Understanding Collaborative Sensemaking Behaviour in Collaborative Information Seeking: An Exploratory Study

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ABSTRACT

Collaborative information seeking (CIS) has become common and occurs when people search the Web together to pursue a complex and exploratory task, such as scientific research, holiday planning, etc. Sensemaking activities are highly involved in these tasks but we have limited understanding of collaborative sensemaking behaviour in the CIS context. In this paper, we describe an exploratory study that aims to investigate the collaborative sensemaking behaviour of online searchers and the difficulties they faced in the CIS process. We present the findings of our study in terms of the activities, strategies and difficulties in collaborative sensemaking process.

Keywords

Collaborative sensemaking, Collaborative information seeking

1. INTRODUCTION

Collaborative information seeking is an umbrella concept which encompasses both explicit and implicit collaboration for seeking information [2]. Our research focuses on explicit CIS, in which collaborators interact with each other directly and share an information need. Most CIS tasks, (e.g. academic research, travel planning, etc.) are complex and exploratory tasks [1] that involve multiple searches and collaborative sensemaking of the retrieved information. However, users' behaviour of collaborative sensemaking is understudied in the context of CIS, and there is a lack of tools supporting collaborative sensemaking in the CIS process.

In general, sensemaking is the process of understanding a problem or topic by building a knowledge structure to organise data, synthesising data into the knowledge structure to form a representation, and constantly adjusting either structure or data to fit each other [10]. Collaborative sensemaking usually involves searchers with diverse backgrounds who try to generate a shared understanding. It can therefore be more complex than, and is not simply an aggregation of, individual sensemaking. Several studies [15] have revealed the need of support for some collaborative sensemaking activities in CIS, for example, understanding the collected information together and construction of an explicit shared representation. However, most design of CIS tools [3, 6, 7] only focus on providing awareness of search activities. In order to design CIS tools that can efficiently supporting collaborative sensemaking, we need to gain a better understanding of the users' collaborative sensemaking behaviour in CIS.

In this paper, we describe an exploratory study to address the gap in understanding user behaviour for collaborative sensemaking in the CIS process. We are particularly interested in identifying the activities, strategies, challenges and difficulties in terms of collaborative sensemaking, and providing an insight into the type of support that collaborators need.

2. RELATED WORK

Collaborative information behaviour has been studied widely in organisations, healthcare, and academic domain and focusing on different aspects of the CIS process. Reddy et al. [11] conducted a field study in an emergency department to investigate why team members collaborate during information seeking process. Shen [13] studied the CIS behaviour of students and define 4 layers in the process: demand analysis, search service, user interaction and presentation. Karunakaran et al. [4] described collaborative information behaviour in organisational context in 3 phases, namely problem identification, collaborative information seeking and information use. They consider CIS as an iterative process of seeking, retrieving and sharing. Collaborative sensemaking and grounding, information sharing and screening are activities present through all the 3 phases. However, there are few studies investigating how online searchers carry out everyday CIS tasks and that focus on the sensemaking behaviour of collaborators.

Most research on sensemaking is at the individual level. Individual sensemaking generally involves activities of recognising a knowledge gap, searching for information, analysing and synthesising information to create an understanding and maybe also a task product [10, 12]. Sensemaking is highly involved when individuals carry out complex and information-intensive search tasks such as academic research, intelligence analysis, etc. In these tasks, not only finding information but also analysing and understanding retrieved information

is needed [5]. In CIS, collaborative sensemaking is the process of collaborators generating a shared understanding of retrieved information [8]. Umapathy [15] reviewed the related literature and argues that collaborators need support for the creation of a shared representations, facilitating interactions, etc. in order to build a shared understanding. Paul and Reddy [9] studied CIS practice in hospital emergency department and claimed that users need to be aware of the sensemaking path and activities of collaborators in order to be able to make sense of the task. Paul and Morris [8] also found that the current design of collaborative search tools [6] focuses on supporting communication and awareness in CIS process but fail to support collaborative sensemaking sufficiently.

To develop supporting systems for collaborative sensemaking, we need to fully understand user need. However, previous studies provide us with little understanding of how online searchers normally perform collaborative sensemaking in CIS tasks. We designed an exploratory user study to investigate how collaborators interact with each other to complete a task using current search engines and other tools (e.g. tools for communication and taking notes, etc.). For the purpose of this study, we want to better understand user behaviour and identify the difficulties users face in terms of collaborative sensemaking in the CIS process.

3. METHODOLOGY
To explore user behaviour in collaborative sensemaking in CIS, we carried out an observational study in which 8 groups, each consisting of 3 participants, were given 1 hour in which to collaboratively search online to plan a weekend in Wales.

We recruited 24 students (14 male, 10 female) with various academic background from our college to form 8 groups. The average age of participants is 23.47 years. Except for one participant, all the other participants have more than 5 years experience of computer use, and 22 out of 24 participants used a search engine several times a day. The average level of search skill in each groups is 3.8 (in a scale from 1-5). 95.83% of our participants reported having experience on collaborative search either with friends (87.5%), classmates (62.5%) or family (29.17%) on travel planning (58.33%), literature/technical research (58.33%), shopping (45.83%) and social planning (41.67%).

The study was conducted in a room with 3 separated cubicles, one for each group member, since we simulated a distributed synchronous collaboration condition. During the task, temporary Skype IDs were created for group members to allow communication within the group. Participants were free to choose the search engine and any other tools they would like to use. We collected data in the form of chat logs, screen recordings, pre- and post- task questionnaires, notes of semi-structured interviews. For the recordings, we used CamStudio [1] to capture the computer screen of the three collaborators simultaneously.

To analyse collected data, we identified activities and strategies from the screen recordings and chat logs. We played the screen recordings of each group member synchronously

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[1]a screen recorder software (http://camstudio.org/)

in ELAN [2] and annotated their behaviour according to the identified activities. By analysing the post-task questionnaires, we also obtained data of how participants felt about their work. Interview transcripts are analysed to further understand the reason behind behaviour and users suggestion for supporting tools.

4. RESULTS AND FINDINGS
In this section, we present the findings of our study in three parts. Firstly, we describe the collaborative sensemaking activities in the CIS process. Then we identify the sensemaking strategies collaborators employed. Finally, we discuss the difficulties and lack of support in the collaborative sensemaking process.

4.1 Collaborative Sensemaking Process
In our study, we observed user sensemaking behaviour and identified four categories of activities in the collaborative sensemaking process. Table 1 gives an overview of the activities involved in the collaborative sensemaking process.

At the beginning, collaborators usually *identify information need* from task description and their existing knowledge. Then each collaborator *searches* for related information separately on search engines. They browse and explore the search results and screen for useful information. When they find something useful or interesting, they *share* the links (the URLs to specific webpages), or the extracted information, to their collaborators on chat tool. Collaborators then view and discuss the shared information. The shared information is *synthesised* into a representation using editing tools when agreed by collaborators.

We consider the iteration of these four activities as a sensemaking loop. By the end of each loop, collaborators compare the representation with task requirements to identify a new information need and then start a new loop of the collaborative sensemaking activities.

4.2 Collaborative Sensemaking Strategies
In collaborative information seeking, collaborators need to make sense of the products as well as the process. Products related strategy refers to how collaborators make sense of the task topic and gathered information. Process related strategy is the way that collaborators make sense of the strategies and path for approaching the task [14]. In our study, we look into how collaborators make sense of the products and process while carrying out the task.

4.2.1 Products Related Strategy
There are two sensemaking strategies defined in individual sensemaking model, data-driven and structure-driven [10]. Data-driven is a bottom-up process of searching, filtering and extracting information to establish a structural representation. In contrast, structure-driven is a top-down process of identifying gaps in a structural representation and searching for related information.

We applied the definition of sensemaking strategies in our study. In our case, for example, to decide on the places

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[2]a video annotation tool (http://www.lat-mpi.eu/tools/elan/)

Table 1: Collaborative Sensemaking Activities

Activities	Description	Examples
Identify information need	Suggest the specific categories of information that need to be searched for on chat tool	One of the collaborators said *we first need to find 2 places for Sunday and Saturday*
Search for information	Compose queries on search engine and explore the search results	One of the collaborators searched *wales tourist attractions* on search engine
Share information	Share information on chat tool, view and discuss the shared information	One of the collaborators shared on chat tool the *stuff to do in barry http://www.barrywales.co.uk/theisland.htm*
Synthesise information in a representation	Organise useful information into a representation	One of the collaborators extract the detailed information of a hotel from the shared webpage and add it into their plan

to visit, structure-driven approach would correspond to collaborators suggesting to go to a national park in Wales, and then searching for information about national parks in Wales. A Data-driven approach would correspond to our participants searching for information for attractions in Wales and finding an interesting museum and then deciding to fit it into their plan.

We found that 70% of the sensemaking loops used a structure-driven approach. This result is different from that of a study of individual sensemaking [16], which showed that the data-driven approach is more popular. Users' preference for structure-driven approach in collaborative sensemaking might because that building a structure before searching is easier for collaborators to coordinate the sensemaking process and construct a shared representation together.

4.2.2 Process Related Strategy
In this study we also observed two strategies collaborators employed to coordinate the sensemaking process, dividing labour and sharing/tracking collaborators' status and task progress.

From our observation, 80% of the groups divided labour. Collaborators usually decomposed the task by suggesting sub-topics of the task on thed chat tool. Each collaborator took a sub-task and then search for related information, so collaborators could solve different information needs at the same time. The remaining 20% of the groups went through each sub-topic together. Division of labour is a strategy to improve efficiency of group work, as search activity is carried out individually in collaborative information seeking process. However, it brings with problems in keeping aware of the sensemaking path and makes it more difficult to generate a shared understanding between collaborators.

We found that two types of clues, namely task progress and collaborators' status, are important for collaborators in the sensemaking process. Task progress is information about what has been done and how much is left in order to complete the task. Status encompasses the activities of collaborators at the moment. Our study revealed that collaborators shared the task progress and their status on chat tools and sometimes also asked for this information. For example, participants said "I've found one (hotel) in Cardiff. Now heading to do the other two", "who is searching for hotel now?", "how is your search coming along?". In in-

terviews, participants claimed that sharing/tracking status and progress helped them keep track of the sensemaking process. Some participants further explained that the purpose to know the status of collaborators is not to avoid overlap but to interact with each other immediately.

4.3 Difficulties and Lack of Support
4.3.1 Construction of structural representations.
Sensemaking is a process of building structure for the task and organising relevant information into a structural representation. We observed two ways in which collaborators create a shared representation. Two groups created a shared document using Google Docs, while the remaining 6 groups chose one of the group members to synthesise information into a final representation. In post-task interviews, we found that among these 6 groups, 2 groups faced difficulties in combining the collaborators' representations of gathered information because the representations did not share the same structure. Groups using a shared document created a structural representation more quickly.

Our findings suggest that users face difficulties in combining more than one representations into a single one, visualising the structure in a shared place could enhance the common understanding between collaborators. However, existing CIS tools provide little help for constructing structural representations collaboratively. Also, the less preference for data-driven approach might indicate that there is a lack of support for collaborators to construct a structure from information.

4.3.2 Sensemaking of shared information
In our study, we found that all of the groups shared information on chat tools. By analysing the chat logs and videos, we noticed that 77.1% of the shared information contained links (the URLs to specific webpages), but only 35.1% of them were explored by the other two collaborators and 28.4% of them were not seen by either of the collaborators. In addition, only 32.4% of the shared links received approval or comments from collaborators. From the limited use of shared information within the groups, we can see that sharing of information on chat tools is not efficient enough for exchanging information and building a shared understanding.

In post-task interviews, we looked into the reasons why collaborators did not view and comment the shared links. Par-

ticipants found it difficult and time-consuming to make sense of the shared webpages by themselves. They did not know which part of the page to look at when exploring a shared page that contains lots of information. Also, participants felt that viewing the shared contents disturbed their own search. They needed to switch between the chat tool and the search engine to follow the dialogue and shared information.

5. CONCLUSIONS AND DISCUSSION

In this paper, we described an observational user study of the sensemaking behaviour for collaborative information seeking. We present findings of the activities, strategies and lack of support in collaborative sensemaking process and provide design implications for new collaborative information seeking tools. Collaborators' sensemaking behaviour consists of iterative activities of identifying information needs, searching for related information, sharing information to collaborators, and synthesising information in a shared representation. The results of our study also show that collaborators face difficulties in the construction of representations and in the sensemaking of the shared information.

The main implications of our study for designing CIS tools are providing a workspace for the sharing and management of information, supporting for structure construction and visualising task progress and collaborators' status. Providing a workspace for collaborators to identify information needs and brainstorm sub-topics could be useful for the construction and the consistency of the structure in representations. Enabling users to organise shared information according to the information need or sub-topics they identified might be helpful for collaborators to make sense of the collected information quickly. Clustering the collected webpages to visualise the topics of information, and thus helping collaborators to form a structure from data, is also worth exploring. Further research should also investigate a clear but not intrusive way of presenting the status of collaborators and of task progress, to invoke more interaction between collaborators in the collaborative sensemaking process.

This study is the first step towards understanding sensemaking in collaborative information seeking from the user's perspective. Future work will focus on investigating sensemaking behaviour in a wider variety of tasks to form a sensemaking model of collaborative information seeking, and to develop a prototype of collaborative information seeking tools to support sensemaking.

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