
Ease of use versus user control: an evaluation of Web and non-Web interfaces of online databases

Hong (Iris) Xie and Colleen Cool

The authors

Hong (Iris) Xie is an Assistant Professor in the School of Library and Information Science at the University of Wisconsin-Milwaukee, Milwaukee, USA.

Colleen Cool is an Assistant Professor in the Graduate School of Library and Information Studies, at Queens College, City University of New York, New York, USA.

Keywords

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Abstract

This paper reports on an investigation comparing searcher experiences with Web and non-Web interfaces to online databases. The study was designed to address the following questions: what is the nature of searcher preferences for Web versus non-Web interfaces to online databases and, more specifically, what are the characteristics of Web and non-Web based interfaces that help or hinder effective searching? Two samples of students enrolled in a graduate level Advanced Databases Searching course were used as participants in the research. In this class, the students used several Web and non-Web based online databases. The data collected from self-administered open-ended questionnaires were employed in the analysis to address the research questions posed above. Results of the study indicate that some of the functions of Web interfaces outperform non-Web interfaces; but at the same time they are not universally preferred. An important dynamic that surfaced in this study which helped to explain searcher preference for one type of interface over another was that of user control versus ease of use in the search process. This study concludes with an argument for greater attention to the tension between user control and ease of use in the design of effective and useful interactive online retrieval systems.

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Introduction

World Wide Web access to online databases is becoming more pervasive, and this development is one of the most important factors influencing developments among database producers, vendors and users. From 1975 to 1998, the number of databases grew from 301 to 11,339; producers have increased from 200 to 3,686; and vendors have grown from 105 to 2,459. In addition, the estimated number of searchers has increased from approximately 750,000 in 1994 to 90 million in 1998 (Williams, 1999). Notess (1998) further pointed out that 1998 saw increased consolidation of Web-based search systems and greater sophistication from database vendors in their delivery of database information via the Web.

Within this environment, some Windows-based online system providers are planning to transfer their services to the Web. For example, Dow Jones Interactive plans to build a Web interface with all the functionality of the latest Windows software. The Dow Jones News/Retrieval software, version 5.0 marks the transition for the entire service to a full Web interface (Feldman, 1996). LEXIS-NEXIS is developing eight information channels for Internet Explorer which include legal, insurance and finance channels (Poyner, 1998).

A fundamental characteristic of Web-based searching is that it is inherently interactive, and that it facilitates a variety of ways for users to interact with both information and systems. Some of the significant characteristics of these new Web-based access mechanisms are that they:

- guide user access to a variety of databases;
- facilitate multiple interactive search strategies, such as browsing, searching, etc.;
- assist mapping to thesaurus terms;
- offer interactive help mechanisms;
- afford multiple manipulations of output;
- provide iterative movement by links.

In general, Web interfaces are more intuitive and flexible to use. Koehler and Mincey (1996) compared the dial-up access and Web access method, and concluded that FirstSearch Web was a major improvement.

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However, not everyone agrees that Web interfaces are better than non-Web interfaces of online databases. In comparisons of non-Web interfaces and Web interfaces of online databases, one issue emerges: it seems as if experienced users do not benefit as much as novice users from the Web interfaces. For example, in a recent study of Web searching behaviour, van Brakel (1997) found that experienced online searchers seemed sceptical that Web interfaces can provide the same search sophistication level as traditional dial-up searching. Bates (1997) compared Web-based packages DIALOG Web and DataStar Web, with the Classic, ASCII, dial-up version of DIALOG with which most experienced online searchers learned to search. She acknowledged the benefits of the Web-based product, but also considered the Web-based product to be less efficient and responsive for the experienced searcher than the ASCII product. In a comparison of DataStar Web and DataStar command language searching, Barker (1998) concluded that, although both interfaces offer access to the same information, there are significant differences. Many of these differences might affect retrieval effectiveness among both novice and experienced searchers.

Research problem

The emergence of Web-based access to online databases opens a new avenue for end users to access online databases via Web interfaces. The literature cited above demonstrates that Web interfaces of online systems are mixed blessings. On the one hand, they are intuitive and easy to use for novices; on the other hand, they are less efficient to control for expert users. In order to support both novice and expert users, we need to first understand how users evaluate non-Web and Web interfaces of online databases. The objective of this study is to explore the nature of searcher preferences for Web versus non-Web interfaces to online databases, and more specifically:

- What are the advantages of Web interfaces that facilitate users in retrieving relevant information?
- What are the problems of Web interfaces that hinder users in retrieving relevant information?

These are the central questions that need to be investigated in order to design interfaces or systems to support end users effectively in their interactions with online systems. Both of these questions have been addressed in this study, which is described below.

Methodology

Data collection

This research is based on two studies. Master's level students in two advanced database searching classes evaluated Web and non-Web interfaces of several online systems. Thirteen students took part in the first study in the autumn of 1997 while 28 students participated in the second study during the spring of 1998. All of the participants had prior experience with DIALOG search. In the advanced database searching class, these students used both Web (DIALOG Web, DataStar Web, WilsonWeb, FirstSearch Web, OVID Web and ProQuest Web), and Windows (DIALOG, DataTimes, LEXIS-NEXIS and Dow Jones Interactive) interfaces of online databases. Table I presents the online systems that subjects used in these two studies. DataTimes (service closed) and DataStar (evaluation version) were excluded from the second study.

Although these systems do not represent all of the available online systems, which are always changing, we use them here to study the general problems raised by the research questions above.

After using each of these systems for a period of several months, participants were asked to evaluate each one in terms of how

Table I Online systems evaluated in the two studies

	First study	Second study
DataStar Web	•	
DataTimes	•	
DIALOG	•	•
DIALOG Web	•	•
Dow Jones Interactive	•	•
FirstSearch Web	•	•
LEXIS-NEXIS	•	•
OVID Web	•	•
ProQuest Web	•	•
Wilson Web	•	•

effectively it helped them, according to the following criteria:

- (1) online system access;
- (2) database selection;
- (3) search strategy formulation and reformulation;
- (4) usefulness of help mechanisms;
- (5) document organisation and display;
- (6) printing, downloading and exporting of results.

These criteria well represent the complete search process. Compared to the first study, the second one solicited more specific evaluation of Web and non-Web interfaces of online systems from subjects.

For each of the criteria, participants were asked to rate the online systems using a five-point scale (1 = none, 2 = a little, 3 = some, 4 = some more and 5 = extremely). Open-ended questions were administered to participants, who were asked about their experiences with database interfaces in terms of the above six criteria. Most importantly, searchers were instructed to elaborate upon their reasons, and to give examples to support their answers.

Data analysis

Qualitative and quantitative methods were used in the study. Content analysis of open-ended data was undertaken, using Strauss and Corbin's (1990) open coding technique. Examples are illustrated in the results.

Results of the first study have been reported in the 1998 National Online Meeting (Xie, 1998); therefore, this paper focuses on the second study. Table II summarises subjects'

experience with information retrieval systems. At the time of this study, most of the subjects (96.5 per cent) had at least some experience searching computerised library catalogues and Web search engines, and about half of the subjects (53.5 per cent) reported having at least some experience searching CD-ROMs. Half of them (50 per cent) had this same level of experience searching full text databases. The majority had little or no experience searching in both ranked-output information retrieval systems (60.7 per cent) and information retrieval systems that provide relevance feedback (75 per cent).

Table III summarises subjects' experience with online systems. The overwhelming majority (92.8 per cent) had at least some experience searching DIALOG, but all of the subjects said that they had little or no experience searching DIALOG Web. About half of the subjects (53.5 per cent) had at least some experience searching Ovid Web, which is readily available at the University library. About 90 per cent of the subjects reported little or no experience searching the other online systems included in this study.

Results

For each of the interface conditions (Web and non-Web), subjects were asked the following questions about the particular system they used. To what extent did the system help you effectively:

- (1) access it?
- (2) select database(s)?

Table II Subjects' experience with information retrieval systems

	None	A little	Some	Some more	A great deal
Searching on computerised library catalogues	0 0.0%	1 3.6%	11 39.3%	8 28.6%	8 28.6%
Searching on CD-ROM systems	6 21.4%	7 25.0%	10 35.7%	3 10.7%	2 7.1%
Searching on World Wide Web search engines	0 0.0%	1 3.6%	9 32.1%	12 42.9%	6 21.4%
Searching full-text databases	2 7.1%	12 42.9%	10 35.7%	3 10.7%	1 3.6%
Searching in ranked-output information retrieval systems	3 10.7%	14 50.0%	9 32.1%	1 3.6%	1 3.6%
Searching in information retrieval systems that provide relevance feedback	7 25.0%	14 50.0%	6 21.4%	1 3.6%	0 0.0

Table III Subjects' experience with online systems

	None	A little	Some	Some more	A great deal
DIALOG	0 0.0%	2 7.1%	13 46.4%	13 46.4%	0 0.0%
Dow Jones Interactive	24 85.7%	2 7.1%	0 0.0%	2 7.1%	0 0.0%
LEXIS-NEXIS	16 57.1%	9 32.1%	3 10.7%	0 0.0%	0 0.0%
DIALOG Web	26 92.9%	2 7.1%	0 0.0%	0 0.0%	0 0.0%
FirstSearch Web	26 92.9%	1 3.6%	1 3.6%	0 0.0%	0 0.0%
OID Web	8 28.6%	5 17.9%	9 32.1%	6 21.4%	0 0.0%
ProQuest Web	25 89.3%	1 3.6%	1 3.6%	1 3.6%	0 0.0%
WilsonWeb	17 60.7%	7 25.0%	3 10.7%	1 3.6%	0 0.0%

- (3) formulate and reformulate your search strategies?
- (4) use help mechanisms?
- (5) organise and display documents?
- (6) print, download and export search results?

The results discussed below are organised in sections corresponding to these questions. For each of the questions, subjects were asked for the reasons associated with their answers.

Online system access

From the qualitative data analysis, two concerns about online system access emerged: ease of access and connection difficulties. The first category mainly focused on the advantages of accessing Web-based online systems, while the second represented the problems searchers encountered in connecting to Web-based online systems. Table IV summarises the extent to which each online system was perceived to help searchers to access the system. The results show that, in general, Web-based systems are better than non-Web systems in helping users access online systems even though the difference is small. The percentage of participants giving ratings of 4 or 5 to DIALOG, LEXIS-NEXIS, and Dow Jones Interactive respectively was 46.5 per cent, 50 per cent and 53.6 per cent. In contrast, when we look at the Web-based systems, the percentage of searchers who rated any one system as "4" or

"5" ranged from 53.6 per cent (FirstSearch Web) to 85.7 per cent (WilsonWeb).

Ease of access

As one searcher claimed: "This is an area where I see overwhelming advantages for the Web-based systems", and almost every searcher agreed that easy access was one of the most distinctive features for Web interfaces. In these systems, users can take control of when and where to use an online system. "With a password, the systems can be accessed from home, from school, the office, wherever Internet access is available," one responded. Any computer that could access the Web could also access these Web-based online systems.

Platform independence was another advantage of Web interfaces. Searchers did not have to spend hours to download the software and install it. Also, they could connect to online services regardless of whether that software was used on a PC, MAC or UNIX, and they could access these systems in a similar way from different systems. No proprietary software or specific operating system or platform was needed, other than a Web browser.

Connection difficulties

"The greatest disadvantage of Web interfaces is the slowness of the systems," commented one of the subjects. Slow connections were identified as one of the problems of Web

Table IV Subjects' evaluation of online system access

	To what extent does each of the following systems help you to effectively access the online system?				
	Not at all	A little	Some	Some more	A great deal
	1	2	3	4	5
DIALOG	6 21.4%	1 3.6%	8 28.6%	8 28.6%	5 17.9%
Dow Jones Interactive	2 7.1%	3 10.7%	8 28.6%	7 25.0%	8 28.6%
LEXIS-NEXIS	2 7.1%	4 14.3%	8 28.6%	11 39.3%	3 10.7%
DIALOG Web	2 7.1%	1 3.6%	4 14.3%	16 57.1%	5 17.9%
FirstSearch Web	0 0.0%	5 17.9%	8 28.6%	12 42.9%	3 10.7%
OVID Web	2 7.1%	1 3.6%	6 21.4%	9 32.1%	10 35.7
ProQuest Web	0 0.0%	2 7.1%	7 25.0%	14 50.0%	5 17.9
WilsonWeb	0 0.0%	0 0.0%	4 14.3%	16 57.1%	8 28.6

access, especially at certain times of the day. Almost every searcher agreed that the response time was better on direct link systems. Users felt frustrated when they lost control of the speed of the system. As one user said: "No matter what kind of wonderful interface you have, it doesn't help if your users cannot access it because of heavy traffic on the server." Slow connection occurs when users try to connect to the online systems as well as in the search process. One subject pointed out: "There were many times when I become impatient with the very slow lag times of the Web systems, especially when I had a large search result." Long waits may also inhibit a high-precision search, since reformulation of a search strategy often means generating new search results each time. Several searchers also complained that they were disconnected for no apparent reasons.

In addition to slow connection and disconnection, some Web interfaces were also criticised for having embedded sign-on buttons. Some systems have several pages prior to the sign-on page, while the other systems have a sign-on link embedded in a list of links. According to one user, "The most trouble I ever had was in finding the 'sign-on' button in OVID. It was buried in a long list of links."

Database selection

In Web interfaces, databases can be selected by choosing a subject, by using a specific type of information provided, by checking the box next to the database label, by clicking on the name of the database itself, by searching relevant databases, or by selecting databases when ordering the service. Three major categories of database selection identified by searchers were: database selection dilemma, database description access, relevant database identification and single versus multiple databases access. Table V presents the extent to which each online system helps searchers effectively select databases. There is no obvious difference between Web-based and window-based online systems. The results suggest that the amount of control searchers have with each online system may determine their preferences for any individual system.

Database selection dilemma

The question of how much control searchers like to have in selecting appropriate databases is a difficult one. On the one hand, searchers appear to prefer easy database selection. In this study, ProQuest was rated the highest in helping users select databases, with 39.3 per cent giving it a rating of 5. In ProQuest users do not need to choose databases, which gives them more time to concentrate on how to

Table V Subjects' evaluation of database selection

	To what extent does each of the following systems help you effectively select database(s)?				
	Not at all	A little	Some	Some more	A great deal
	1	2	3	4	5
DIALOG	3 10.7%	2 7.1%	5 17.9%	7 25.0%	11 39.3%
Dow Jones Interactive	1 3.6%	2 7.1%	7 25.0%	9 32.1%	9 32.1%
LEXIS-NEXIS	6 21.4%	10 35.7%	7 25.0%	4 14.3%	1 3.6%
DIALOG Web	2 7.1%	3 10.7%	9 32.1%	5 17.9%	9 32.1%
FirstSearch Web	0 0.0%	4 14.3%	12 42.9%	11 39.3%	1 3.6%
OVID Web	3 10.7%	0 0.0%	6 21.4%	13 46.4%	6 21.4%
ProQuest Web	5 17.9%	2 7.1%	4 14.3%	6 21.4%	11 39.3%
WilsonWeb	0 0.0%	1 3.6%	8 28.6%	10 35.7%	9 32.1%

formulate their search strategies. At the same time, LEXIS-NEXIS was rated the lowest, with 57 per cent of the searchers saying that LEXIS-NEXIS did nothing or did little to help in their database selection process. We might say that LEXIS-NEXIS provides the user with complete control, but this control may be too difficult to master.

On the other hand, some searchers were not satisfied that they lost the control they had before in searching traditional DIALOG. About 25 per cent of searchers thought that ProQuest offered none or little help to them in their database selection process. Here are some comments: "I found this to be particularly disappointing for the fact that it removes from the searchers a certain control and autonomy on their searches. This way of operating may be good for a novice but I believe experienced searchers prefer to select databases themselves. ProQuest's decision to choose a database for the user takes too much control out of the user's hands and so makes his/her searches too ineffective to be considered." Others argued they felt they lost control over which databases to select and what corresponding search strategies to take. Also "it would not be a realistic option to search an overwhelming number of databases with each search."

Database description access

It is essential for searchers to have rudimentary knowledge of databases before they select the appropriate ones for their searches. In traditional online systems, such as LEXIS-NEXIS and DIALOG, pre-planning is necessary for searchers to select the most appropriate database(s). According to one searcher, "for DIALOG, searchers must know the database or study the printed material to know which databases are available. LEXIS-NEXIS' menus are not easy to visualise without prior knowledge or practice, so I need to learn the library and file system. It was frustrating."

Web-based systems have some clear advantages. According to searchers, the visual layout made the database selection an easy task because all databases or database groups were listed in one place. The various point-and-click menus, subject arrangements, and check boxes made it easy to select relevant databases. WilsonWeb (96.4 per cent), OVID Web (89.3 per cent), FirstSearch Web (85.8 per cent) and DIALOG Web (82.1 per cent) were rated high (3 or higher) in providing help in selecting databases, and they were the most praised systems in providing easy access database description. OVID Web was well complimented for its feature-"I"

(Information) icon. As one subject said: “I particularly prefer the OVID Web and DIALOG Web because easy access can be hyper-linked to the database-specific information.” Another subject added: “the ‘I’ icon placed at the left of the databases’ name is the easiest and quickest way of getting information on the content of databases throughout the various systems”. WilsonWeb was highly regarded for its descriptive names of databases, meaning that users do not have to memorise database descriptions. Some searchers also liked the display of database descriptions in FirstSearch Web in which they did not have to click help.

Relevant database identification

With an increasing number of online databases, users like to be able to select relevant databases within one system. The mechanism which enables searchers to search across all the databases to find the appropriate databases when they are not sure which database or databases to select is a powerful tool. Even though traditional interfaces also provided this feature, users preferred Web interfaces because that feature normally was on the same screen as a list of available databases, such as DIALOG’s Dialindex and WilsonWeb’s “Find Terms in Database”. They hoped that other Web-based products also provided this option. One searcher concluded: “Even if a user does not use Dialindex to find the number of hits, its categories are very useful to narrow searches to one area without having to look up individual relevant databases.”

Single versus multiple database access

Some non-Web graphical interfaces, such as Dow Jones Interactive and LEXIS-NEXIS, offer users the opportunity to select groups of databases as well as individual ones, and they also allow users to keep their source lists. For most of the searchers, the biggest problem of Web interfaces was that most of them only allow one database to be selected. One searcher mentioned: “a major disadvantage is that only one database can be chosen at a time for FirstSearch Web.” FirstSearch Web was considered one of the inconvenient systems because if a searcher wants to perform the same search in several databases the query must be retyped with each new database that is opened.

Search strategy formulation and reformulation

Browsing features, search assistance, relevance feedback features and search history links were identified as the major issues related to search strategy formulation and reformulation. According to these searchers, Web interfaces with their own characteristics, to a great extent, assisted them in selecting fields and terms, connecting search histories, and limiting their searches. For example, graphics and colour often helped searchers to understand concepts and operations. However, these mechanisms also brought some problems that need to be improved.

Table VI summarises how each online system helps searchers formulate and reformulate search strategies. We see that there is not much difference between Web-based and non-Web online systems in terms of assisting searchers to formulate and reformulate search strategies. Among all the systems, OVID Web was rated the highest. Seventy-eight per cent of the searchers (rated 4 or 5) thought OVID Web helped them formulate and reformulate their search strategies. In addition to OVID Web, there is little difference between Web and non-Web online systems.

Browsing features

Browsing features that help users formulate and reformulate their search strategies, especially when they have problems in constructing a query, are highly praised. According to one user, “The browsing feature was especially useful in searching for concepts that I didn’t know very well for proper names and for document types.” One searcher summarised his selection of browsing features for an ideal online system: “a term index as well as a browse index in FirstSearch Web is excellent, so are ‘Expand’ on DIALOG and ‘index’ on WilsonWeb. ProQuest has some unique features that I would like to see incorporated into my ideal database.” Among all the browsing features, ProQuest’s table of contents is the one most welcomed. One searcher said: “I like the idea that I can go into so many journals as if I were sitting in the stacks. To be able to go into the table of contents in periodicals and newspapers as if the volume were right in front of me proved very valuable.” Another searcher described his experience: “After searching a particular issue of *The Magazine Antiques* of December

Table VI Subjects' evaluation of search strategy formulation and reformulation

	To what extent does each of the following systems help you effectively formulate and reformulate your search strategies?				
	Not at all	A little	Some	Some more	A great deal
	1	2	3	4	5
DIALOG	4 14.3%	2 7.1%	4 14.3%	10 35.7%	8 28.6%
Dow Jones Interactive	0 0.0%	4 14.3%	8 28.6%	12 42.9%	4 14.3%
LEXIS-NEXIS	1 3.6%	6 21.4%	8 28.6%	12 42.9%	1 3.6%
DIALOG Web	2 7.1%	4 14.3%	7 25.0%	7 25.0%	8 28.6%
FirstSearch Web	0 0.0%	3 10.7%	14 50.0%	9 32.1%	2 7.1%
OVID Web	0 0.0%	0 0.0%	6 21.4%	11 39.3%	11 39.3%
ProQuest Web	1 3.6%	3 10.7%	9 32.1%	10 35.7%	5 17.9%
WilsonWeb	0 0.0%	2 7.1%	10 35.7%	11 39.3%	5 17.9%

1994, I must say it is really amazing to be able to visualise the magazines as if it were in my hands and simply clicking on an hyper-linked title to get an article.”

Search assistance

Although they like to have the same fields available for all the databases, searchers also felt that “it would be insane to try and list all of the types of fields and limits for all the databases”. In using Web interfaces, searchers took advantage of clicking check-boxes and pull-down menus for selecting different fields. In general, they liked the way that they did not have to remember complex commands as they had to do in traditional interfaces. However, searchers also pointed out problems brought by the assistance features. Some interfaces, such as WilsonWeb, did not reset the search choices for a new search, and that made several users redo their searches. Assistant features in OVID Web and ProQuest Web provided helpful guidance for searchers in terms of field selection. Simultaneously, they also required several steps for users to formulate their queries. One searcher identified the problem this way: “the multiple interfaces needed to enter fields and dates makes the process too cumbersome and the momentum of the search is distracted.” Not all Web interfaces

showed all fields that existed in a database, so sometimes searchers had to consult the manual to figure out which ones were available.

Relevance feedback features

The index features provided by the Web interfaces impressed most of the users. They felt the index features of Web databases seemed easier to use than that of non-Web interfaces because of the hyperlinks. WilsonWeb’s index, ProQuest Web’s related terminology, DIALOG’s descriptor, FirstSearch Web’s keyword index and OVID Web’s vocabulary mapping were the examples of these index features. These systems provide a sort of relevance feedback through using some of the various index terms and descriptors of a bibliographical record as hyperlinks which can serve as commands to initiate a new search. Relevance feedback gives users a greater degree of control. One searcher pointed out: “It does not feel as if you have much control when you query this system, but the system gives you so much feedback that in some ways, I think you do have control.”

Search history link

In Web interfaces, searchers were satisfied with the ability to view their search histories

and reformulate their queries. Almost all the Web interfaces created sets for recombination by selecting Boolean “and” or “or” sets. Most Web interfaces allowed searchers to have the flexibility to go back to their search history and modify their query. FirstSearch Web had a history button that searchers could press when they wanted to review the history. OVID Web had a “combine searches” icon at the top throughout its databases and proved to be very useful to these searchers. One searcher emphasised: “The combining search feature in OVID Web reminds me of DIALOG as it also gives me a better feeling of control over my search.” Another subject thought the Web led to the advantage of Web interfaces: “one of the great advantages of the Web online systems is the ‘back’ and ‘forward’ buttons in the browser. In this way if a searcher gets lost ending up in a place they do not want to be or forget how they get there, they can find their way back to the previous page.” However, to some searchers, the extensive history lists of each search that showed all the time were a disadvantage in Web interfaces, such as the search history in WilsonWeb.

Usefulness of help mechanisms

The help mechanism is a key component of an online system. A well-designed help mechanism enhances the use of a system, while a poorly designed help mechanism will hinder use. In this study, users preferred the help mechanism to be sensitive to their problems and well organised for easy access. Table VII summarises the extent to which each online system helps searchers use help mechanisms. The results show the overwhelming advantage of Web interfaces over non-Web interfaces, except Dow Jones Interactive. The percentage of subjects who rated the system 4 or 5 for Web interfaces are OVID Web (78.5 per cent), WilsonWeb (57.2 per cent), ProQuest Web (53.6 per cent), FirstSearch Web (50 per cent) and DIALOG Web (46.4 per cent) compared to non-Web interface such as DIALOG (28.6 per cent) and LEXIS-NEXIS (25 per cent).

Context sensitivity

Many searchers in this study stressed the need for a system to offer help specific to their problems in the search process, and most of the Web interfaces did not provide the context-sensitive help that LEXIS-NEXIS and Dow Jones Interactive provided. Often, it

was very difficult for users to figure out not only how to solve their problems but also how to characterise or label their problems. Web interfaces, such as WilsonWeb, FirstSearch Web and ProQuest Web are context sensitive, hyper-linked and index specified. However, it is difficult to move from general help to a help screen that addresses the problems a searcher encounters when searching specific database(s). One feature that WilsonWeb has is a searching “hint” that appears at the top of the search window. For non-Web interfaces, familiarity with documentation and experience with the system is the only way to accomplish complex searches except in Dow Jones Interactive. One subject described a type of problem frequently encountered across all systems: “when queries are not well formulated according to the system’s requirements, most systems will prompt the searcher saying that a suffix, or field or operator is not supported or is an unrecognised command, but rarely has any system been very specific to the particular reason or where the fault is precisely happening’.”

Well-organised help functions

According to searchers, the advantage of the “help” function of Web interfaces was the hyperlink access, so they could easily get to a specific topic. They identified three types of help that they liked:

- (1) ProQuest Web presented a book style format based on a hierarchical table of contents with hyperlinks to pages with help on the specific topics.
- (2) OVID Web allowed easy access to the help screen by offering buttons next to their databases and search fields.
- (3) FirstSearch Web took searchers directly to the help associated with that page.

Instead of reading through the help screens to learn the search syntax, searchers preferred to view examples, especially those examples where their displays could be easily controlled. “Examples and tips” of Dow Jones Interactive is a well-liked help mechanism. Searchers found it was easy to scan and to understand examples and tips in Dow Jones Interactive. Sixty-one of the participants rated it 4 or 5 in terms of helping them use the help mechanism. One criticism of this feature had to do with the inability of searchers to print the screen for reference, thus requiring them to go back and forth during the process.

Table VII Subjects' evaluation of help mechanisms

	To what extent does each of the following systems help you effectively use help mechanisms?				
	Not at all	A little	Some	Some more	A great deal
	1	2	3	4	5
DIALOG	6 21.4%	5 17.9%	9 32.1%	5 17.9%	3 10.7%
Dow Jones Interactive	0 0.0%	3 10.7%	8 28.6%	12 42.9%	5 17.9%
LEXIS-NEXIS	4 14.3%	9 32.1%	8 28.6%	6 21.4%	1 3.6%
DIALOG Web	2 7.1%	6 21.4%	7 25.0%	6 21.4%	7 25.0%
FirstSearch Web	0 0.0%	5 17.9%	9 32.1%	13 46.4%	1 3.6%
OVID Web	0 0.0%	1 3.6%	5 17.9%	16 57.1%	6 21.4%
ProQuest Web	0 0.0%	2 7.1%	11 39.3%	12 42.9%	3 10.7%
WilsonWeb	0 0.0%	4 14.3%	8 28.6%	15 53.6%	1 3.6%

Document organisation and display

In Web interfaces, documents were typically displayed in citation format, with other options such as abstract, full record, full text, PDF, or text and image, etc. As for document organisation and display, users were concerned with three issues:

- (1) how many formats they could view a document;
- (2) how they can effectively organise their search results;
- (3) whether different types of display could help them to evaluate the relevance of an item.

Almost every system was rated highly in helping searchers effectively organise and display documents, with ProQuest Web rated the highest (see Table VIII).

Multiple display choices

In terms of document organisation and display, users preferred to have multiple display choices. ProQuest Web was regarded as the best service to allow extensive display choices, e.g. citation, abstract, text only, page image (PDF), and text plus graphics. Eighty-two per cent of the subjects (rated 4 or 5) considered ProQuest the system that helped them effectively organise and display results. Its text plus graphics option was the one considered most useful. Both WilsonWeb and

ProQuest Web presented Adobe Acrobat portable document format (PDF) which allowed searchers to view documents as they appeared in print format. FirstSearch Web was praised for its method of containing Internet accessible resources that directly link to a variety of Web pages. In addition, users found those databases that displayed citations and abstracts on a single immediate page preferable over those in which they had to mark and click to see the citations. FirstSearch Web's requirement of tagging, saving, and then viewing records was considered inconvenient and inefficient.

Organisation features

Sorting and ranking were considered very helpful. The systems where one can view by relevance, subject or sort by subject, author and title were appreciated by searchers. Removing duplicates is another useful feature especially for those systems that allow multiple database searching. However, some of them were not frequently used by searchers because users did not quite understand the mechanisms of these features.

Evaluation facilitation

In addition to multiple display choices, searchers also expected that different formats of display could help them to effectively evaluate documents. For the time being,

Table VIII Subjects' evaluation of the organisation and display of documents

	To what extent does each of the following systems help you effectively organise and display documents?				
	Not at all	A little	Some	Some more	A great deal
	1	2	3	4	5
DIALOG	3 10.7%	4 4.3%	4 14.3%	14 50.0%	3 10.7%
Dow Jones Interactive	0 0.0%	2 7.1%	5 17.9%	13 46.4%	8 28.6%
LEXIS-NEXIS	0 0.0%	6 21.4%	7 25.0%	12 42.9%	3 10.7%
DIALOG Web	0 0.0%	3 10.7%	5 17.9%	14 50.0%	6 21.4%
FirstSearch Web	0 0.0%	4 14.3%	13 46.4%	10 35.7%	1 3.6%
OVID Web	0 0.0%	1 3.6%	5 17.9%	13 46.4%	9 32.1%
ProQuest Web	0 0.0%	1 3.6%	4 14.3%	8 28.6%	15 53.6%
WilsonWeb	0 0.0%	1 3.6%	10 35.7%	12 42.9%	5 17.9%

those highlighted search terms were widely used to facilitate their evaluation of information on Web interfaces. Key words in context (KWIC) format in LEXIS-NEXIS, DIALOG, Dow Jones Interactive and OVID Web is one of their favourite formats as it assisted them to look for factual data without having to sift through the full text.

Printing, downloading and exporting

Printing, downloading and exporting are the final steps that searchers have to take to finish their information-seeking process. There are three major concerns of these users:

- (1) how to print search results easily;
- (2) how to keep the styles of the documents intact;
- (3) how to send the search results in a quick and convenient way.

The Web interfaces of OVID, ProQuest and Wilson were rated the highest in helping searchers to effectively print, download and export results while non-Web interface of LEXIS-NEXIS was rated the lowest (28.6 per cent rated 1 or 2) (see Table IX).

Print function

Most searchers took advantage of the Web browser to print by hitting the “print” button. Users could easily print in the search process

on Web interfaces. However, searchers were annoyed that the graphics of the screen were also printed out, and that was why they liked WilsonWeb and ProQuest Web which contained a feature to redisplay the document in a clean copy. Users preferred to have some kind of control in printing search results. As one searcher said: “I would never trust the LEXIS-NEXIS print feature where the printed material is generated after one logs off the program.” Users also liked the fact that most systems allowed them to print results with indications of the source and the search statements.

Style retainability

As to downloading search results, users preferred to keep the original style so that they could edit it and present it to patrons in a good format. They preferred rich text format, so they could retain the styles of search results. Searchers were also happy that ProQuest Web and WilsonWeb allowed them to download PDF files.

Search result transferability

As for exporting search results, searchers were impressed that they could display or save a document, and especially that they could e-mail results directly to their clients from most of the Web-based online systems. “One of the

Table IX Subjects' evaluation of printing, downloading and exporting search results

	To what extent does each of the following systems help you effectively print, download and export search results? Why?				
	Not at all	A little	Some	Some more	A great deal
	1	2	3	4	5
DIALOG	2 7.1%	2 7.1%	6 21.4%	8 28.6%	10 35.7%
Dow Jones Interactive	0 0.0%	0 0.0%	11 39.3%	9 32.1%	8 28.6%
LEXIS-NEXIS	1 3.6%	7 25.0%	9 32.1%	6 21.4%	5 17.9%
DIALOG Web	1 3.6%	1 3.6%	9 32.1%	10 35.7%	7 25.0%
FirstSearch Web	0 0.0%	2 7.1%	11 39.3%	9 32.1%	6 21.4%
OVID Web	0 0.0%	1 3.6%	2 7.1%	12 42.9%	13 46.4%
ProQuest Web	0 0.0%	1 3.6%	4 14.3%	9 32.1%	14 50.0%
WilsonWeb	0 0.0%	0 0.0%	7 25.0%	15 53.6%	6 21.4%

obvious advantages of the Web systems is the ability to e-mail the search results,” commented one searcher. They hoped that all Web interfaces could offer this quick, easy and convenient service.

Summary of the results

To return to the main questions: What are the advantages of Web interfaces that facilitate users in retrieving relevant information? and what are the problems of Web interfaces that hinder users in retrieving relevant information? Table X summarises the advantages and problems of Web interfaces discussed above, as identified by the participants. The results show that Web-based online systems have many advantages over non-Web based systems, while at the same time they also have some problems. Many of these features are related to issues of user control versus ease of use. This issue is further discussed below.

Ease of use versus user control

It seems that Web online systems fall short in features for searchers who have had prior experience on traditional online systems, but are helpful for novice searchers. Web interface designers should consider the needs of both

experienced and novice searchers. In this study, experienced searchers had their own unique ways to evaluate Web and non-Web online systems. On the one hand, they preferred the ease of use variety of functions of Web interfaces; on the other hand, they were also concerned that they might lose the control they had before, in the traditional online system environment. One searcher summarised his expectation of an online system: “an online system must be as user friendly as possible but not sacrifice the ability to provide sophisticated and technical data as efficiently, accurately and expediently as possible.”

At the same time, not all functions of Web interfaces are easy to use. As we have noted above, one of the most important characteristics of the Web-based interfaces is that they are interactive, and as such they provide a wider range of possibilities for searchers, giving them greater control over their search process. Greater user control comes at a price – often that of greater complexity and increased effort. One significant finding of this study is that in an ideal online world searchers want both greater user control and greater ease of use.

Our finding that searchers want some measure of control over the operation of the system is not surprising. Several years ago,

Table X Advantages and problems of Web-based online systems

Advantages of Web-based online systems	Problems of Web-based online systems
Ease of access online systems	Connection difficulties
Ease of database selection	Minimal database selection control
Ease of access database description	Single database access
Relevant database identification	Complex search assistance
Browsing features	Lack of flexibility of search history
Helpful search assistance	Lack of context sensitivity in help mechanisms
Relevance feedback features	Lack of examples and tips
Search history link	Non-intuitive organisation features
Well-organised help functions	
Multiple display choices	
Multiple organisation choices	
Evaluation facilitation	
Ease of print	
Style retainability	
Search result transferability	

Bates (1990) wrote a provocative piece in which she compared information retrieval systems to automobiles. Many people prefer automatic transmissions in their automobiles, wrote Bates, and many people welcome the development of information retrieval systems that can perform many of their searching tasks “automatically”. However, we should not forget that there are many people who prefer to drive manual transmissions, and similarly, there are many searchers who prefer a high degree of control in their use of online systems. One of the searchers in our study echoes this sentiment by comparing the situation of traditional versus Web interfaces to that of manual and automatic cameras: “Advanced searchers, like advanced photographers, find they can get a better focus by doing it themselves while novice users do better with the automatic.”

One area in which searchers seem to uniformly wish for greater control is that of database selection. Our results, and the results of others (Belkin *et al.*, 1996; Koenemann, 1996), indicate that database selection is something that users do not feel comfortable leaving up to the system. In a controlled experimental study, Park (1999) investigated user preference for two types of information retrieval systems that contained multiple databases. In the first, databases were merged and searched as an integrated system. The second, highly preferred system allowed users to select individual databases and search them with a common interface. In this particular study, users preferred the common interface even though it meant greater effort in terms of making database

selection. The results of our study extend the findings of Park to suggest that users want control, while they also want ease of use. Searchers in our study wanted to control database selection, and at the same time they wanted help from the system in the form of database descriptions, to enable them to make good selections.

When searchers enjoyed the helpful search assistance to formulate and reformulate their queries, they also expressed their concerns in using such assistance. As one searcher said: “Sometimes I’d rather just memorise commands; at least then you know all the options available to you.” An intelligent help mechanism is uniformly preferred by our searchers, who want some measure of control and then ease of access if they need it. Web interfaces provided potentially useful features to organise results, but they were not frequently used because of the complexity of their mechanisms. Compared to non-Web systems, the print functions of Web-based online systems were praised by searchers because they were easy to control and easy to use.

What users really want is empowerment: control, and the ability to exercise this control. This is what effective interactive retrieval systems should strive for. The question for system/interface design here is how to provide searchers with ease of use of systems and at the same time allow searchers to have a certain degree of control? In contemplating the design of an ideal system for online information searching, it would be difficult for relatively advanced searchers to adopt the perspective of a total novice. At the

same time, novice users will gradually become expert users towards online systems. How can one system accommodate these different needs? One solution could be to design systems that provide both command and guided search, as DIALOG Web does.

However, the question remains as to whether to design command search functionality that keeps all of the traditional formats, or to further develop systems that take advantage of the Web interface. One searcher criticised the command search in DIALOG Web:

“DIALOG Web does not seem to have taken advantage of the Web at all. They just put a simple Web wrapper on the traditional interface.”

According to users, DIALOG and LEXIS-NEXIS window interfaces supported more sophisticated search formulation than Web interfaces, and the structure of the Web interfaces encouraged users to do simple searches and combine them later. The traditional command-line searching, while time-consuming to learn, allows for very powerful and flexible searches to be performed. Web-based interfaces generally use form-based searches, which can impede searchers' ability to perform. Several searchers called for expansion of the advanced search capabilities of Web interfaces. OVID Web is a good example. The basic mode offers a simplified opportunity for the novice or for just a quick search. Advanced mode is well designed and offers much opportunity for sophisticated techniques. One can use fields, indexes, thesauri, and tools to design and expand a query.

Conclusion

Web-based online systems are becoming more and more popular. It is the trend to convert non-Web online services to Web-based services. Web-based online systems provide users with new access mechanisms to support users in their interactions with information and systems. However, these systems also pose new problems to users, especially experienced users, in terms of how to effectively employ these access mechanisms. In order to facilitate users to effectively seek relevant information, it is important to design online systems that offer ease of use with great user control.

Further studies should investigate how users interact with different online systems, and how these interfaces/systems facilitate

users' interaction with information and systems. Moreover, these studies should also examine how novice users evaluate online interfaces/systems, especially the similarities and differences between experienced and novice users, to provide recommendations on how online systems can best accommodate different levels of users.

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