand users' information needs and the difficulties they encounter, eventually providing insights into system design to assist with cross-session search.

One challenge of understanding cross-session search is to understand what causes people to stop an on-going search session. Reasons that stop people from searching on a topic, or using a specific query are relatively clear (e.g., [25]). However, stopping a search session of cross-session tasks is quite different: people may not stop their search on the topic even when they stopping a session, and/or they might continue to use the same queries in a later search session. Some seminal work in this area includes the Multiple Information Seeking Episode (MISE) model by Lin and Belkin [10, 12]. They outlined two categories about why people stop sessions for cross-session tasks: 1) external interruptions–referred to as reasons not directly related to the task (e.g., distractions, time running out, or mental/physical fatigue); 2) internal interruptions–referred to as reasons directly related to the task (e.g., need to consult other sources, need to process the found information, lack of understanding of the problem). Through a diary study and field study, MacKay and Watters [14] observed both external and internal interruptions that made student participants terminate their search sessions when the tasks spread over time.

Another challenge is to identify the reasons that cause people to resume a search session for the same task. Spink et al. [20, 22] conducted experimental studies and identified six reasons for successive search, which include: (1) to refine and enhance the search using results from previous searches, (2) to seek additional information, (3) to search different databases, (4) to refine the search because too much data was retrieved in a previous search, (5) to refine the search due to increased problem complexity due to previous search results, and (6) because their first search was just exploratory [23, p.719-720]. Lin and Belkin's MISE model [10] proposed eight renewal modes for why people resume cross-session searches: (1)
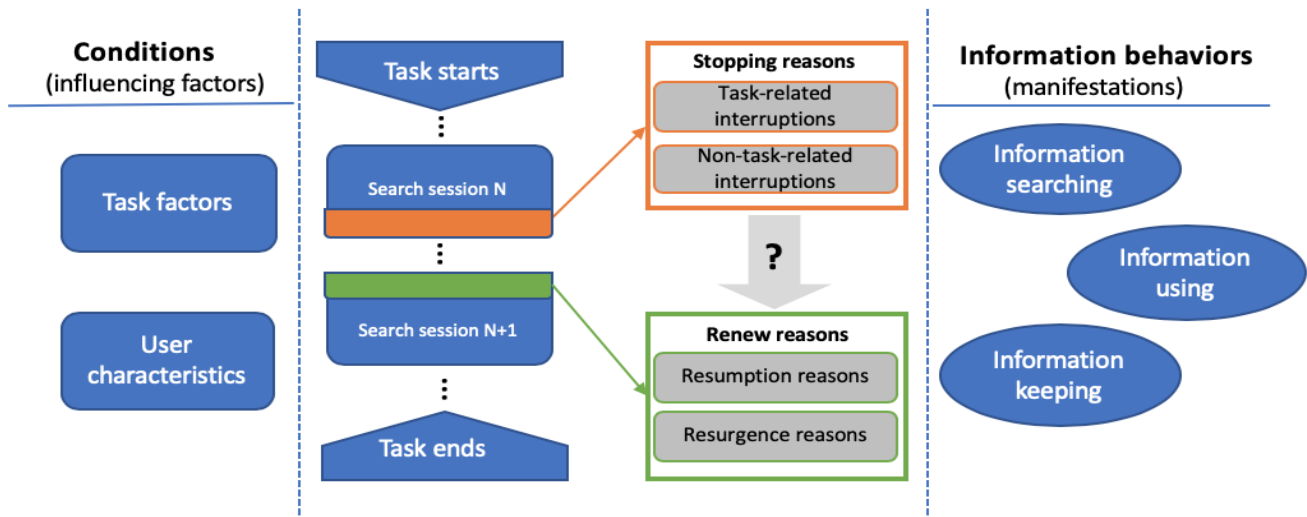
Figure 1: **Interruption and renewal in cross-session search. In this figure, the middle block represents a generic model of cross session search. The proposed research mainly focus on the stopping reasons, renew reasons, and relations with task factors and user characteristics, measured by information behaviors.**

transmuting – the problem gets elaborated and changes from its original form to a transmuted form; (2) spawning – the problem spawns sub-problems; (3) transiting – the original problem transits to another, different problem; (4) rolling back – something that was thought to have been solved by a previous search turns out to be unresolved; (5) lost-treatment – "the information... once found, is not available in the treatment application stage" [11, p.396]; (6) unanswered – the problem was unanswered by previous searches; (7) cultivated – occurs when a searcher is trying to stay abreast of an area of interest; (8) anticipated – the information problem has not occurred yet, but is anticipated based on the current information. They further grouped these reasons into to categories: resumption renewal (1, 6, 7, 8), and resurgence renewal (2, 3, 4, 5) depending on whether the later search session is to continue the previously stopped session or to restart search because the problem "which has been resolved emerges or comes back again" [10, p. 40].

But, it is still unclear how we can conceptualize the stopping and renew reasons, how they relate to, and interact with each other, and how the relationships are reflected in users' information behavior, as well as how other influencing factors (such as task factors and user characteristics) would affect stopping and renewal reasons, during cross-session search in real-world settings.

2 RESEARCH QUESTIONS

Inspired by the existing literature, in particular information search (e.g., [2, 4, 6]) and interruptions (e.g., [3, 7]), we propose to characterize stopping reasons and renewal reasons in cross-session search (as shown in the middle block of Figure 1). The central part of the research is to characterize different types of reasons that cause people to stop an earlier search session, the reasons that lead them to search again later, and the relationships in between these. We will further focus on how task factors and user characteristics may influence these reasons, as well as how information behaviors may

be affected by the cross-session causes. Specifically, we propose to address the following three research questions:

RQ1: How and why do people search across sessions in their daily life and work? Previous research has provided insights about cross-session search in specific contexts (e.g., academic, corporate) and among specific populations (e.g., knowledge workers) [5, 14, 22]. A variety of characteristics of cross-session searches along different dimensions (e.g., task topics, timeline, search sessions, information keeping methods) have been found by different studies [1, 14–16]. Our study is seeking to build on the results from prior work to update and extend our understanding of how cross-session searches manifest in real-world work tasks in people's everyday lives. More specifically, we focus on: 1) characterizing everyday tasks that lead people to search across multiple sessions; 2) discovering motivations for people to stop and later continue a search across multiple sessions; 3) identifying strategies people use to keep and transfer the information found across different sessions.

RQ2: Identify the characteristics of different types of stopping reasons and renewal reasons and their reflection in information behaviors during cross-session search. Spink [22] identified six reasons why people conducted successive searches when they searched specific databases by assisted by intermediators. Lin and Belkin's MISE model [10] theoretically outlined the cross-session search interruptions and renewal modes based on the review of the literature (see details in the Motivation section). Later studies found some examples with specific user groups (e.g., [14]). However, additional, updated, research is needed about how these reasons occur and are manifested in real-world situations. Researchers in other areas (e.g., HCI, psychology, marketing) have found that interruption and its effects can be analyzed along different dimensions (e.g., sources, complexity, relevance, etc.) [19], which provide insight into our study of stopping reasons in cross-session search. In the

proposed study, we will explore the features of these reasons and their relations within the cross-session search process, including 1) to identify the characteristics of different types of interruptions (stopping reasons) during cross-session search; 2) to discover the characteristics of different renewal reasons; 3) to shed light on the correlations of stopping reasons to renewal reasons (as shown in Figure 1).

RQ3: Explore task factors and user characteristics leading to different types of search stopping and renewal reasons. Information search has long been found to be affected by many factors ranging from specific search systems to searchers' backgrounds. Researchers found that sub-task structures and searching across different devices have influences on users' cross-session search behavior (e.g., [13, 24]). However, a systematic understanding of what task factors (e.g., task complexity, types of task goal, the timeline of tasks) and users' characteristics (e.g., prior knowledge, interests, cognition) affect the interruption/renewal reasons in cross-session search and the interaction between the reasons are still missing. Extending our previous work on understanding of the types of causes for searching across-session, we propose to investigate further the effects of 1) task factors on the stopping/renew reasons in cross-session search; 2) the users' characteristics on causing cross-session search; 3) the influence of task factors and users' characteristics on different stopping/renewal reasons.

3 PROGRESS MADE

RQ1 has been addressed in our preliminary study [9]. We conducted a crowdsourced survey to gain a broad understanding of real-world cross-session search characteristics, where a modified version of the Critical Incident Technique (CIT) was adapted to design survey questions. The purpose of using CIT is to systematically identify important aspects of an event that a person experienced [18]. The questionnaire contains four sections: 1) basic demographic information (e.g., age, gender, education background), 2) questions about a recent task, 3) questions about the most recent search session they conducted for the task, 4) questions about the methods they used for keeping and transferring the information found between sessions. Our question formats include open-response questions, multiple-choice questions, and 7-point Likert-type questions. The survey required about 15-20 minutes to complete. We distributed our survey for two weeks using the Amazon Mechanical Turk service. We analyzed 110 responses and report our results in [9].

Along with participants' self-reported quantitative data, we conducted a qualitative analysis of the open-ended questions. We found that: 1) cross-session work tasks (CSWTs) vary in topic and scope. They often tend to be more complex in terms of time period, number of searches, cognitive processes involved; 2) CSWTs often involve cross-device searching and consulting multiple information sources; 3) the causes of cross-session search vary, but some reasons are more popular than others (See Table 1 and Table 2)[2]. A majority of our participants indicated stopping their session for a single reason while they often gave multiple reasons that together motivated them to restart their most recent search session. Our analysis also

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[2]In the survey, people can choose multiple options for reasons causing them to start or stop the most recent search session. Therefore, the sums of the frequency in both tables are larger than 110.

Table 1: Task-related session stopping reasons

	Task related interruptions	Freq.
1	Found all needed info	53
2	Need to process the gathered info	33
3	Need to consult other sources	17
4	Need to validate the found info	16
5	No task-related reasons	8
6	Task deadline approaching	4
7	Cannot find needed info.	1
8	Forgot the reason	1
9	Cannot complete task	0

Table 2: Renewal reasons for the most recent search session

	General/specific	Freq.
1	Need to find specific information	87
2	Need to find general knowledge	36
	Lin & Belkin MISE reasons	
3	Cultivated (need to update)	24
4	Unanswered problem	19
5	Spawning (sub-problems emerged)	17
6	Rolling back (previous info did not work)	9
7	Transmuting (task was unclear)	7
8	Information anticipated	2
9	Other	1
10	Lost treatment (need to re-find)	0

found that people reacquainted themselves by using many traditional strategies, including re-reading saved information, notes, completed work, and/or re-finding information. However, we also found reasons why reacquainting with previously found information may not be necessary in some types of renewing a search. These results suggest that participants were aware of the reasons that cause them to search for multiple sessions. Meanwhile, their needs for renewing another search session are often more complicated than just reviewing what they found before. And current search systems provide little help with the cross-session search.

The results from this initial study provides the necessary foundation for the proposed research: the analysis of task characteristics provides insights on different factors we should consider when analyzing the relationships between stopping/renewal reasons. Users' different reacquainting behavior and the underlying causes indicate that their information behavior could vary across sessions and may relate to the reasons why they stopped and restarted.

4 PLAN FOR FUTURE STUDY

RQ2 and **RQ3** will be the central part of the proposed dissertation. I plan to conduct a diary study by employing a combination of different data collection instruments, including 1) pre/post-task questionnaires, 2) search log data, 3) diaries of relative search and working experiences about the task, and 4) interviews. To emphasize, by using a diary study, we want to collect stopping and renewal reasons for different search sessions as they happen naturally. Unlike in laboratory study, the participants will conduct their searches at their own pace without designed interventions. After each search session, the participants will use a web-based diary to record: the reasons for starting the session, the information they looked for, how they (would) use the information for completing their tasks,

and what reasons made them stop. We will also ask participants to record off-line task activities (if any) between sessions. Diary studies are useful for collecting data as they happen in real life environments [7]. We will further ask participants to report details about the reasons that cause them to stop search sessions at different stages of the task, and what effects these interruptions have on them. The recorded diaries will provide us with information about in-situ stopping and renewal reasons for cross-session search, participants' perceptions of the contextual factors, and other relevant activities through the process. We note there will be some negative side of a diary study. For instance, recording diary entries may interrupt users' activities for the task, especially at the beginning of the study. Keeping a diary could make participants review their task and search behavior, which may introduce unexpected influence on the cross-session search process. We will continue to work on the design to minimize these potential effects.

In addition, we will conduct both quantitative and qualitative analysis of the search log data and interview data. By analyzing these data, we will mainly focus on: 1) participants' information searching behaviors during their multiple search sessions (e.g., queries, session duration, viewed pages), 2) their information keeping activities, types of information saved, as well as the purposes of information saving. Furthermore, through content analysis (e.g., open coding, focused coding), we want to explore what and how different factors– task characteristics (e.g., task complexity, structures), users' personal factors (e.g., prior knowledge, interests)–have an effect on cross-session search.

5 ACKNOWLEDGMENTS

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