Display of Search Results in Google-based Yahoo! vs. LCC&K Interfaces: A Comparison Study

Offer Drori
Hebrew University of Jerusalem & SHAAM – Information Systems, Jerulsalem, Israel

offerd@cs.huji.ac.il

Abstract

Search results retrieved from textual databases may be presented in several ways. In commercial search engines, the most common method is the presentation of a list that includes the titles of the retrieved documents, and, sometimes, the first few lines of each document and additional information. A series of studies at the Hebrew University examined the impact of different textual elements presented to the user on the effectiveness of the search. In the current experiment, presentation of search results in the Google-based Yahoo! interface was compared to presentation of search results in the LCC&K (Line in Context, Categories, & Keywords) interface that was developed consequent to the findings of a previous series of studies.

The findings indicate a distinct advantage to the LCC&K interface in terms of objective components (such as duration of search time), and subjective components (such as the user's increasing sense of confidence as the search progressed that it would yield the correct answer, the user's sense of comfort, the extent to which the interface can mislead the user, etc.). This paper will address the experiment process and its findings.

Keywords: Search results, displaying list, information retrieval, interface for search results

Introduction

Presentation of the search results from textual databases is based on two fundamental principles: Visualization of the results through graphical elements, and utilization of textual components to design the list of results. This study focused on the textual elements used to present search results.

Over the past 15 years, various studies have examined the presentation of the list of items that constitute a search result from information retrieval systems. These studies drew on characteristics that included presenting the titles of the documents in the list, use of significant words from the documents in the list, presenting the search terms, presenting the contents of the document, etc. They included:

- Use of the document's titles: (Amento et al., 1999; Sebrechts & Cugini, 1999; Zamir & Etzioni, 1999; Veerasamy & Heikes, 1997; Chimera, 1992).
- Use of the search terms: Tilebars (Hearst, 1995).
- Use of shared characteristics of the documents, such as author, publisher, year, etc.: SensMaker (Baldonado & Winograd, 1997) and Shneiderman (Shneiderman, 1998).

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- Use of the document's contents: (Chimera, 1992; Hertzum, 1996; Landauer, 1995) and Superbook (Egan et al., 1989).

Other studies used the clustering characteristic of documents having a shared characteristic: Grouper (Zamir & Etzioni, 1999; Allen 1994), NIRVE (Sebrechts & Cugini, 1999), and Scatter/Gather (Pirollo et al., 1986).

An examination of the commercial search engines also discloses that most display the title of a document, the first few lines, and its Internet address (URL). Other search engines, mainly Google-based, display the line from the document that contains the search terms. Most studies published to date have not tested the advantages of the method espoused in the respective study over existing methods. Those that have conducted such tests compared the method espoused in the study to other specific methods.

An orderly, comprehensive study was done at the Hebrew University of Jerusalem to define which components systems users wanted to see in the display of the search results.

This series of studies examined the effect of the various components that comprise the presentation of the search results based on the UTECDSR model (Drori, 2000a). The UTECDSR model (see Figure 1) includes 2 hierarchic levels, both based on presenting the information as exclusively textual (without visualization). The model includes elements contained in the documents that are a part of the list (such as the document's title, URL, etc.) in addition to informative elements contained in the document's environment, but not in the document itself (such as citation of external documents, information from the database that yielded the document, etc.).

Findings from a series of studies conducted at the Hebrew University indicate that combining the document's title with several lines from the text that contain the search terms is preferable to presenting merely the first lines of the document (Drori, 2001a). In addition, the study found that presenting the document's title, lines relevant to the search, and keywords is preferred over presenting the same information without keywords (Drori, 2002).

Another finding indicates that display of the document title, lines that contain the search terms, and the documents' categories is preferable to displaying the information without the including the documents' categories (Drori, 2000c). The last finding of the study indicates that presenting keywords relating to the document is equivalent in importance to presenting the documents' categories together with the titles. In

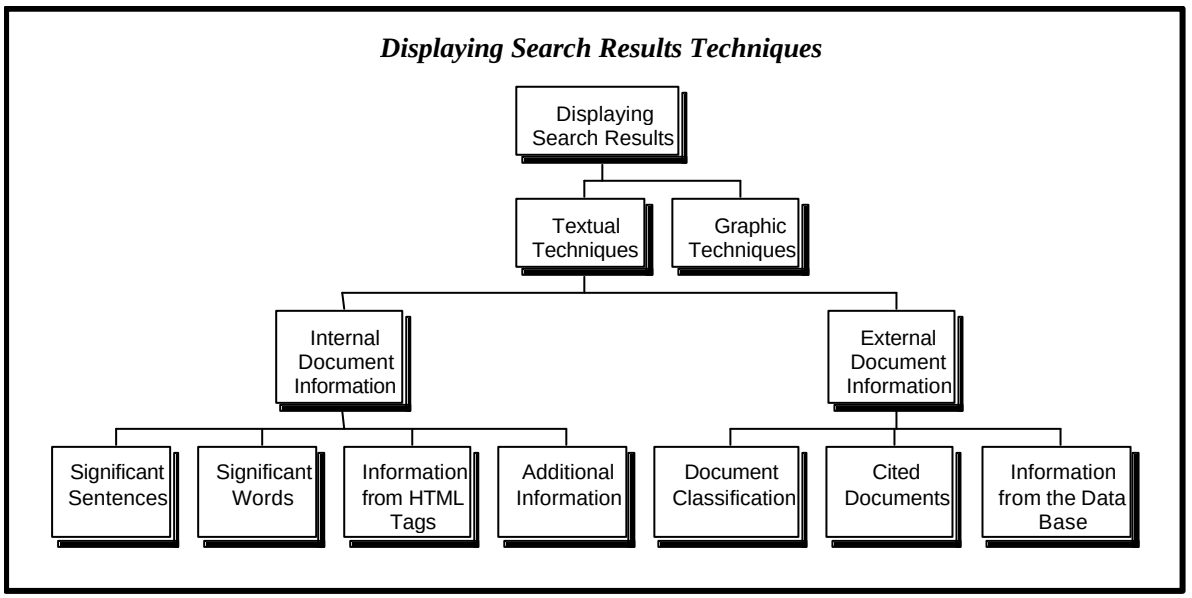

Figure 1. Display techniques for search results (UTECDSR)

addition, displaying the name of the source that created the document and the document URL was found to have only marginal importance (Drori, 2000b).

The Study's Objective

The study's objective was to compare the popular Yahoo! interface (based, as noted above, on Google) to the research interface LCC&K, which was developed based on the parameters outlined in the series of studies detailed above. The study addressed the duration of the search process and the time required to obtain a correct answer using each method, and also examined subjective data such as the user's sense of ease, the user's sense of confidence as the search progressed that it would yield the correct answer, and the extent to which any of the presented information accompanying the title in either the interfaces could be misleading in terms of the search mission.

Study Questions

1. What document details are most important to present in the results list as expressed in the Google-based Yahoo! interface compared to the LCC&K research interface (title, lines relevant to the search, the document's category, keywords, etc.)?
2. What are the quantity, content, and length of information elements from the document that the user deems as being maximally effective in terms of the search mission?

Design of the Study

The study design employed users performing various searches. Each group used two methods of presentation of information. Each group was given a number of search missions.

(The first search query was: What is the exact length of the Jordan River? The second search query was: What is the exact date of birth (day, month, and year) of George Washington, first president of the United States?)

Each mission was executed using a different method of presentation. The search missions included words with identical spelling but different meanings (homographs), which were intended to make it difficult for users to locate the documents relevant to the search query. The selection of these kinds of missions was done in purpose to make the problems more complicated.

Each user was asked to use both of the experimental interfaces for the different search missions. After entering the search query and locating the answer out of the list of documents in the search results interface, the user was asked to note the answer that was found in the appropriate field, and to transmit it to the experimental system. The experimental system simultaneously transmitted the address (URL) of the document in which the answer was found. The testers knew the correct answer and were able to define whether the user had located the correct document and the correct answer.

For the purpose of the experiment, and so as to prevent interfering noises, a simulator was developed that presented the user with the search results according to the interface being employed. The choice between the interfaces participating in the experiment and the users was random. Each user used both of the experimental interfaces for the different search missions. Each interface presented an identical number of documents in the search results list. The placement of the documents containing the correct answers was random but care was taken to place them in relatively the same position in the list (in both of the lists they were placed in the central section of the list). The details of the interfaces used in the experiment appear in the next section. The addition of categories and keywords to the new interface was based a text-analysis algorithm.

The laboratory experiments began with explanations and guidance on the study's objectives and the display interfaces that would be used in the experiment. We confirmed that subjects understood the instructions by allowing them to practice on the system before conducting the searches actually assigned in the experiment. The experiment was conducted discretely, on a "one on one" basis between tester and subject. Subjects were given unlimited time to perform the search missions.

The Interfaces in the Experiment

Yahoo!, the most useful Internet search engine, is powered by the Google search engine. The results list presented the title of the document and a line from the document that contains the search terms. If the search terms appear in the title, they are emphasized by use of a bold typeface. The document's URL is presented below the title, along with a reference to pages linked to the page. The document's URL, along with a reference to similar pages, is presented at the end, under the line from the document that contains the search terms (see Image 1).

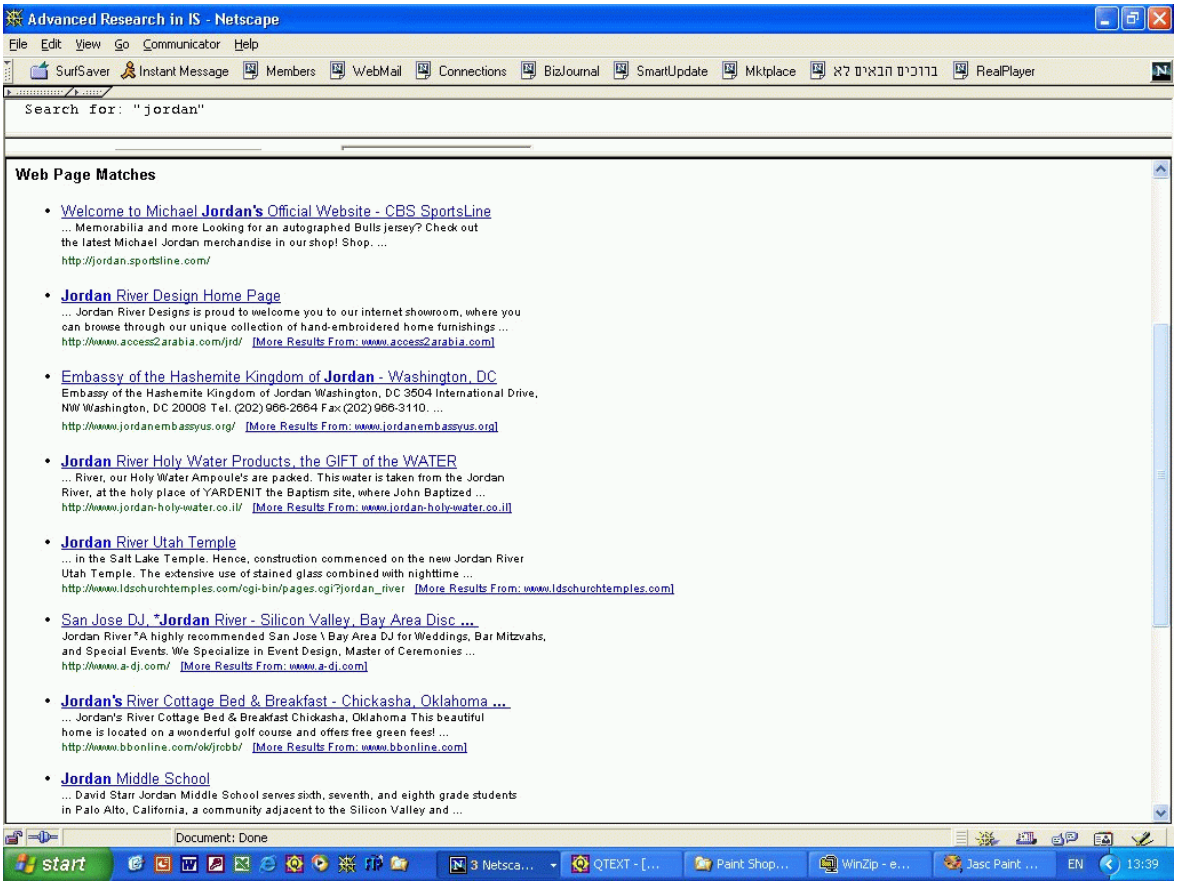

Image 1 - The experiment's Yahoo!-based interface

The research interface LCC&K (Lines in Context, Category & Keywords) displays the search results by presenting the document's title and up to 3 lines from the document that include the search terms. The search terms are emphasized in the document's title as well as in the lines from the document. The document's subject category is presented above the title, and its keywords are presented below the title. A small graphic icon draws attention to the categories and keywords. This interface does not display the document's URL (see Image 2).

For summary of the differences between the two interfaces see table 1.

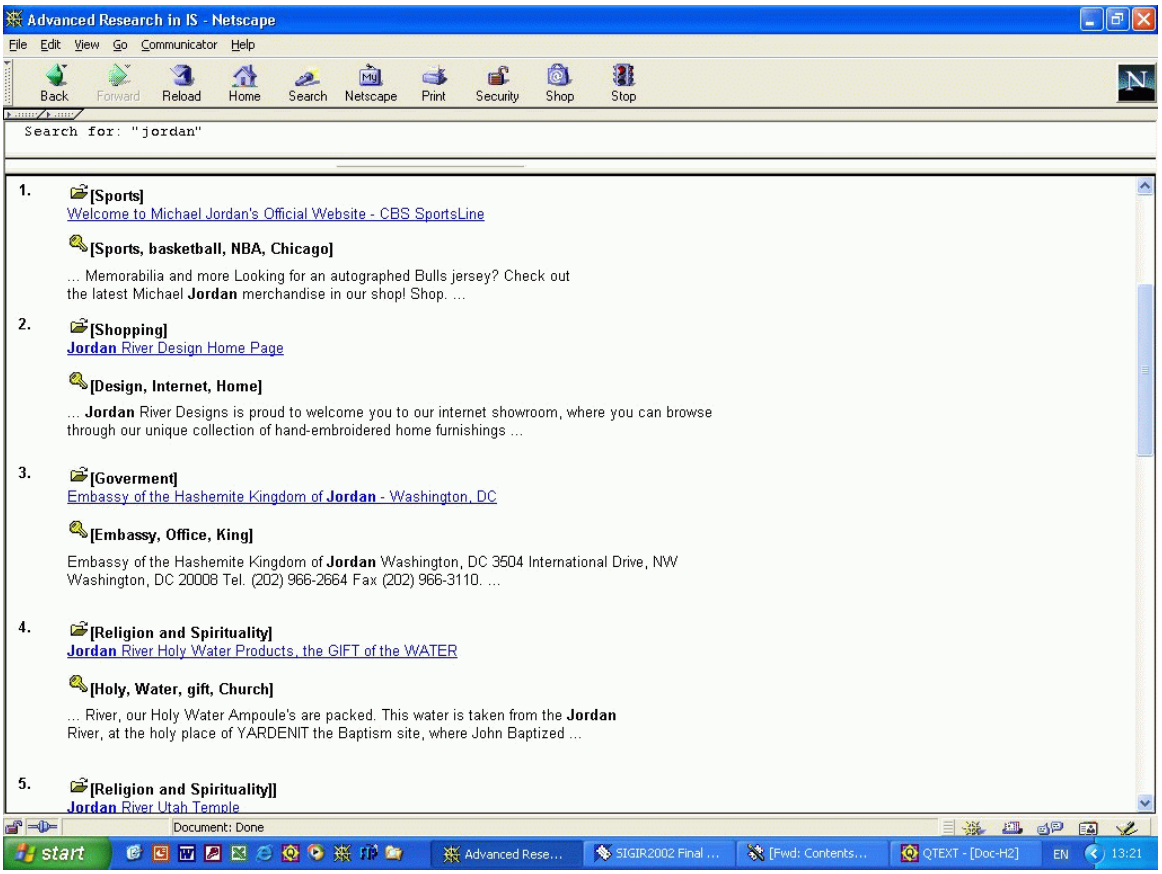

Image 2 - The experiment's LCC&K-based interface

Interface	Heading	Line with search term	Search term highlighted in heading	Search term highlighted in search summary	Document URL	Related documents	Document category	Keywords
Yahoo	✓	✓ (1 line)	✓	×	✓	✓	×	×
Lcc&K	✓	✓ (up to 3 lines)	✓	✓	×	×	✓ (above the heading + icon)	✓ (under the heading + icon)

Table 1 – Summary of the differences between the two interfaces

Selection of Users

Users were selected at random out of the study's population (programming and planning staffers from two computer units). Search missions were also randomly selected.

Data Collection

Data compiled for each user included demographic data such as gender, age, education, computer proficiency, Internet proficiency, etc. Additional objective and subjective data was also compiled for each user. Objective data included duration of each search mission using each method (compiled by means of

a computerized system) and correctness of the answer (verified by the editor of the study who had all the answers in the database). Subjective data included a feedback form completed by each user at the end of the experiment. The form was used to gauge the user's views on the ease of use, sense of confidence that progress of the search would yield the answer, relevance of the information in the results list, etc. Table 2 presents the parameters collected throughout the study and the values used in the feedback form.

ISSUE EXAMINED	TABLE OF VALUES FOR THE ANSWER
Sense of ease during the search	1-5 5–Very comfortable 1–Not comfortable at all
Preference for a specific display interface in commercial search engines	1-5 5–Marked preference 1–No preference
Sense of confidence that progress of the search would yield the answer	1-5 5–Considerable confidence 1–Complete lack of confidence
Sense that the answer was correct	1-5 5–Absolutely Correct 1–Absolutely Incorrect
Quantity of information displayed	1-5 5–Too little 1–Too much 3–Correct amount
Extent of the displayed information's relevance to the search query	1–5 5–Very Relevant 1–Very Irrelevant
Extent to which the information accompanying the document title was misleading with regard to the search query	1–5 5–Not misleading at all 1–Very misleading
Extent to which display of the document's category contributes to the search's effectiveness	1–5 5–Very low contribution 1–Very high contribution
Speed with which answer was obtained using the respective method	1–5 5–Very slow 1–Very fast
Elements important to the user in any search interface (time, sense of ease, satisfaction with search terms, confidence, locating answer without reading the document)	1–5 5–Considerably significant 1–Insignificant
Importance of various methods for performing a complex search	1–5 5–Very important 1–Not important
Advantage of a specific method depending on the complexity of the search mission	1–4 4–No advantage 3–Easy missions 2–Moderately-complex missions 1–Complex missions
Duration of time to obtain information	Measured in seconds
Correctness of the answer	Subject's response verified manually

Table 2 – Data compiled in the study

Duration of experiment

The experiment took place from August 2001 to November 2001.

Centralization of results for the experiment

The experiment was performed with the help of 24 participants-users, comprising staffers from two computer units. Average age of the users was 32. 70% are male (the demographic data are provided for the reader only for information purposes and no analysis was done). Average monthly Internet use is 53 hours, and average monthly use of the Internet's commercial search engines is 8 hours. 88% of the users define themselves as very experienced computer users, 8% report moderate levels of experience, and only 4% report having minimal computer experience. 92% of the users have not used the "find" option to locate an answer in a document text.

Useful statistical terms used in this paper are: **Mean – the average value arrived at**; **SD – standard deviation** (standard deviation of the average with regard to the total number of observations): the lower the standard deviation, the narrower the dispersal of the data and the more meaningful the average result; **P – probability**: in such experiments, a result lower than 0.005 is deemed significant; **Duncan** – a statistical method to check the variance between different groups of methods that allows the existence of the variance to be established directly.

This method in the Anova test gave us a simple means to determine whether there was a significant (i.e., meaningful) difference among the various methods of presentation in different interfaces.

A significant variance (Duncan = there is, see table 3) means that there is a meaningful difference among the methods (in the SAS program that we employed for statistical analysis of the results, the Duncan function automatically groups the different methods). Where the variance is not significant (Duncan = there isn't), it means that the user considers the different methods to be similar and doesn't significantly differentiate among them.

The Interfaces used for the Experiment:

LCC&K: document titles + lines from document containing the search terms in context + categories + keywords

Yahoo!: document titles + line from document containing the search terms in context + document's URL

The main findings from the feedback form data are shown in Tables 3 and 4.

Examined variable	**Methods of presentation Mean (SD)**		**F** (P=0.0001)	**Duncan** (0.05)
	LCC&K	***Yahoo!***		
Sense of ease	4.54 (0.83)	2.87 (1.03)	37.78	All There is
A reported desire that search engines should use the respective method	4.5 (0.97)	2.79 (1.18)	29.86	All There is
Sense of confidence during use	4.71 (0.62)	2.96 (0.95)	56.51	All There is

Sense of confidence in the correctness of the answer	5.0 (0.0)	4.87 (0.34)	3.29	All There is
Quantity of information displayed	2.79 (0.51)	3.62 (1.44)	7.15	All There is
Extent of the displayed information's relevance to the search query	4.66 (0.76)	3.16 (0.82)	43.33	All There is
Extent to which the information accompanying the document title was misleading with regard to the search query	4.42 (1.01)	2.66 (0.92)	39.16	All There is
Extent to which display of the document's category contributes to the search's effectiveness	1.5 (0.88)	2.96 (0.62)	43.55	All There is
Speed with which answer was obtained using the respective method	1.21 (0.41)	1.79 (0.41)	23.73	All There is
Importance of various methods to perform a complex search	3.66 (0.70)	2.33 (0.76)	39.78	All There is
Advantage of a specific method depending on the complexity of the search mission	1.25 (0.53)	3.58 (0.77)	147.80	All There is

Table 3 – Results of the Anova test to examine the variance between the different methods used by LCC&K and Yahoo!

	Ranking the importance of the criteria					**F (P=0.0001)**	**Duncan (0.05)**
	Duration of search until answer obtained	Sense of ease	Sense of satisfaction that search terms were adequately defined	Confidence in the accuracy of the answer	Ability to ascertain answer without reading the documents		
	A	B	C	D	E		
Mean (SD)	2.58 (1.17)	1.87 (0.89)	2.50 (1.06)	3.79 (1.38)	4.21 (1.10)	17.56	D, E; A; B, C

Table 4 – Results of criteria ranking according to its importance to the user (D&E are different from A and both are different from B&C)

Time Results

Table 5 details the times required to obtain the correct answers (after incorrect answers were sifted), summarized in seconds. For each search mission, the data relevant to each method was compiled.

Mission	**N**	**Yahoo!**	**LCC&K**
1- Jordan	24	127.58	60.25
2 - Washington	24	105.66	78.60

Table 5 – Times, in seconds, to obtain correct answers for the search missions using the different methods

Discussion and Conclusions

Discussion

In this section, we will discuss the results and their implications.

Table 3 indicates that users perceived a significant difference between the methods, and shows that LCC&K has a distinct advantage over Yahoo!. This advantage is expressed in the user's perception of the criteria tested: the sense of ease during the search, the quantity of information presented, the relevance of the categories and keywords that accompany the title, the accurate focus of the information accompanying the title (i.e., the information is not misleading), the extent to which presentation of the documents' categories contributes to the effectiveness of the search, the extent of the user's desire that commercial search engines would use the respective search method, the importance of the respective method in performing a complex search, the advantage of a specific method for searches of varying complexity, and the speed with which an answer is obtained.

High ratings are particularly noteworthy for two criteria: the presentation of the documents' categories as significantly contributing to the effectiveness of the search, and the extent to which presenting several lines from the document that include the search terms does not mislead the user in the course of the search process (a phenomenon that could have occurred, for example, where the search terms are homographs [two words spelled alike but different in meaning or derivation]). One element did not rate as having a significant advantage: the sense of confidence in the correctness of the answer. Notwithstanding, LCC&K was still deemed to have a slight edge over Yahoo!

Table 4 demonstrates that users preferred the interface that allowed them to decide which documents in the results list were relevant to the search mission, without the need to actually read the documents in question. In addition, users rated as important the sense of confidence that progress of the search would yield the correct answer, so that selecting the document relevant to fulfilling the search mission could be done without hesitation or unnecessary internal conflict. The remaining criteria were rated as less significant.

Analyzing the length of time required to obtain answers in the two interfaces demonstrates a distinct advantage to the LCC&K interface. This interface allowed the same search missions to be completed in significantly less time that the interface commonly used on the Internet.

Conclusions

Analysis of the Results and Conclusions

The conclusions will be presented with regard to the questions examined by the study, as presented above.

The first question examined in the study:

What details of a document are the most important to present in the results list (title, lines relevant to the search, the document's category, keywords, etc.)?

We have seen that both methods make use of the document's title. The LCC&K method presents up to three lines from the document that contain the search terms, and also underlines the terms. The Yahoo! method presents only one line that includes the search term, and the search terms are underlined only if they appear in the document's title. In addition, the LCCK&K method presents the document's category and keywords, while Yahoo! presents the document's URL and references to similar documents.

The study's findings point to a distinct preference for the method that presents a number of lines from the document that contain the search terms, and underlines the search terms wherever they appear. In

addition, the study found that adding the documents' category to the title and keywords also contributes to the user's sense of the effectiveness of the search. The study found that the LCC&K method was preferred according to almost all the criteria (except one), and that it is preferable mainly for complex search missions.

The second question examined in the study:

What are the quantity, content, and length of information elements from the document that the user deems as being maximally effective in terms of the search mission?

The study examined two methods of presenting the list of search results in response to a search query in a textual database. Each method was tested in several categories. The tested methods were the LCC&K method (document title + lines containing the search terms + document's category + keywords) and the Yahoo! method (document title + lines containing the search terms + document's URL).

The Study's Conclusions are as Follows:

1. The LCC&K method is preferred over the Yahoo! method as far as the user's sense of ease during the search (Especially using document's category + keywords).
2. Users indicated that they would prefer that Internet search engines use the LCC&K method rather than the Yahoo! method.
3. As the search progressed, users reported a higher degree of confidence that the correct result would be obtained when using the LCC&K method than when using the Yahoo! method.
4. Users reported a similar sense of confidence in the correctness of the answer obtained through both methods, with a slight advantage to the LCC&K method. The high rating for both methods can be explained by the fact that most users were able to obtain the correct answer in the course of the search, making them highly confident without connection to the method used to present search results.
5. The amount of information displayed in the LCC&K interface was deemed more appropriate to the search mission than the amount of information displayed in the Yahoo! interface.
6. Users reported that the information accompanying the title in the LCC&K interface results list contributed more to the effectiveness of the search mission than did the information accompanying the title in Yahoo! interface results list.
7. Users reported that the information accompanying the title in the search results displayed by the LCC&K method were not misleading, even though this can occur where search terms are homographs.
8. Lengths of time to obtain the correct answer using the different methods:
   Users reported a clear advantage to the LCC&K method, which was deemed to be a faster interface than the Yahoo! method. This finding is reinforced when examining the actual, objectively-tested results of the times for performance of any of the search missions. In two search missions, the search using the LCC&K method yielded the answer most quickly (60 seconds as opposed to 128 seconds in the Yahoo! method, and 79 seconds as opposed to 106 seconds in the Yahoo! method). See table 5.
9. Table 4, which ranks the criteria insofar as their importance to the user, shows that users perceive the two most important criteria to be the ability to obtain the answer without reading all the documents in the results list, and, to a lesser extent, their sense of confidence in the correctness of the answer. Both these criteria were also significant in their variance from other criteria.

The next two most important criteria were the time it took to locate the answer and, to a lesser extent, the user's sense of satisfaction that the defined search terms were adequate.

The criterion deemed the least important was the user's sense of ease during the search process. This criterion was also found to be significantly different from the others.

Summary and Future Research

The findings of this study confirm the findings of the previous series of studies that examined the advantages of using certain textual components in presenting a list of search results. Information components that users deemed effective include the document title and relevant lines from the document that include the search terms. These elements appear in both interfaces. Nonetheless, they preferred the LCC&K interface, deeming the additional displayed elements of categories, keywords, the number of search terms presented and highlighted in search results, and the faster search results, as having significant value. The perception that the LCC&K interface was preferred is particularly important when noting that it was compared to the highly popular Google interface, which is currently viewed as having an excellent reputation in the realm of search engines.

More extensive study must be made of a larger number of users in order to establish more general conclusions. In addition, a study is planned to examine the effect of the language on the search results interface. The planned study will be based on databases of information in Hebrew, for a Hebrew-speaking population.

In addition, another study is being planned to examine the LCC&K interface in comparison with the Google interface, which differs in several parameters from the Google-based Yahoo! interface.

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Biography

Offer Drori, Ph.D. in computer science. Homepage: http://shum.huji.ac.il/~offerd/, E-mail: mailto:offerd@cc.huji.ac.il

Lecturer at the School of Business Administration, School of Engineering and Computer Science of The Hebrew University of Jerusalem.

Head of information database systems, SHAAM Information Systems.

Chairman, Special Interest Group on Text Retrieval Systems (SIGTRS) - http://sigtrs.huji.ac.il

Area of professional engagement and research: Online information systems, system analysis and design, large information databases, information retrieval, human-computer interaction.

Membership: ACM (Association for Computing Machinery), Israel Association of System Analysts, IPA (Information Processing Association of Israel)