1.0 Introduction

Meet the GUI (graphical user interface) OPAC, what Crawford has described as "the user friendly, bandwidth-intensive, hardware-dependent, slow for complex searches, GUI interface that is so much fun to use the first time around." [1] It sparkles and fascinates. It draws you in. You ponder, "What's behind this cute little icon?" Just point and click to find out. Another click or two... ("Hmmm, this looks familiar.") and a list of index terms to scan appears. Another click... a list of book titles. Click on one of these... a book catalog record to ponder. This book is not what you want? O.K., move back over to the window with the list of terms (you may have to maximize it), or, maybe, click on the "NEW SEARCH" button and try again. Some things change, some things remain the same.

Williams et al. describe three types of user interfaces that have been developed to facilitate interaction between a user and an information system: command-driven, menu-driven, and GUI. They define a GUI as a:

User interface that uses images to represent options. Some of these images take the form of icons, small pictorial figures that represent tasks, functions, or programs. [2]

Windows, which divide the display screen into sections, and additional direct-manipulation (e.g., point-and-click) devices are also usually featured in graphical user interfaces. Williams et al. state that GUIs are "the easiest interface to use." [3] This is a popular, but largely unexamined assumption today.

Pollitt et al. would have us believe that:

User interfaces which adopt a graphical or window-based approach to search databases should improve access and the effectiveness of end-user searching. The graphic user interface (GUI) is revolutionising the usability of the personal computer in every application. [4]
The user interface component of computerized interactive information retrieval systems like online library catalogs is the locus in time and space, typically defined by a particular mix of hardware and software facilities, where the user and the information system interact and communicate to carry out useful information seeking tasks. In today's online catalogs, this user interface is primarily manifest through a particular online catalog's input devices and screen displays. However, these tangible components are only part of the story. The user interface in information systems is a complex environment in which system features must match up appropriately with a bewildering variety of users' personal characteristics, cognitive abilities, and task requirements. In the best of cases, this environment, with its brew of tangibles and intangibles, affords the user a comfortable, supportive "space" to carry out information seeking tasks. These tasks require not only appropriate information input and output, but comprehensible decision making support facilities as well.

Looking for documents or other publications in an online catalog is not just a mechanistic information seeking activity. It is a dynamic, decision making activity which requires that careful consideration be given not only to the information to be provided, but also to the manner in which that information is presented in displays and to the set of decision making facilities available to assist the user in carrying out primary tasks and subtasks. Among these tasks are identifying and locating documents, reviewing them, selecting some as suitable to the need or interest, and using retrieved, found data to modify or continue a search strategy. Thus, a major goal of information system design is to develop a user interface that will facilitate the semantically demanding cognitive tasks of user comprehension and decision making. This goal is only partially accomplished by presenting easy-to-use search input screens and legible displays of bibliographic information.

There is much discussion about the "usability" of computer systems designed for and used by "end users." There seems to be agreement that system design features greatly determine the usability of information systems for their primary clients, and, further, that usability is a dimension that may have a profound influence on both search performance and users' satisfaction with the search system. Given the variety of things one might use a computer system to do, usability is surely a relative measure. Furthermore, user characteristics are also determining factors in achieving optimal usability. Allen has pointed out that user characteristics interact with system features to influence usability in unpredictable ways: "The objective of usability in information technology can be achieved if system designers understand how system features and user characteristics combine." [6]

Not all catalog users are the same, and a "one-size-fits-all" OPAC interface will be less usable for some users than others. Allen, whose OPAC research has addressed differential cognitive abilities of users, recommends that system designers "customize information systems for some users," and incorporate user-selectable options in the user interface. [7] System designers, especially designers of user interfaces, must take into account
the primary tasks to be performed with the system and the
can show the characteristics brought to the tasks by the users of the system.
An understanding of these tasks and characteristics will inform
the design of appropriate information search, presentation, review, selection, and related decision making facilities. Too
often in online catalog interface design only one or two of these
facilities have been optimized. For example, search input may be
simplified, but no dynamic review and feedback facility is
provided to support search continuation or enhancement based on
information that has already been found and displayed.

In this age of distributed, client/server computing arrangements
to support wide-scale information retrieval, it is all too
tempting to believe that sufficient usability improvements can be
made at the client (user interface) level without regard to the
server's search engine or database content and structure.
However, search engines and databases impose fundamental limits
on the search and interaction options that may be presented at
the client level. For example, consider the OPAC whose database
does not incorporate vocabulary control and has no hypertext
linkages. GUI technologies cannot overcome limitations like
these. We would do well to heed the insights of OPAC researcher
Hancock-Beaulieu:

> Clearly a more friendly interface which enables the user to
search more intuitively cannot be developed independently,
without taking account of the functionality of the search
software and the nature of the raw database. Improvements
in human-computer interaction in online catalogues would
seem to require the following criteria: greater flexibility
in input/output facilities, improved capability of the
search mechanisms, [and] better representations of the
knowledge base. [8]

Although much has been written about the design and use of online
catalog user interfaces and screen displays, actual design is
still more of an art than a science. There has been surprisingly
little research on the sequencing of online catalog display
screens appropriate to a dynamic search and review process, or on
information requirements of the process beyond what is displayed
as bibliographic information. Online catalog user interfaces
have been "acceptance tested" more often in the marketplace than
in the laboratory or controlled field experiments. Nonetheless,
a great deal of research from related areas and experience gained
through 15 years of online catalog interface design, use, and
evaluation can be brought to bear on the design of user-system
interaction styles and methods, and on useful, informative screen
displays. (For a useful summary of this research and experience,
see Shneiderman. [9])

3.0 Designing Effective Bibliographic Displays

Some attention has been given by researchers to the question of
how best to display discrete bibliographic records (presumably
resulting from a search) on an online catalog's VDU screen (see,
[12] Shires and Olszak, [13] and Allen [14]). Both content and
presentation issues have been addressed. Great effort has been
extended to provide online user assistance and "help" features to
ease the use of online catalogs. Less concern has been shown for the dynamic aspects of the communicative, decision making interaction between the user and the system during the search process, and the information and display requirements for supporting that interaction. Such requirements include the proper sequencing (or formatting) of separate screens and a dynamic, proactive role for individual displays of bibliographic information. In traditional library catalogs, the bibliographic record was thought to be the end point, or stopping point, in the search process. Some early online catalogs reflected this tradition by displaying "The End" at the bottom of a screen that displayed a complete bibliographic record.

It has become commonplace to label unique data elements in displayed bibliographic records. Other than this practice, there is as yet no uniform or standard practice followed in the presentation of bibliographic records with regard to choices of labels for data elements, order of data elements, or screen layout and typography. Previous catalog research has indicated that users frequently do not notice the subject descriptors assigned to a work and included in the bibliographic record, and they do not understand descriptors' collocative function for identifying similar or related works.

On the subject of information displays, Reynolds has written:

> The initial impression created by any display of information can have a strong influence on users' attitudes towards that information. They will almost certainly form judgements about whether the display is likely to be easy or difficult to use or, indeed, whether it will be worth their while attempting to use it at all. [15]

The design of the full bibliographic record displays should be based on research-informed decisions made about data content, format, order of data elements, labeling, and typography. Data in the MARC record judged to be extraneous to the tasks at hand should be omitted from the displays. Considerations of both task and user characteristics must be included in the remaining aspects of the displays. Reynolds goes on to say that "a good presentation is, first and foremost, one which makes clear the structure and sequence of the information content and which takes into account the way in which the information will be used. To meet these requirements, one needs ways of visually emphasising, dividing and relating items of information." [16] Data field labels should be chosen carefully to avoid jargon and to indicate not only the meaning of the data, but also, in the case of the subject headings, their use and function (e.g., "SUBJECT GROUP" rather than just "SUBJECT"). With regard to sequence and structure, the MARC format structure, even with its arcane numeric labels disguised, is not suitable for end users. There is no uniform practice regarding which data fields are displayed first in bibliographic records. Designers might consider displaying the title field first in the case of monographs, although this may not be the best sequence for all types of materials. Also, research suggests like data elements should be grouped together, unlike MARC which separates "added entries" from the "main entry."
Recent research by Allen suggests that displaying subject headings first in the display, at the top of the bibliographic record, improves subject searching performance on some search tasks. [17] He attributes this influence to the perceptual speed factor in identifying appropriate elements in a bibliographic display.

In a research project described by Hildreth, a different approach was employed to bring the subject headings to the notice of the searcher. [18] Subject headings were not displayed first in the bibliographic record, but were highlighted in a window within the record. By moving the cursor arrow to a subject heading inside this window, users could activate hypertext links to gather and retrieve related works. This combination of special prompts, labeling, and formatting of the subject data in the bibliographic record seemed to have had a positive influence on the search performance of inexperienced users (see Figure 1).

The typographical conventions followed in the bibliographic displays used in Hildreth's research conform to the findings of Fryser and Stirling. [19] This research showed that users preferred labeled displays and conventional uppercase and lowercase typography for the presentation of bibliographic information.

Effective bibliographic displays are influenced by both content and presentation factors. The design goal is to facilitate user comprehension and decision making. Key decisions involved in the bibliographic search process include accurate identification of a work, suitability of a retrieved work for a particular need, and the desirability of modifying a search strategy or expanding a search. The data content of the records in the database is often out of the hands of the system designer. The designer has to use the available tools to present information in the most useful way contemplated.

To date, there has been a paucity of empirical research that addresses issues involved in the effective display of bibliographic information. Although Hildreth's research reported here did not directly address these issues, the users of the experimental online catalog expressed general satisfaction with the displays and reported no difficulties in the use of the test versions that could be attributed to factors associated with the bibliographic displays.

4.0 Two Design Principles to Consider

Reflections on the online catalog user interface as a complex
environment for supporting search, selection, review, and related
decision making activities led this author to the articulation of
principles and goals which should guide the design and
development of the online catalog interface.

The first principle is that the online catalog system should
never permit a user's search attempt to fail to retrieve one or
more bibliographic records for review and action. Many searches
in existing online catalogs fail to retrieve even a single
record, and most online catalogs offer little or no assistance to
the searcher when this result occurs. The assumption behind this
principle (always retrieve something for display and review) is
that something in a heterogeneous online catalog database might
satisfy the request to some degree, or serve, even in its
rejection by the user, to supply useful information that can be
used to further the search.

A second principle is never assume the display of a bibliographic
record is the end of a search, merely to be selected or rejected,
then "set aside." Bibliographic records are for use, not just as
location devices, but as information-laden devices for furthering
the search. This action role of bibliographic displays is often
overlooked in system design. Bibliographic records can be
generative; they may have a springboard effect in the search
process, or serve as information "seeds" to fertilize subsequent
searching.

Searching and browsing are nondeterministic, dynamic processes;
it may be best to think of even the most precisely formed queries
in conventional query-oriented systems as dynamic queries,
subject to change in the search process. The user may know
precisely what he or she wants and uses the online catalog merely
to locate that particular item and determine its availability.
Yet, this single-minded user may choose from a variety of ways of
searching for the item, may encounter other interesting items
while searching for the desired item, or may even lose interest
in the original item as alternatives are brought to his or her
attention. For these reasons, found data--terms, titles, subject
descriptors, and entire records--should be able to serve as
useful data for expanding a search or revising a search strategy.
In short, it ought to be easy for search output to serve as
search input. Display formats and prompts, point-and-click, and
linked-record, hypertext navigation facilities should be employed
in online catalogs to satisfy these principles and requirements.

Research has identified several key problem areas in the use of
conventional online catalogs that can be alleviated through
interface design. Good reviews of these research findings can be
found in Larson [20] and Hildreth. [21] Several of these
problems are listed below:

1. Initial system entry and orientation. Bates calls it
the "docking" problem. [22]

2. Required use of unfamiliar commands or excessive
keyboarding.

3. Entering or finding suitable search terms.
4. Modifying a search strategy or query to achieve better results.

5. No way to provide feedback to retrieved information so that it can be exploited to yield enhanced search results.

6. Interpreting and understanding information in bibliographic displays to support decisions regarding the suitability and usefulness of retrieved items.

7. Knowing where one is in the search process or knowing what may be done next.

A common problem with flexible, hypertext retrieval systems that offer many alternative search paths is the feeling of disorientation users experience after searching for a time. Faced with many choices and paths to pursue, users typically begin to wonder where they are and how they got there. Lacking sufficient markers and prompts, they often feel lost. This experience is exacerbated in nonlinear hypertext search systems that have been implemented in earlier screen technologies developed to support only linear modes of searching. With these earlier technologies, one screen is displayed at a time, containing a single logical unit of information which represents a single stage or level in the search process. Related screens that may provide search and browse context, history, or alternative directions to pursue are simply not displayed simultaneously to the user. Newer GUI display technologies offer some solutions to this problem through the use of multiple windows and direct-manipulation devices.

5.0 What Do GUIs Bring to OPACs?

Before GUIs we not only had inventive menu-driven interfaces, but some OPACs had rudimentary cursor-controlled "point-and-click" interfaces that permitted a degree of direct manipulation of data and functions highlighted on the display screens. No doubt, GUIs are generally more attractive and colorful than character-based interfaces, and they hold the promise of making OPAC searching both easier and more richly interactive.

Some basic features of GUI interfaces are:

- Multi-windowed views of multiple kinds of data.
- Sizeable, moveable windows.
- Scroll bars to scan through data and lists.
- Pull-down menus and pop-up dialogue boxes with preformatted data entry spaces.
- Hot buttons for activating functions.
- Point-and-click device-based interaction.
Such GUI interfaces are familiar to the growing number of Apple Macintosh and Microsoft Windows personal computer users. How should these GUI features be incorporated in the next generation of OPACs? Armed with these new GUI, multi-window capabilities, the designer's dilemma can be expressed in this query: "What do we do with the windows?" What have we learned regarding what should be displayed in the windows and how the windows should be sequenced? The use of direct-manipulation, point-and-click capabilities at the interface needs further user testing. As Caplan warns, "it is a great step backwards to force patrons to switch from keyboard to mouse with great regularity. . . . basic acts like entering a search should not require hand movement from the keyboard to the mouse pad." [23]

6.0 Conclusion

The march to GUIs by OPAC designers and vendors will continue unimpeded, so we must be on guard against the very real possibility of throwing out the baby with the bath water. We must not abandon sound principles as we make cosmetic improvements to the user interface. Point-and-click interfaces predate GUIs. More than window dressing, users need help in understanding the search process as consisting of complex, interrelated stages and levels of interaction between a variety of kinds of data and functions.

For example, more useful than icons and direct-manipulation devices would be:

- Character-based helpful prompts displayed on the screen.
- Flexible movement among various levels of a search as they are presented in multiple windows.
- The ability to gather in works related to a work on display, or works linked to a displayed heading or call number.

Rao et al. suggest a paradigm shift in our thinking about user interface design. Instead of concentrating on user-system interaction we should become less fond of system features and focus, rather, on "user-information" interaction. The authors argue that "effective information access involves rich interactions between users and information residing in diverse locations." [24] A goal of interface designers should be to increase the "quality of the interactions between users and information in an information workspace." [25] In other words, the design goal should be to provide an intuitive interface that permits more direct, informed interaction on the part of the user with the interrelated stages or levels of a search as it is displayed and seen in context. Unlike the linear, straightjacket, no rear-window approach of earlier OPACs, GUI online catalogs can simultaneously present multiple levels of the search territory and permit the user to flexibly pursue his or her own course as his or her interest dictates.

Notes


3. Ibid., 145.


5. Ibid.


7. Ibid.


16. Ibid.


25. Ibid.

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