An Exploratory Study on Knowledge Sharing in Information Retrieval

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Abstract

Different types of knowledge have been found important for a successful search. We designed a user interface: CIRR tool (Collaborative Information Retrieval Research) that supports sharing of search results as well as search queries (knowledge of finding the relevant items). We conducted a pilot study to explore what factors would affect the use of these knowledge sharing features. The results demonstrate that knowledge sharing in general is preferred by only some subjects for some tasks. For those who preferred sharing they share search queries, domain knowledge, and search results, rather than the usefulness judgment. The findings also show that knowledge sharing does not seem to have effects on search performance. However, it is significantly associated with the perceived task difficulty. The possible reasons leading to these results are analyzed. Limitations of this study are pointed out and the future studies are discussed.

1. Introduction

With the explosion of the accessible digital information on the Internet, information searching is becoming an increasingly demanding task for common people. How to effectively help people quickly find relevant information has been a major concern of designers and researchers in information retrieval (IR) systems.

One way is to enable users to share the knowledge that a successful search needs. Systems have been designed to, more or less, support this, such as collaborative systems. One of the limitations of such systems is the user can share only one type of knowledge. Searching depends on several kinds of knowledge, namely, domain knowledge, search knowledge, system knowledge, and information resource knowledge [25]. Domain knowledge represents to what extent a user understands a search topic. Search knowledge, reflects the degree a user knows how to plan his/her search, namely, search strategies, including systems selection, term selection, the use of operators, parentheses, truncation marks, and in the end the formulation, modification, and expansion of search queries or statements. System knowledge reflects a user's understanding of functions and characteristics of a system and how the system can assist him/her to achieve the search goal. Information source knowledge refers to a user's knowledge of locating potential useful online databases or web sources in relating to a specific IR task. Search results represent such knowledge. It should be pointed out that in reality it is hard to draw a clear line between these knowledge types. For example, search knowledge implies domain knowledge (from the search terms selected) and system knowledge (the operators used reflect the system's characteristics). It would be helpful if sharing of all kinds of needed knowledge is supported by the system.

Although the importance of different types of knowledge in IR is well studied, as is reviewed in the next section, few studies examine what kind of knowledge users want or do not want to share, and why. There is no empirical evidence showing users would be willing to share others' knowledge when engaging in IR tasks, and this sharing would impact the users' search performance.

In this study, we were concerned with the following research questions:

Q1: Do users prefer to share knowledge for IR tasks?
Q2: If they prefer, what kind of knowledge they prefer to share or not to share and why?
Q3: If they prefer to share knowledge, can the knowledge sharing improve users' search performance?

We also assumed that the knowledge sharing behavior in IR be related with the user's search expertise level and the difficult level of the search task on hand. These assumptions lead to two more research questions:

Q4: Is knowledge sharing associated with users' searching expertise?
Q5: Is knowledge sharing associated with users' perceived task difficulty?

We designed a user interface system that captures and facilitates knowledge sharing for IR tasks. This user interface is used as a research tool in the investigation of the research questions.

In the remainder of the paper, we first review the related studies in the next section. In Section 3 we introduce the user interface system that is used as the experimental system in this study. The methodology of this study is addressed in Section 4. Section 5 reports the results. We further discuss the results in Section 6. The paper is concluded with future research directions in Section 7.

2. Related research

2.1. IR knowledge

How domain knowledge impacts information searching draws much attention in information science area. Studies [1], [19], [14], [17], [28], [30] find that domain knowledge influences users' search behavior, even though there has been no consensus on its effects on search performance. However, as a representation of knowledge level in a certain domain, high domain knowledge a searcher has helps him/her make relevance judgments and evaluates whether search results answer the questions, regardless that this user is an adult or a child [19], [11].

As mentioned above, search knowledge is critical for a successful search. In particular for users searching on Boolean systems, if without training in Boolean language, it is impossible for them to conduct even a simple search because of the difficulty in constructing a search query. This incurs much criticism [5], [10]. In addition, Fenichel [7] concluded that novices search more slowly, make more errors, and use less thesaurus terms than the experienced subjects. Yuan [31] found that search experience impinges on several aspects of users' behavior, including commands and features used during the search, search speeds, learning approaches, and so on. To search performance, Elkerton and Williges [6] found the expert users significantly outperform the novices. Howard [12] pointed out that a searcher with both searching and database experience performed best. Marchionini, Lin, and Dwiggins [20] also concluded that both the subject specialists and search specialists are able to conduct more successful search than the novices.

Whereas many current search systems, for example, web search engines, are simplified and end-users can easily conduct a search using natural language, the search behavior and performance between search experts and novices are still very different. Bhavnani [3] found that domain search experts used more advanced search strategies than unfamiliar domain searchers, and thus obtained better search performance. The study conducted by Lazondoer [18] demonstrates that experienced searchers spend less time in strategy selection when they are engaging in the low and medium search task than novices. These studies disclose users' behavior features during Web searching in everyday life. However, how to help them improve their searching skills remains an open question.

It is indispensable for users to master some characteristics of the system to effectively interact with it. According to Lazonder [18], successful strategy execution includes clicking hyperlinks, entering keywords, scrolling a page and other interactive activities with the system, which requires at least some basic knowledge about web browser and search engine. Some studies also demonstrate that novices have to spend more time to get familiar with the functions and features provided by the system, and during this process, incorrect actions usually occur [29], [8], [18]. Therefore, to some extent system knowledge may influence users' search behavior and performance.

Information source knowledge determines how quickly and precisely a user is able to relate potential useful online databases or web sources to his/her search task. It is obvious that this is also an issue associated with successful search. To an expert searcher with domain knowledge, s/he usually is able to directly access authoritative information sources. Hölscher and Strube's [13] found that experts in both domain and search knowledge really work in this way. If a user is familiar with various related information sources and their characteristics, it is easier and faster for the user to locate comprehensive and useful information.

In summary, it is necessary to have certain levels of IR knowledge in order to make IR successful. However, for end-users who have no necessary IR knowledge, it is desired to share experts' knowledge. Typically, in information science area formal training is the way to achieve knowledge sharing. Tenopir [26] wrote that it is a great learning tool seeing expert searchers' search strategies for common users. Some studies also suggest that trained novices could perform as well as expert searchers [7], [21], [28]. Nevertheless, it is often impossible to train each novice. Developing and studying systems that facilitate IR knowledge sharing are thus desirable.

2.2. Knowledge sharing systems in IR

Though there are not many studies concentrating on knowledge sharing in IR, there have been some systems aimed at sharing search expertise /experience. Twidale and Nichols [27] introduced the ARIADNE system as an example of computerized support for collaborative browsing in a library catalog system. The system supports only collaborative browsing, not search activities, and it supports collaborative activities only for small groups of people. When constructing search agents for users, Newell [22] found that instead of simply conducting a search using traditional methods, a user may obtain better search results by using an existing agent created by another user with a similar background to do a similar search. The search results generated by the existing agent would be of interest to this user. Romano, Roussinov, Nunamaker, and Chen [23] described a prototype system, CIRE, which combines the features of IR and group support systems and attempts to solve the problem of individuals searching independently in IR. One limitation of the system is that it is designed for small working teams rather than the general public. AntWorld [16] is a collaborative Web IR system that captures human intelligence: people's relevance judgments on retrieved Web documents. The system enables people to share relevant searches by using the collaborative filtering recommendation method. However, no explicit sharing of search queries is supported.

Hust, Klink, Junker and Dengel [15] proposed a new query expansion method based on the collaborative IR concept: to use the terms in globally available similar search queries to expand the current query. Their experiment shows that the method has some advantages compared to the conventional query expansion methods.

Based on his findings, Bhavnani, et al. [3], [4] proposed a design named Strategy Hubs, which embeds into the system the expert search procedures for the healthcare domain to assist the uninitiated searchers to advance their search performance. The results indicate that it does help the novices improve their search performance, especially when searching on the difficult questions and the comprehensive questions assigned by the researchers. This study demonstrates that search knowledge sharing may be necessary and it may be an effective way to enhance users' IR knowledge. However, sharing experts' search procedures is just one aspects of knowledge sharing. We still need to explore new approach to IR knowledge sharing.

3. Implementation of knowledge sharing system-CIRR tool: a prototype user interface system

CIRR (Collaborative Information Retrieval Research) is designed as a research tool for collaborative IR experiments. It is devised to support the sharing of search knowledge among users who search the Web using search engines. For experiment purpose we use Google search engine. The current system has the capability of capturing relevance judgments, annotating documents, and recording the search sessions, including search queries, retrieved document URLs, relevance judgments and annotations. The data collected is analyzed to compare the user search performance under different conditions. In order to run experiments, the system allows pre-loaded search topics, creating and configuration of user groups, collection of user data through both pre- and post-search questionnaires, and reporting of searching task progress.

The prototype system currently consists of the following major components

- A web server that supports Java Servlets and JavaServer Pages
- A relational database server
- A web browser
- A system task console that provides the functionality for user tasks

The task console is a JavaScript application. It serves as a user interface to the system's database server: save and retrieve data to and from the database. As a system that intends to facilitate knowledge sharing for searches, the task console provides the major functions for fulfilling this goal. It has the following functions: relevance judgments recording, annotation recording, and group report display that makes previous searchers' search queries and results on the same topic available. All these functions are part of the Task Console Window, whose screen shot is depicted by Figure 1.

Among these functions, the system's group function is currently the major tool for facilitating sharing of search knowledge in the prototype system. It has two major features: 1). Creating and managing user groups based on their background, search interests, etc. 2). The console contains a dropdown menu called "Group Reports" with the all existing user groups listed there.

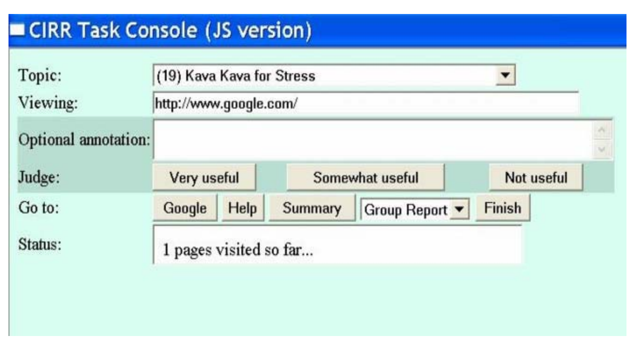

Figure 1. The task console window.

The user can select any of those items. Upon selection, a "Group report" will be generated and loaded into the document window. This is similar to what happens when the user clicks on "Summary" and his own activity summary is loaded into the document window. The report includes records of the activity of all users from the chosen group on the current topic. It provides the URL, the judgment(s) made by all users in the group, the username of the user who made the judgment, the date and time the judgment was made, the rank that the website had on the Google search page, and the search query that was used to find the website. Included also is the ranking position of this document in Google's search result list. The user can view this report for a particular document to see other people's judgment, or for other people's search queries to see how the document is retrieved.

The contents of the group report reflects the search knowledge, relevance judgment knowledge, as well as the information source knowledge that other searchers have on the current search topic, and we assume this knowledge be helpful for the current user to find useful information.

4. Methodology

4.1. Variables and measures

A few variables/factors are involved in the study. These include the knowledge sharing behavior, search performance, search expertise, and perceived task difficulty.

Knowledge sharing is an important variable investigated in this study. We investigate it from two aspects, that is, the usage of knowledge sharing and the usefulness of knowledge sharing. The usage of knowledge sharing is operationalized as the usage of the group report provided by the CIRR task console. It is measured as a binary value, i.e., "Yes" or "No". The usefulness of knowledge sharing we operationalize it as the usefulness of the group report. We asked the subjects to rate five statements from "Disagree (1)" to "Strongly agree (5)" in the exit questionnaire:

1) The group report is easy to understand
2) I like working with the group report
3) I usually agree with other group members' judgment
4) Other people's search result have positively influenced my usefulness judgment
5) Overall, the group report feature helps me get more documents/pages for the given tasks

Search performance is measured by both a subjective measure, i.e., a subject's self-assessed satisfaction with his/her search results (SR) and an objective measure: Mean Average Precision (MAP) scores for each subject User satisfaction is measured by ratings on a 5-point scale in the post-questionnaire, from "Not at all (1)" to "Extremely (5)".

Both performance measures are applied at two levels: individual task level (each task) and all search tasks level. We use the following notations hereafter for the search performance measures:

- TSR: a subject's satisfaction with an individual task
- SSR: a subject's satisfaction with all tasks
- TMAP: a subject's MAP score for each task
- SMAP: a subject's the mean MAP score for all search tasks.

Search expertise refers to a subject's search knowledge level. In this study it is operationalized as whether a subject has been trained professionally in searching. It is also a binary variable, we use "Yes" or "No" to measure it.

Perceived task difficulty (PTD) indicates a subject's self-assessed task difficulty. It has been identified as a factor influencing human information behavior [2]. In this study we investigated the relationship between PTD and knowledge sharing. We ask the subjects to rate the statement "Was it easy to do the search on this topic" from "Not at all" (1) to Extremely"(5) in the post-questionnaire to measure PTD.

4.2. Research design

Participants: We recruited 22 Rutgers graduate students as the subjects. Among them nine comes from library and information science (LIS) and the others are from science and humanity. For the subjects from LIS, they must have finished the searching class offered by MLIS program at Rutgers University, so they are considered as "trained searchers". Accordingly, the others are treated as "non-trained searchers".

Instruments: We used a pre-search questionnaire to collect the participants' demographic data, including their current academic status, major, computer experience, searching experience, searching topics in everyday life, favorite search engines, and so on. A post-search questionnaire was used to collect the participants' self-assessed task difficulty, domain knowledge level, the helpfulness of previous knowledge, the difficulty to get started on the search topic, their satisfaction with the search results for each topic, and new knowledge learning from the searching. We used an exit questionnaire to collect the participants' opinion regarding the system's usability issues and the usefulness of the group report feature. We also video-taped the participants' search sessions to collect the participants' verbal protocols.

User tasks: Six search topics with two difficult levels on health and genetically modified food were provided to the participants to search using the system. The topics are constructed in a format similar to those in TREC experiments.

Procedure: For the first sixteen subjects, the experiment was conducted in a usability lab. These participants are asked to read the instructions and the system's user guide before they start. Then they create their own user names on the system. During the registration process, they fill out the pre-search questionnaire. Each subject is also given a quick demo on how to use the system. The group report feature is emphasized during this process and the subject is encouraged to use it. Then the user conducts the search on the topics in the assigned order. After the search on a topic is completed, the subject has to fill out a post-search questionnaire. At the end of the process, an exit questionnaire is administered to the participants. Thinking-aloud is required for the subjects. The other seven subjects finished this experiment by themselves at home or any other convenient places. The group report feature is encouraged to use.

5. Results

5.1. Do users prefer to share knowledge in general for IR tasks?

As mentioned earlier, knowledge sharing is operationalized as the usage of the group report embedded in CIRR task console. We find that among 22 subjects, 13 subjects (59%) use the group report feature during their searching and 9 (41%) do not use it. Moreover, 22 subjects in fact totally finish 132 tasks (22*6), and only 41% (54) tasks are finished under the help of the group feature while 59% (78) tasks are not (χ^2 (1, N=132) = 4.36, p < .05). Table 1 describes the number of tasks which is used the feature.

Table 1: Usage of group report by tasks

Tasks (T*22)	T1	T2	T3	T4	T5	T6
# of tasks used the report	9	7	7	10	11	10

The distribution of the use of the function in terms of the number of tasks is presented in Table 2.

Table 2. Distribution of the use of group report vs. the number of tasks

# of tasks	1	2	3	4	5	6	not used at all
#of subjects	2	0	3	2	1	5	9

In addition to the 9 subjects who did not use the function at all, we find that a few subjects used the function for only less than 3 search tasks.

Therefore, it seems that the group feature is preferred to use merely by some subjects for some tasks.

5.2. If they prefer, what kind of knowledge they prefer to share and why?

5.2.1. What to share and why? We peruse the subjects' comments on the group feature in the exit questionnaire. They prefer to share the following IR knowledge.

Search terms and query sharing: most subjects have realized that the big advantage of this system is to share other people's queries, by which they can select appropriate search terms as well as improve the comprehension of search tasks. As noted above, a query is not only a search statement, but also represents people's search knowledge, domain knowledge and even search experience. Sharing query is one of the reasons the subjects enjoy this system. For example, some subjects wrote: "[I]t gives ideas for more search terms" or "[T]his system allows us to see as to what search query, other guys used for gathering the results. This is particularly useful for difficult to find topics." Moreover, some subjects used the group report to check whether they missed important terms in the query. This helps them to formulate more effective queries. However, even if most of the subjects positively assessed the query sharing in this system, some of them criticized the machine format of the query. They stressed that this is a drawback damaging the usability of the group report to some extent.

Domain knowledge sharing: most of subjects express that by visiting the group report they can gain much sense of what to search, especially when they have difficulty in understanding some topics. For example, a subject wrote down "depending on the topic, if easy, no need to use it;" the other one said: "[It is] helpful when you are stuck on a topic." This indicates that low topic knowledge level may lead to domain knowledge sharing.

Information source sharing: the subjects also pointed out another advantages of visiting the group report, that is, the group report helps them locate the useful sources. Some subjects stated, "[I]t helps me improve my query and select types of sources that would contain good information" or "[I]t was useful to consult the group report and see how others had particular sites, what queries they had used, etc." Source sharing is based on that these subjects believe that other people usually have useful findings, and the URLs that are judged useful merit special attention. Additionally, to some subjects, sharing sources helps them narrow down their search by referring to the similar sites and "…skipping 'useless' information".

5.1.2. What not to share and why? Although the subjects prefer to share some search knowledge, however, they are not interested in sharing usefulness or relevance judgments. In commenting on the statement "I usually agree with other group members' judgment" in the exit questionnaire, some stated, "[I] did not pay much attention to the judgment" or "I really didn't pay much attention to the "usefulness' judgments of the other participants-just the sites themselves." Others did not pay attention to the judgments but merely looked at queries. They remarked that the usefulness judgment on a document is different from person to person. People usually prefer their own judgments. Sometimes they make a totally opposite judgment to the same documents/web pages that other searchers have judged. For those who did not use the function, they usually trust themselves in doing search, and consider it unnecessary to visit other people's work report. Another reason is that the group report button in the interface is not very salient. Some subjects ignored it or forgot to use it. This is apparently a user interface design problem.

5.3. If they prefer to share knowledge, can knowledge sharing improve users' search performance?

Depending on whether the group report feature was used in performing a search task, all the search tasks (22 subjects * 6 = 132) are divided into two categories: Y (used) and N (not used). Table 3 summarizes the two categories' mean search performance measures, TSR and MAP on each task, respectively.

Table 3: Usage of the group feature (Y/N), TSR and TMAP

Usage	T1		T2		T3		T4		T5		T6	
	TSR	MAP	TSR	MAP	TSR	MAP	TSR	MAP	TSR	MAP	TSR	MAP
Y = 54	4.33	.33	4.29	.39	5.00	.60	4.00	.43	3.73	.44	3.60	.38
N = 78	4.31	.46	4.07	.48	4.47	.54	3.83	.43	3.73	.45	3.50	.28

No significant difference was found between the two groups by a t-test, neither in terms of TSR nor TMAP. In other words, the usage of the group feature does not result in significant different search performance.

5.4. Is usefulness of the group feature is correlated to search performance?

For those subjects who used the group report feature in accomplishing their tasks, they were asked to rate the feature's usefulness based on the five statements listed in Section 4. The mean of the ratings from each subject who used the feature, along with the subject's overall satisfaction score and MAP score, are displayed in Table 4 below. The subjects are ranked in decreasing order of their usefulness rating scores.

Table 4: Usefulness of group report by subjects, SSR, and SMAP

Subject #	Usefulness (mean/SD)	SSR	SMAP
5	3.80 (1.30)	4.67	.54
8	3.80 (1.30)	3.83	.38
11	3.20 (.44)	4.33	.45
6	3.00 (1.00)	4.17	.31
10	3.00 (.70)	4.00	.20
13	3.00 (.00)	3.33	.49
2	2.80 (1.09)	3.83	.51
3	2.80 (1.78)	4.33	.44
15	2.80 (.44)	4.00	.45
9	2.60 (.54)	4.17	.47
1	2.40 (.55)	4.33	.45
12	2.00 (.70)	3.67	.51
16	1.60 (.54)	4.00	.35

We do not find significant correlation between search performance and usefulness of the group feature, whether in SMAP or in SSR.

5.5. Is knowledge sharing related to the users' searching expertise?

In this study, the subjects from LIS are treated as trained professionals with search expertise. Subjects from other non-LIS fields are treated as non-trained searchers without search expertise.

Taking all tasks (22(subjects) * 6 = 132) into consideration, we used Chi-square test to run an analysis. A significant association between usage of the group feature and the subjects' search expertise is detected (χ^2 (1, N=132) = 13.89, p<.01). Table 5 displays the crosstabulation between search expertise and usage of the feature.

Table 5: Search expertise and usage of the feature

		Search expertise		Total
		Y	N	
Usage of the feature	Y	32	22	54
	N	21	57	78
Total		53	79	132

Our qualitative data also supports this result. An examination of the subjects' comments on the usefulness of the group report feature reveals that the feature draws more attention from the trained group than from the non-trained group. In general, both groups agree that they utilize this feature in favor of its support of sharing of queries, information sources, and needed domain knowledge. Both groups have subjects who do not pay much attention to other people's usefulness judgment, and prefer to independently make their own judgment, even if they retrieved the web pages that had been regarded as useless by other subjects. However, the trained searchers are more critical of the usability issues of the group feature, such as the clarity of the report, visibility of the group function, and the whole function of this feature, than those non-trained searchers. For example, some of them stated, "[T]he machine format of the queries made it slightly more difficult to understand than otherwise". In addition, most of the subjects who refused to read other subjects' report are trained searchers. A subject in this group explicitly expressed that she had no patience to read the report, and she could do better than other subjects. Another subject even stated, "[I]t (the group report) was mostly a waste of time. I could check out the sites on my own as quickly." On the other hand, the non-trained searchers give more positive assessments. For example, some non-trained subjects noted that the group report's "format and color coordination" "make for easy reference," and "it is well organized".

The findings suggest that more search expertise may demand less knowledge sharing but better system usability. Also, from the comparison of the two groups, in general the non-trained searchers evaluate its usefulness higher (3.00 vs. 2.68). Though the difference is not statistically significant, it still shows that the non-trained users may prefer sharing knowledge more than the trained users.

5.6. Is knowledge sharing associated with users' perceived task difficulty?

The six search tasks are designed at two difficulty levels: first 3 ones are easier ones and the last 3 are difficult ones. We found that the subjects' perceived task difficulty (PTD) ratings are consistent with this design. The subjects' ratings of the task difficulty are shown in Table 6.

Table 6: The mean of PTD of each task

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
Mean (SD)	4.27 (.77)	3.95 (.84)	4.64 (.58)	3.27 (1.16)	3.50 (1.102)	3.45 (.96)

The table shows that the first three tasks are relatively easier than the last three; particularly the standard deviations of Task 4, 5, and 6 indicate that the variation of the subject's assessment of task difficulty is higher compared to the first three.

Further testing indicates that PDT is significantly associated with the usage of the group feature. We differentiate all tasks (132: 22 (subjects)*6) as high perceived difficult tasks (H) and low perceived difficult tasks (L) based on the mean (mean=3.83; H<3.83, L>3.83). A Chi-square testing finds that PDT is significantly associated with the usage of the group feature (χ^2 (1, N=132) = 4.71, p<.05). Table 7 is the crosstabulation of PDT and usage of the feature.

Table 7: The usage of the group feature (Y/N) and perceived task difficulty

		PDT		Total
		H	L	
Usage of the feature	Y	22	32	54
	N	18	60	78
Total		40	92	132

Table 1 in Section 5.1 also shows that the subjects used the group report more times when they were engaging in Tasks 4, 5, and 6 than in other tasks. This demonstrates that PTD may be a critical factor leading to the use of the feature. Some subjects commented that when they stuck on a topic, the group report is a helpful tool to make the searching moving forward.

Theoretically, knowledge sharing should influence the subjects' search performance. However, we do not see any significant difference in the subjects' search performance between tasks used the feature and those did not use the feature. Since the usage of the group feature is significantly associated with the task difficulty, we investigated whether task difficulty is correlated to search performance. We do find that there is a significant correlation between PTD and TMAP (r (130)=.184, p<.05) and TSR (r (130)=.476, p<.01). This means that when the subjects engage in easier tasks, they may have higher performance and higher satisfaction with the results.

It is possible that knowledge sharing only influence the subjects' search performance in difficult tasks. However, our current experiment cannot test these possible hypotheses. This is what we will continue to investigate in the future studies.

Nevertheless, we cannot deny that the group feature really helps the subjects to complete the tasks they feel difficult, just like what they comment on the usefulness of the group feature.

6. Conclusion and future work

This paper discusses knowledge sharing in IR by investigating the attitude of the subjects to knowledge sharing, what kinds of search knowledge are shared and what are not, how knowledge sharing influences search performance, and its relationship with search expertise and perceived task difficulty.

We develop an IR user interface system - CIRR to capture and organize users' IR knowledge. This system provides a platform for supporting knowledge sharing. After implementing the prototype system, a pilot study was conducted. The results demonstrate that knowledge sharing is preferred by some subjects for some tasks. The subjects use the group feature embedded in the interface to share their queries, domain knowledge, and search results. Very interestingly, they usually don't share usefulness judgment.

However, our findings show that knowledge sharing does not seem to have significant influence on search performance. Neither does the usefulness of the feature.

We do find a significant association between search expertise and the usage of the group feature. From qualitative data, this association appears to exist as well. We also find the usage of the group feature is significantly associated with the perceived task difficulty. We discuss the possible influence of this finding on the relationship between knowledge sharing and search performance. However, these findings need further investigations due to the limitations of this study, such as the small sample size, the use of a particular search engine (Google, the subjects are familiar with it), the assigned search topics (too difficult for many subjects), and so on.

We plan to continue exploring these issues by improving the functions of the group feature and redesigning the experiment. In future experiments, we will recruit a larger sample to validate the results drawn from the current study.

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