A user study on features supporting subjective relevance for information retrieval interfaces

Foo, Schubert; Theng, Yin-Leng; Lee, Shu Shing; Goh, Dion Hoe-Lian

2006

Lee, S. S., Theng Y.-L., Goh, D., & Foo, S. (2006). A user study on features supporting subjective relevance for information retrieval interfaces. Proceedings of the 9th International Conference on Asian Digital Libraries ICADL 2006, (November 27-30, Kyoto, Japan), Lecture Notes in Computer Science 4312, 212-222.

<https://hdl.handle.net/10356/79623>

<https://doi.org/10.1007/11931584>

The original publication is available at www.springerlink.com.

Downloaded on 26 Apr 2023 20:13:13 SGT

Lee, S.S., Theng Y.L., **Goh, D.H.**, and Foo, S. (2006). A user study on features supporting subjective relevance for information retrieval interfaces. *Proceedings of the 9th International Conference on Asian Digital Libraries ICADL 2006*, (November 27-30, Kyoto, Japan), *Lecture Notes in Computer Science 4312*, 212-222..

A User Study on Features Supporting Subjective Relevance for Information Retrieval Interfaces

Shu-Shing Lee, Yin-Leng Theng, Dion Hoe-Lian Goh and
Schubert Shou-Boon Foo

Division of Information Studies
School of Communication and Information
Nanyang Technological University
Singapore 637718

{ps7918592b, tyltheng, ashlgo, assfoo}@ntu.edu.sg

Abstract. Objective relevance regards retrieved documents as relevant without considering users' tasks. Subjective relevance, in contrast, focuses on usefulness of documents for users' contexts. This paper aims to enhance objective relevance and address its limitations by designing a mock-up interface based on ACM Digital Library so as to enhance its support for users' evaluating the subjective relevance of documents. Important features elicited using a factor analytic approach from an earlier study were used to inform design of the search, results list and document record pages in the mock-up. A pilot study was conducted to gather users' feedback about usefulness of designed features. Findings indicated that majority of important features designed were useful. However, subjects suggested that the design of some features could be further improved to facilitate their support for SR. The paper concludes by discussing recommendations for improving the mock-up.

1 Introduction

Information retrieval (IR) systems are traditionally developed using the "best match" principle assuming that users can specify their needs in queries [2]. This principle retrieves documents by matching query terms to terms in documents, and regards retrieved documents as relevant. Here, relevance is computed objectively without considering users' needs and tasks [11].

This paper enhances objective relevance and addresses its limitations by using the subjective relevance approach to design a mock-up IR interface supporting users' evaluations of subjective relevance of documents. The SR concept provides suitable theoretical underpinnings as it focuses on document's relevance for users' needs [6]. Our paper builds on an earlier quantitative study [7] where users' perceptions of importance of SR features were investigated using a factor-analytic approach. Here, we highlight how important features elicited are designed in a mock-up IR interface based on ACM Digital Library so as to enhance its support for SR. A pilot study was conducted to gather users' feedback on usefulness of designed features and how its design could be improved. The paper concludes with recommendations to enhance the mock-up interface's support for SR.

2 Related Work

Different approaches have been used to develop user-centered IR systems aimed at enhancing objective relevance. In the digital library domain, researchers have designed user-centered systems that guide users retrieve relevant documents. For example, the *Digital Work Environment* [8] points users to documents based on user categories and tasks. Another example uses participatory design techniques to develop a user-centered children's digital library, *SearchKids* [5].

A different research area aims to enhance objective relevance by looking at user-centered criteria and dimensions affecting relevance judgments. Examples of such works are [1] and [9]. These works enable designers to provide appropriate information in IR systems to help users find relevant documents for tasks.

3 Our Previous Work

Here, we briefly describe an earlier quantitative study [7] to provide background for this paper. SR types [4] and exploratory factor analysis were used to provide rationale for the quantitative study. In that study, users rated their perceived importance of SR features. The SR concept was defined as usefulness of an information object for users' needs [3]. SR also referred to different intellectual interpretations that a user conducted to interpret if an information object was useful [3]. The SR types were [4]:

- Topical relevance: This relevance is achieved if the topic covered by the assessed information object corresponds to the topic in user's information need.
- Pertinence relevance: This relevance is measured based on a relation between user's knowledge state and retrieved information objects as interpreted by the user.
- Situational relevance: This relevance is determined based on whether the user can use retrieved information objects to address a particular task.
- Motivational relevance: This relevance is assessed based on whether the user can use retrieved information objects in ways that are accepted by the community.

In that study, SR features were organized into three IR interaction stages: 1) the search page; 2) results list page; and 3) document record page. Data gathered was analyzed using exploratory factor analysis to identify groups of important SR features for each stage. Findings indicated different groups of important SR features for the search page, results list page and document record page. These groupings highlighted an order of importance amongst groups of features for each stage. Hence, findings were implied that different clusters of features could be combined to provide rationale for designing different levels of SR support in the search page, results list page, and document record page. Details for this study are found in [7].

4 Using Factor Analysis to Inform Interface Design

The mock-up IR interface was designed using findings elicited through a factor analytic approach in our earlier study. The mock-up was designed to enhance ACM Digital Library's (ACMDL) support for SR by implementing new features and different levels of SR support so that users' evaluations of subjective relevance of documents were facilitated. Reason for enhancing ACMDL's interface was because its features were in line with important features highlighted in the earlier study. Thus, it was inferred that ACMDL's interface had the potential to provide better SR support if findings from our earlier study were incorporated.

Groups of SR features elicited from our earlier study were implied as different clusters of important features that could be designed to provide different levels of SR support for the search page, results list page and document record page. These levels of SR support were conceptualized in the mock-up as basic/advanced search pages; results list page in brief/extended format; and document record page in brief/extended format. Although findings from the earlier study provided important SR features to design in the mock-up, it did not indicate the general look and feel of the interface. Hence, Shneiderman's [10] design heuristics were used to inform design of the mockup. Detailed design of each page in the mock-up is described below.

Design of Basic and Advanced Search Pages

Three groups of important SR features were elicited from the earlier study [7]. These groups focused on three aspects of the search page: 1) providing search options; 2) providing additional features in basic and advanced search pages; and 3) providing default search features. These groups were interpreted as follows: 1) for features in groups that did not specify if it should be designed in the basic or advanced search pages, such features were implemented in both search pages and 2) in instances where the feature was only applicable to either of the search page, it was designed for the specific page. In addition, one feature in the third group specified that the method of entering queries should be similar to those in search engines. Thus, it was inferred that the basic search page should have one query box while the advanced search page should have multiple query boxes for users to construct complex queries.

The basic search page was designed with the simplistic design of search engines in mind. This page consisted of a query box and a drop down menu of search fields. Search examples, “clear query” button, and search history were included to support query formulation and re-formulation. A note was designed to indicate that queries were treated as a phrase search if no Boolean operators were specified. These features designed were new as the original ACMDL interface only included a query box and a “search” button. Design of basic search page is presented in Figure 1.

Figure 1. Features and Recommendations for Basic Search Page

Design of advanced search page was based on the advanced search page in ACMDL. Query boxes from ACMDL were maintained and changes were made to the drop down menu of search fields. The advanced search page included features, such as, “clear query” button, search examples and search history to facilitate query formulation. Our design streamlined the original advanced search page in ACMDL by only providing multiple query boxes with different search options so users could build complex queries. Moreover, our design also incorporated new features, like, search history and “clear query” button. Figure 2 shows the designed advanced search page.

Figure 2. Features and Recommendations for Advanced Search Page

Design of Results List Page in Brief and Extended Format

Exploratory factor analysis conducted in our earlier study highlighted five groups of important SR features [7]. The groups focused on different parts of the results list page, like: 1) pointing users to other documents; 2) providing features that supported evaluation of contents and document type for tasks; 3) providing alternate ways of presenting results list; 4) provide additional information to support evaluation; and 5) provide common features available in results list. These groups were implied as having a decreasing order of importance.

To provide different levels of SR support for the results list page, features in groups 1 and 5 were combined to design a brief format results list page. Reason being group 5 focused on common features, like, ordering documents by relevance, showing relevance percentage and searching within results list, while group 1 focused on pointing users to other documents, thus, features in group 1 could not stand on its own to form a results list page. Figure 3 shows the results list page in brief format.

The extended format results list page included all groups of important features elicited in the earlier study [7]. This page provided features that helped users evaluated appropriate contents and document type for tasks. Examples of features were: 1) provided abstract for each document; 2) displayed paragraph/few lines of full text where search terms appeared; and 3) categorized documents by document type. Different ways of presenting retrieved documents were also designed. This included: 1) sorted documents retrieved by frequency of use and 2) presented results list in Venn diagram format based on query issued. Due to the different ways of presenting results list, an "about results list" feature was designed to provide explanation of how to use features in this page. This page also included additional information to support document evaluation, such as: 1) provided general information about document

source; 2) provided document source's table of contents; and 3) provided subject categories. The designed extended format results list page is shown in Figure 4.

Figure 3. Features and Recommendations for Results List Page (Brief Format)

Figure 4. Features and Recommendations for Results List Page (Extended Format)

Our design enhanced ACMDL by providing two levels of SR support through the results list page in brief and extended formats. New features implemented were: 1) providing different ways of pointing users to other documents; 2) providing various ways of presenting results list; 3) providing additional information about the document to support evaluation; and 4) providing different ways of showing contents either through an abstract or paragraph of full text where query terms appeared.

Design of Document Record Page in Brief and Extended Format

Our earlier study elicited three groups of SR features for the document record page [7]. These groups focused on: 1) allowing users to seek others' help in evaluating documents; 2) providing features that supported access and management of full text; and 3) highlighting portions in full text plus pointing users to other documents. When designing the page, these groups were considered in decreasing order of importance.

Users in the earlier study rated importance of features based on an understanding that this page included detailed information about the document, thus, the document record page in brief format incorporated features from groups 1 and 2 plus details about documents such as title, author, publisher, source, etc.. Figure 5 shows the mockup of document record page in brief format.

Figure 5. Features and Recommendations for Document Record Page in Brief Format

The document record page in extended format was designed by implementing all groups of features elicited for document record page in our earlier study [7]. This page had all features designed in the brief format plus three extra features. These features were: 1) highlighted search terms in html format full text; 2) provided links to full text of documents referenced in the current document; 3) provided full text in PDF format. The document record page (extended format) is shown in Figure 6.

The improvement done to ACMDL was to provide two versions of the document record page depending on the amount of information users needed to support their subjective evaluations of documents. Our design of the document record page valued-added ACMDL by: 1) providing different kinds of collaborative features for users to contact others and authors; 2) facilitating access by providing full text in compressed / uncompressed format; 3) providing “reader” software to decompress files; and 4) linking users to pages in full text where search terms appeared. Moreover, the document record page (extended format) included a feature that highlighted search terms in full text. This feature was unavailable in the original ACMDL’s interface.

Figure 6. Features and Recommendations for Document Record Page in Extended Format

5 A Pilot Study

A pilot study was carried out to elicit users’ feedback regarding usefulness of designed features and gather recommendations for improving the mock-up interface.

Selected Groups: Profiles of Subjects

Two experts and novices were respectively selected to participate in the study. All four subjects were postgraduate students. Subjects were considered experts based on whether they were doing research on interface design.

Methodology

The study consisted of two parts. In the first part, subjects completed three tasks using the mock-up IR interface. The three tasks were: 1) finding a particular document in the results list page; 2) finding an expert for a particular document and 3) downloading the full text of a particular document. This was done to expose subjects to how the interface worked. In the second part, a demonstration of each feature was shown. Next, subjects indicated in a handout the extent of usefulness for each feature

using a five point scale (very useful, useful, neutral, not useful, and not useful at all). Subjects also came together to discuss comments on how features could be improved.

6 Findings

Here, we discuss how subjects rated the usefulness of features designed in the search page, results list page and document record page in comparison with important features elicited in the earlier study. We will also highlight subjects' recommendations for improving the interface. To facilitate discussion, expert subjects are referred as subjects 1 and 2 while novice subjects are labeled as subjects 3 and 4.

6.1 Findings for Basic and Advanced Search Pages

Subjects indicated that majority of features designed were very useful or useful. Thus, findings elicited here were in line with important features highlighted in our earlier study. Subjects also provided feedback on how the design of some SR features could be improved. For example, subject 2 felt that the "clear query" button might not facilitate query formulation in the basic and advanced search pages. This was because users might not want to clear the entire query or they could easily "clear" a query by using the "backspace" key on the keyboard. However, this feedback was not used to refine the mock-up as the other subjects did not mention this problem.

Subjects commented that although it was important to treat queries as a phrase if no Boolean operators were specified, this feature might be problematic when users specified two query keywords that were not meaningful when combined as a phrase. Thus, no documents might be retrieved. This feature could also be tricky when users specified two query phrases. The interface then had to consider if it should combine the phrases using Boolean operator, AND, or treat the phrases as one phrase. Hence, to reduce the negative aspects of this feature, the recommendation was for the basic search page to include a note which advised users to look at search examples and change the query accordingly if they did not want search terms to be treated as a phrase when no Boolean operators were specified.

Subjects also commented that it would be good to indicate how users' queries in the different search boxes might be combined when they executed queries in the advanced search page. The recommendation here was to include a note in advanced search page to indicate that queries in the different search boxes would be combined using Boolean operator, AND. Respective recommendations for basic and advanced search pages are shown in Figures 1 and 2.

6.2 Findings for Results List Page in Brief and Extended Format

Again, subjects' feedback on usefulness of designed features was in line with important features elicited in the earlier study. Although recommendations of documents based on users' profiles was indicated as an important SR feature in our earlier study, subject 2 indicated limitations regarding the design of this feature in the mock-up. Specifically, subject 2 highlighted that this feature designed in the results list page for both formats had to clearly state how it tracked users' profiles to make document recommendations. For example, system could track profiles automatically or recommendations could be based on a user specified profile.

Subject 2 indicated that the feature designed for results list page (extended format) such as: 1) sorting retrieved documents by frequency of use and 2) showing a paragraph in which search terms appeared could be enhanced. This was because it was difficult to measure frequency of use as frequency of documents being accessed

might not imply relevance. However, since subject 2 was the only person who brought out this point, no further recommendations were suggested. Moreover, subject 2 also mentioned that showing all paragraphs of full text where search terms appeared could be more useful than showing just one paragraph. However, this recommendation might not be appropriate as it could cause the interface to be cluttered.

All subjects mentioned that the attempt to represent results list in a Venn diagram was interesting. However, they commented that this representation might be confusing when there were more than three query terms. Hence, the recommendation for results list page in extended format was to simplify the Venn diagram into individual parts and show the different combinations of relationships within the diagram. Recommendations for results list page in brief and extended format are shown in Figures 4 and 5 respectively.

6.3 Findings for Document Record Page in Brief and Extended Format

Subjects indicated that important features elicited from our earlier study that were implemented in the document record page for brief and extended formats were useful. However, there was room for improvement based on subjects' remarks for refining the design of some features.

All subjects suggested that the feature, "authors' contact details" should be placed next to the each authors' name rather than at the bottom of the page so that the overall design becomes more integrated. Subjects 1 and 3 indicated that the document record pages should not only specify the full text's compressed format but it should also indicate the document format when the file was uncompressed. In addition, "reader" software for uncompressing and accessing full text should be available for users.

7 Discussion

Our mock-up interface was designed based on groups of important features elicited from an earlier, quantitative study. Hence, it was expected that all features designed should be useful to subjects in our current study. However, subjects indicated that majority of features designed were useful but some features needed further improvement. This could be due to two reasons: 1) users in the earlier quantitative study rated importance of SR features based on their perceptions without actually looking at how features were designed; and 2) features in the mock-up were useful but due to the way it was designed, the feature could not reach its maximum potential. Thus, based on subjects' comments and eliciting feedback from more subjects, the mock-up could be refined so all features implemented were useful for SR.

Our methodology asked subjects to come together to discuss and agree on different recommendations to improve design features. However, it was noted that novice subjects were concerned with the functionality and how they could use SR features effectively to help them evaluate relevant documents. Expert subjects, in contrast, were concerned with how features were designed so that users could easily understand its functionality and use it for their needs.

Although our work described here employed user-centered methods to guide the design of our interface, techniques used were different from those in [5; 8]. In our context, a factor analytic approach was employed to understand users' perceptions of importance of SR features. Subsequently, important features elicited were designed to enhance ACMDL's support for SR. Then a pilot study was conducted to gather users' feedback on usefulness of designed features and comments to improve the interface.

Our work also differed from those investigating user-centered criteria for relevance judgments, such as, [1] and [9]. Our approach here focused on usefulness of features in helping users evaluate the subjective relevance of documents rather than investigate the criteria used to make relevance judgments of documents.

8 Conclusion and On-going Work

In this paper, we have shown how important SR features elicited using a factor analytic approach in an earlier study was designed in an IR interface. These important features were designed in a mock-up based on ACMDL's interface so as to enhance ACMDL's support for SR. A pilot study was conducted to understand usefulness of designed features and comments were elicited to improve the interface.

Our approach described here has contributions to research. Our work has shown how important features elicited using factor analysis could inform the design of an IR interface supporting SR. Moreover, to ensure that important features designed were useful in helping users evaluate the subjective relevance of documents, a pilot study was conducted. The study gathered feedback to refine the interface's support for SR.

Findings presented here are preliminary and part of on-going research. Future work could focus on conducting evaluations with more users to elicit comprehensive feedback about features designed in the interface. Moreover, elicited feedback could be implemented to further enhance the interface's support for SR.

References

1. Barry, C. L. (1994). User-defined relevance criteria: an exploratory study. *Journal of the American Society for Information Science*, 45 (3), 149-159.
2. Belkin, N. J., Oddy, R. N., and Brooks, H. (1982). ASK for information retrieval: Part I. background and theory. *The Journal of Documentation*, 38 (2), 61-71.
3. Cosijin, E., and Ingwersen, P. (2000). Dimensions of relevance. *Information Processing and Management* 36, 533-550.
4. Borlund, P. and Ingwersen, P. (1998). Measures for relative relevance and ranked half-life: Performance indicators for interactive IR. *Proceedings of the 21st Annual International ACM SIGIR Conference on Research and Development in Information Retrieval*, ACM Press, 324-331.
5. Druin, A. et al. (2001). Designing a digital library for young children: An intergenerational partnership. *Proceedings of the 1st ACM/IEEE-CS Joint Conference on Digital Libraries*, ACM Press, 398-401.
6. Ingwersen, P. and Borlund, P. (1996). Information transfer viewed as interactive cognitive processes. In Ingwersen, P. and Pors, N. O. (Eds.). *Information Science: Integration in Perspective*. Royal School of Librarianship, Denmark, 219-232.
7. Lee, S. -S., Theng, Y. -L., Goh, H. -L. D., and Foo, S. -B. S. (2006). An exploratory factor analytic approach to understand design features for academic learning environments. *Accepted for publication in ECDL 2006*.
8. Meyyapan, N., Chowdhury, G. G. and Foo, S. (2001). Use of a digital work environment prototype to create a user-centered university library. *Journal of Information Science*, 27 (4), 249-264.
9. Mizzaro, S. (1998). How many relevances in information retrieval?. *Interacting with Computers*, 10, 303-320.
10. Shneiderman, B. (1998). *Designing the user interface: Strategies for effective human-computer interaction*. USA: Addison Wesley Longman, Inc..
11. Tang, R. and Solomon, P. (1998). Toward an understanding of the dynamics of relevance judgment: An analysis of one person's search behavior. *Information Process and Management* 34, 237-256.