Cummings, Joel and Johnson, Ryan. The Use and Usability of SFX: Context-Sensitive Reference Linking. Library Hi Tech 2003 21(1) 70-85

The Use and Usability of SFX: Context-Sensitive Reference Linking

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Keywords: OpenURL, Metadata, XML, Usability Testing, Use Statistics, SFX

ABSTRACT

SFX is an XML based product designed to inter-link electronic resources with other resources in context-sensitive manner. SFX was first developed at the University of Ghent by Herbert Von de Sompel and has been released as a commercial product by Ex Libris. Use statistics garnered from SFX's statistics module since the implementation July of 2001 are discussed in the context of an academic research library environment. The results from usability testing conducted at Washington State University are reported. These usage statistics demonstrated a pattern of increasing use and exceptional use from FirstSearch databases.

INTRODUCTION:

SFX creates dynamically generated sets of links to library resources and other electronic documents based on the metadata in electronic documents. While the initial focus of the development of this standard was on bibliographic metadata, metadata from any type of document could conceivably be used, as suggested by SFX's initial creator Herbert Van de Sompel (Sompel and Beit-Arie, 2001a). SFX and its competitors work by transferring context sensitive metadata from a source database via NISO's proposed OpenURL metadata standard (OpenURL, 2002) into a Link Resolver. In this case, the Link Resolver is on an SFX server.

It creates a set of links to a variety of resources based upon an established set of rules and locally established thresholds to generate a set of options in the form of hypertext links. These links are known as extended services and are loaded into an SFX services menu. These extended services direct the users to electronic documents known as targets based upon the initial document's metadata and thresholds set on the library's SFX server. Thresholds control the appearance of particular types of extended services on the generated SFX services menu. Thresholds are series of parameters for specific targets to control which services appear using factors such as year ranges, volumes or issues (see figure 1).

This is a process referred to as context sensitive linking. Context sensitive linking allows the institution to control the library users' interaction and guarantee that they receive access to all of the potential resources.

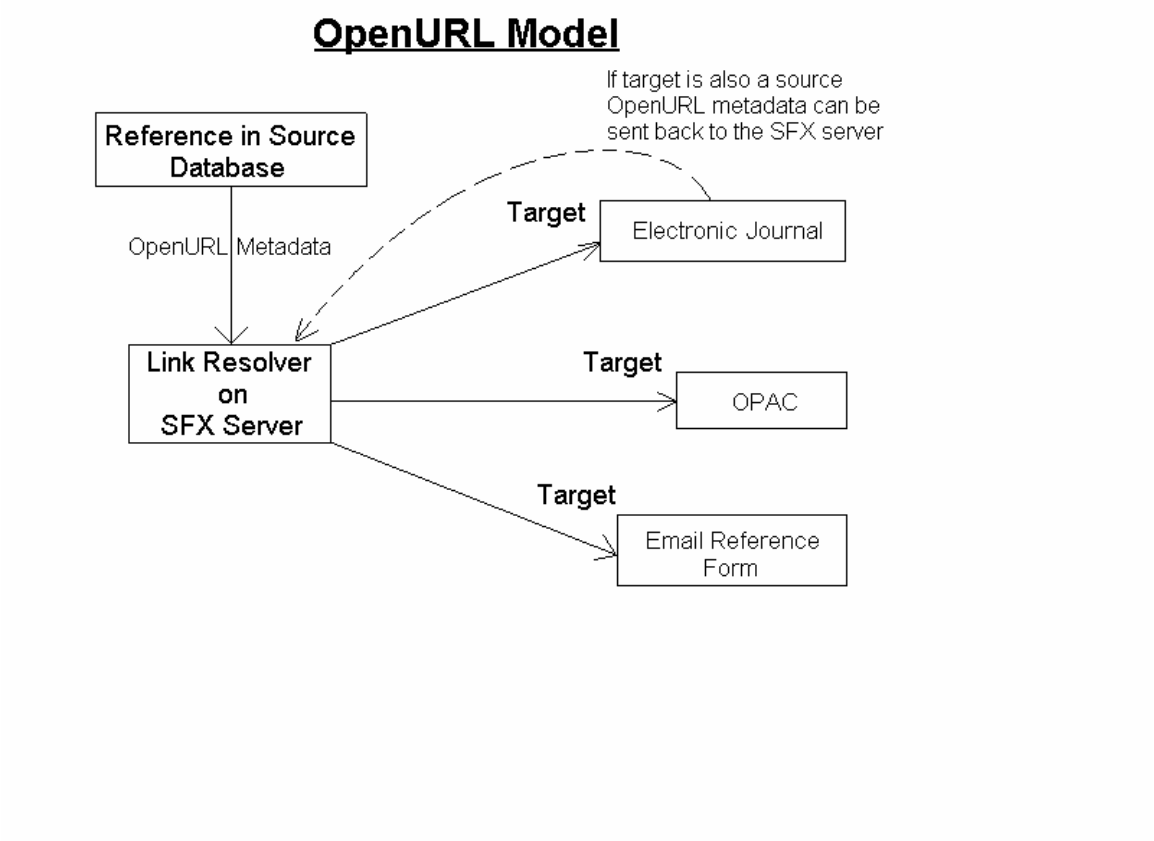


Figure 1
OpenURL Model

The source databases available at Washington State University in the spring of 2002 were largely, but not exclusively, abstracting and indexing services. Potentially the types of electronic documents that could be linked through SFX include Abstracting and Indexing (A&I) databases, full-text publishers' websites, preprint archives, library Online Public Access Catalogs (OPACs), tables of contents databases or locally created databases. The OpenURL is a transportable metadata format, which means that it allows for the transfer of designated pieces of information from a source to a server that can act upon that metadata. This standard is currently under development by a NISO committee (NISO, 2002).

From the library users' perspective, they will see three types of screens when SFX is enabled. The first is a Source screen typically found in A&I database record screens or browse lists. The only difference the library user is likely to see in an SFX source database is the appearance of an SFX link, frequently as an icon on the record screens (see figure 2). If the user clicks on the SFX link, an SFX Services Menu is generated. The Services Menu sometimes

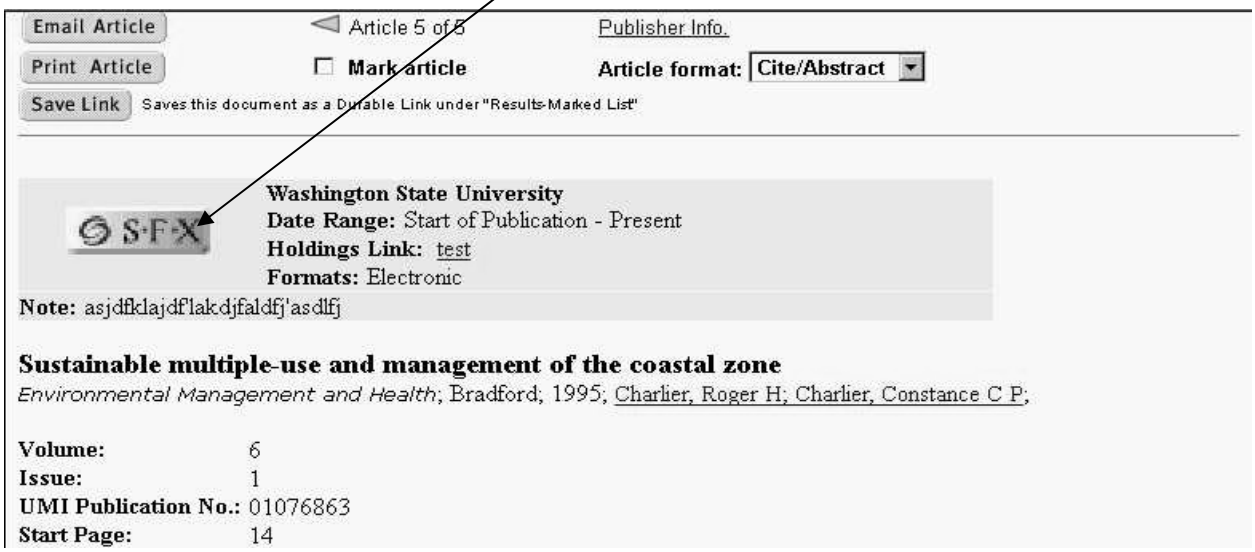
appears in a new browser window, depending on the preference of the source provider. The SFX services menu displays options for the library user (see figure 3).

Services may include, but are not limited to, searching the local library catalog, retrieving the full text of the article referred to on the source screen or requesting said article via interlibrary loan. If a library user selects a service, the target is loaded into a new window of the user's web browser. The services indicate what types of options are available and provide connections to the targets. Please note, in this process library user's initial search results are still available, enabling the library user easily to return their search results in the source database. If the target screen is also enabled as an SFX source, the target can then be used to generate another SFX services screen (Walker, 2001).

Figure 2
SFX Buttons in Source Databases

The SFX button appears in a variety of ways within the individual database records.

In Proquest, the citation will include an **SFX button** as part of the display:

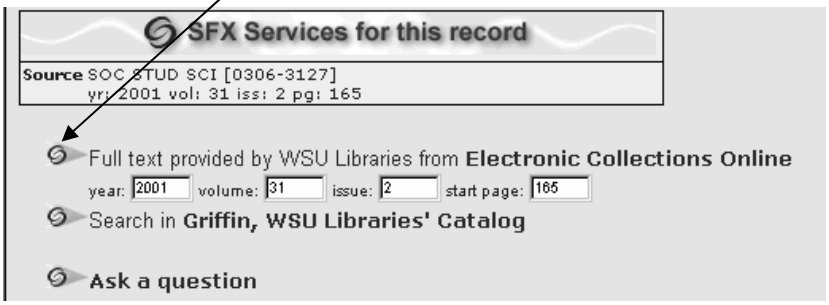


In the Web of Science, the **SFX button** appears near the top of the record citation:

(Johnson and McCord, 2001)

Figure 3
SFX Services Menu

Clicking on the SFX button will open a menu screen with a list of Targets in a new window. To select a Target, click on the **"S" icon** on the left.



(Johnson and McCord, 2001)

By allowing for the creation of links based upon a dynamic database, the need for constant maintenance resulting from high obsolescence rates of fixed URLs

can be overcome (Koehler 2002). This creates an environment where the dynamic linking of electronic objects via the OpenURL standard has practical advantages over other methods of link maintenance. For example, this allows for the elimination of tracking and correcting of URLs. This would eliminate the need for libraries to create, send and repeatedly update lists of licensed electronic journals that are sent to database vendors to keep various interconnecting systems, such as PubMed Link-Out, up to date. The vendor may have the opportunity to eliminate the repeated handling of such lists when, or if, a significant number of their customers employ software such as SFX. For the Washington State University Libraries, the chance to have the OPAC become a source, thereby eliminating the need for manually coded and maintained 856 links, is also a potential advantage of dynamic linkages.

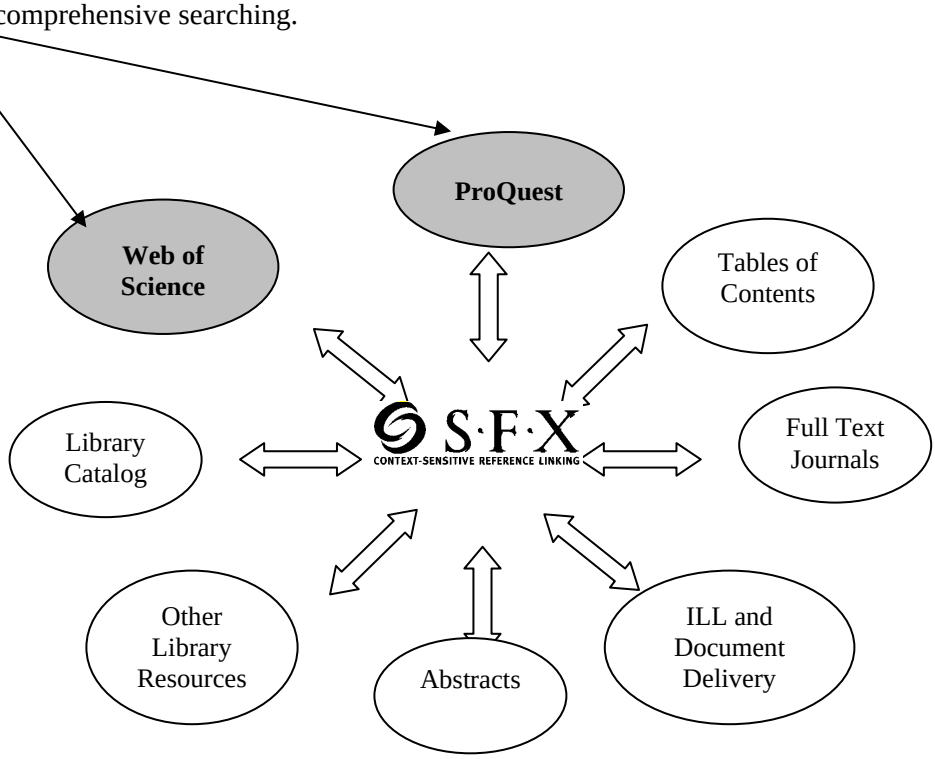
SFX is the product that Washington State University chose to help integrate the many A&I databases with the ever increasing number of electronic journals, but this is only one application of SFX. Currently the Washington State University Libraries includes extended services that link to the digital reference services of the library and the variety of Interlibrary Loan and end-user initiated document delivery services available to library users. Innovative Interfaces has introduced a competing product called Web Bridge, which is a part of their integrated software package called Millennium Access Plus. There are other similar products currently under development by a variety of companies including OCLC. In a series of articles, Van de Sompel described the utility and the necessity of an open and dynamic linking system (Von de Sompel and Hochstenbach, 1999) for academic libraries in particular, and in scholarly communication in general (Von de Sompel and Beit-Arie, 2001a). More recently he has suggested how current OpenURL specifications could be generalized beyond the scholarly information environment by making reference to the Bison-Futé model, which Van de Sompel describes as a conceptual generalization of the OpenURL framework (Von de Sompel and Beit-Arie, 2001b).

The need for the seamless user access to information, including electronic resources, is an expressed direction of the Washington State Universities Libraries' strategic plan (Washington State University Libraries, 2001), and was part the rationale behind the decision to purchase SFX. These Strategic Directions also state a preference for the collecting of information in electronic formats over print materials whenever feasible (Washington State University Libraries, 2001). SFX's ability to facilitate a seamless connection is a step in the direction towards seamless access to information (see figure 4), even though, the use of SFX is not without problems, as usability testing showed.

Washington State University is decentralizing with an expanding distance education program and four growing branch campuses that add to an existing network of extension offices and extension research facilities across Washington State. Consequently, the ability to provide successful geographically distributed library service is increasingly important. SFX functions well in this environment by making it easier for library users to move from sources of metadata, such as A&I databases to the desired document.

Figure 4
SFX: Entry Points

SFX uses the Open URL metadata standard, so only resources that use this standard can be linked together using SFX. As more resources adopt this standard, more library databases will become "**entry points**" for comprehensive searching.



(Johnson and McCord, 2001)

IMPLEMENTATION OF SFX

In June 2001, two days of onsite training were provided by Ex Libris, including a general session designed for the public service librarians to help them to assist users and provide library instruction. The "SFX Team" (Janet Chisman - Library Systems, Joel Cummings - Science, Engineering and Agriculture, Ryan Johnson - Humanities and Social Sciences, and Sarah McCord - Health Sciences) decided what services should be available and what the wording on the SFX Services Menu should be. They also conducted a series of instructional sessions for library faculty and staff prior to the public release on August 13th, 2001.

Source databases were activated from August until February (see table 1). Almost all of the electronic journals available to library users have been incorporated into the SFX system as targets. Currently, Lexis-Nexis is the only major provider of full-text that remains to be added. The authors of this article would like to acknowledge the efforts of the other members of the SFX Team, at the Washington State University' Libraries: Janet Chisman and Sarah McCord.

Table 1

Activation of SFX Sources at Washington State University

Source	Date Activated	Source Databases Available
Web of Science	August 10th, 2001	Science Citation Index, Social Science Citation Index
Institute of Physics	August 13th, 2001	
Proquest	September 25th, 2001	ABI Inform, Proquest Research
FirstSearch	December 28, 2001	Agricola, Applied Science and Technology Abtracts, Art Abstracts, Articles1st, Arts & Humanities Search, Biography Index, Biology Digest, Biological & Agricultural Index, Book Review Digest, BooksInPrint, Contemporary Women's Issues, EconLit, Electronic Collections Online, ERIC, FactSearch, General Science Abstracts, GEOBASE, GPO, Internet and Personal Computing Abstracts, Library Literature, Medline, MLA Bibliography, PAIS International, PsychINFO, SIRS Researcher SocAbstracts, Social Sciences Index, UnionLists WorldAlmanac, WorldCAT
Cambridge Scientific Abstracts	January 2002	ArtBibliographies Modern, Environmental Sciences and Pollution Management, Zoological Record Plus
SilverPlatter	January 2002	Beast, Biological Abstracts, Georef, Sports Discus and VET.
Chemical Abstracts: (Chemport)	February 2002	Chemical Abstracts, CASREACT and Medline,

USAGE STATISTICS

SFX contains a statistical module as an integral part of the product. This allows the library to determine continually the levels of system use as a whole, as well as of the various sources, targets and services that have been incorporated. It is also meant to discover whether there are problems in the system. By constantly evaluating usage, user education efforts can be adapted to promote under utilized resources or modify those aspects of the system that allow for local control to enhance the user experience, and also suggest modifications to vendors or to Ex Libris. The statistics referred to below were accumulated on Sunday, May 12th, 2002.

Use of SFX at Washington State University has been growing since its implementation in August 2001. The average number of uses per day has increased from fewer than 20 in the first few months to 231 by month April 2002 (see table 2). We believe this growth has resulted from a variety of factors. The first, and possibly the most important, is increased number of sources. In the first few months most of the A&I databases available to did not present users with this option. This has changed over time, (see table 1), in particular with the activation of thirty FirstSearch databases in SFX at the end of December.

The FirstSearch Databases licensed for use at Washington State University include such highly used databases as Agricola, ERIC, Sociological Abstracts, and the MLA Bibliography. Six databases from Silver Platter have been activated, including Biological Abstracts and Sport Discus. Three databases from Cambridge Scientific Abstracts have been activated – Zoological Record Plus, Environmental Sciences & Pollution Management and ArtBibliographies Modern. In addition, the Institute of Physics and Chemport have been activated. Chemport's OpenUrl metadata requests do not include Source IDs, and consequently its requests are recorded under the source entitled "Default" in the SFX statistics module. In addition, SilverPlatter requests had been recorded as the source "Default" prior to the implementation of WebSPIRS 5.0.

Table 2

Average SFX requests use per day

Month	Average number of requests
August	7.9
September	17.0
October	18.1
November	17.0
December	20.9
January	128.1
February	220.0
March	189.0
April	231.7

In addition to adding more sources, librarians have also continued to introduce SFX through a variety of public services, such as library instruction, reference and faculty liaison. Finally, we were able to incorporate some of the findings from the usability testing to be discussed in this article. FirstSearch allows the library to augment the SFX button with the text "Locate Document." This allows us to overcome the most significant barrier to use, namely the failure of users to identify the SFX button as a usable tool.

FirstSearch is clearly the source of the vast majority of the SFX requests (see table 3). From its activation, FirstSearch has led the way. A majority of the databases that allow for the use of SFX are found in FirstSearch, and it is easier to identify and select SFX as a means of acquiring more information about the citation in these databases. While FirstSearch is the most used database provider, there is no way within the statistical module to determine which of the thirty SFX-enabled databases the users are connecting to SFX from. This is true of all of the database providers. In almost every case, the source is a collection of A&I databases and we can not distinguish between these databases with any accuracy.

Table 3

Requests by Source

Source	Total Requests	Percentage of total requests
FIRSTSEARCH	19008	72.8
DEFAULT	2328	8.9
PROQUEST	2194	8.4
WOS	1203	4.6
SILVERPLATTER	780	3.0
CSA	533	2.0
IOP	42	0.2
TL*	23	0.1

*TL is Test Local

In addition to which sources are being used, the SFX statistics show which extended services the users are requesting. The two most requested services are Full-Text and searching the catalog (getHolding) (see table 4). There have even been 1,663 searches of the catalog when Full-Text was available. While many users request full-

text, they use a wide variety of targets to fulfill their needs. The most heavily used target is Proquest followed closely by Elsevier's Science Direct and FirstSearch's Electronic Collection Online (ECO) (see table 5).

Table 4

Most Frequently Requested Services

Service	Number of Requests
getHolding	10498
getFullTxt	7811
getDocumentDelivery	1416
getWebService	324

Table 5

Top Twenty-Five Full-Text Targets

Host	Number of Requests
Proquest	3412
Elsevier Science Direct	2023
Electronic Collections Online	1269
Wiley Interscience	427
American Chemical Society	277
Ingenta Journals	245
Synergy	231
MCB Emerald	206
Springer Link Journals	190
Project Muse	169
JSTOR: Arts And Science	162
Highwire Press Free	150
Journals Ovid	135
Highwire Press	98
American Institute of Physics	79
Cambridge University	69
Bio One	51
Nature	48
US Government Documents	42
Miscellaneous Free E	40
JSTOR: General Science	37
Catchword	36
American Physical Society	35
JSTOR: Ecology	32
Academic Press Ideal	28

Not only are the requests for full-text distributed widely over a number of providers, they are even more widely spread across a larger number of journal titles. 5,625 individual journal titles have been accessed via SFX. 2,463 of these have only been requested once (see table 6). The ten most requested titles cover both the sciences and social sciences (see table 7). Environmental Management and Health is sixth on the list and is something of a statistical anomaly because it was the example used in the early staff training, artificially inflating its use.

Table 6

Number of Requests be Journal Title

Number of Requests	Number of Titles
101 or more	7
51-100	18
41-50	10
31-40	25
21-30	88
16-20	79
11-15	157
6-10	552
5	254
4	359
3	555
2	1040
1	2463

Table 7

Most Frequently requested "Journals" by Name

Rank	Title	Requests
1	Dissertation Abstracts International. B, The Sciences and Engineering.	250
2	Dissertation Abstracts International A, The Humanities and Social Sciences	203
3	Science	172
4	Phytochemistry	142
5	Journal of Agricultural and Food Chemistry	135
6	Environmental Management and Health	108
7	Communication Abstracts	102
8	The American Psychologist	87
9	Nature	84
10	Strategic Management Journal	84

USABILITY TESTING

As part of the implementation of SFX at the Washington State University Libraries, usability testing was conducted by Janet Chisman and Joel Cummings (Chisman et al, 2001). The goals of the usability tests were to determine whether users were able to make use of SFXs interconnection of resources and which, if any, specific features of the user interfaces presented barriers to the software's use. The usability testing was not attempting to

statistically describe the user population's behavior. Instead, the testing was conducted to find potential interface problems and determine potential methods of improving the usability of the SFX user interface.

With this intention in mind, the total number of test participants was considerably lower than it would have been if the study was attempting to determine what percentage of library users would be able to use SFX. These tests were to find potential problems so that some method of mitigating them could then be sought. The probability of not finding a problem that occurs frequently is small, even with a small number of people. Three or four individuals is usually adequate to find major problems with an interface (Rubin, 1994). The probability of not finding or missing a problem can be described as $P=E^n$, where E the percentage of user population who do not encounter that problem, and n is the test population size. E is an unknown and the usability testing is not attempting to determine its value. The testing centered around the two major sources activated for to Washington State University Library users in the fall of 2001 – Proquest and Web of Science.

RESULTS

Using self-selected users of Web of Science or ProQuest, participants attempted to complete the assigned tasks while being monitored by two observers. The observers sat behind the test participants and in a position where they clearly see the whole computer screen. Notes were taken on test subjects' behavior, and spoken comments. Other data recorded for each of the test participants included the ability to complete each of their assigned tasks, and the time the test participant took attempting to complete the tasks – rounded to the nearest minute. Finally, each subject was asked to complete an exit questionnaire.

To find test participants, a Web page soliciting candidates was placed between the libraries' links to these databases and the databases themselves. The users included undergraduate, graduate and faculty from a variety of social science and scientific disciplines at Washington State University's largest campus located in Pullman, Washington. The test participants were instructed to verbalize their thoughts when conducting the tests to give the observers more insight into the test participants behavior.

Three test participants completed all questions for either Proquest or Web of Science. In an effort to expand the number of test participants, the last participant to perform the tasks for Web of Science also attempted the second and third tasks for the Proquest sections.

The first question for both Web of Science and Proquest was "Do you see anything on this screen that you could click on to find an actual copy of this article?" (see figure 5 and 6) This task was designed to test if library users would have problems connecting the SFX icon with the functions of SFX, if they had never learnt of SFX and its functions? By early October, SFX had been mentioned in a few library instruction classes and a library guide had been created and made available from the libraries Web site, (Johnson and McCord, 2001), but SFX had not been given a concerted publicity push on the Pullman campus. This task is designed to test the usability of SFX in an environment where library instruction program had not promoted its use.

Figure 5

Finding an Article From The Source Database: Web of Science

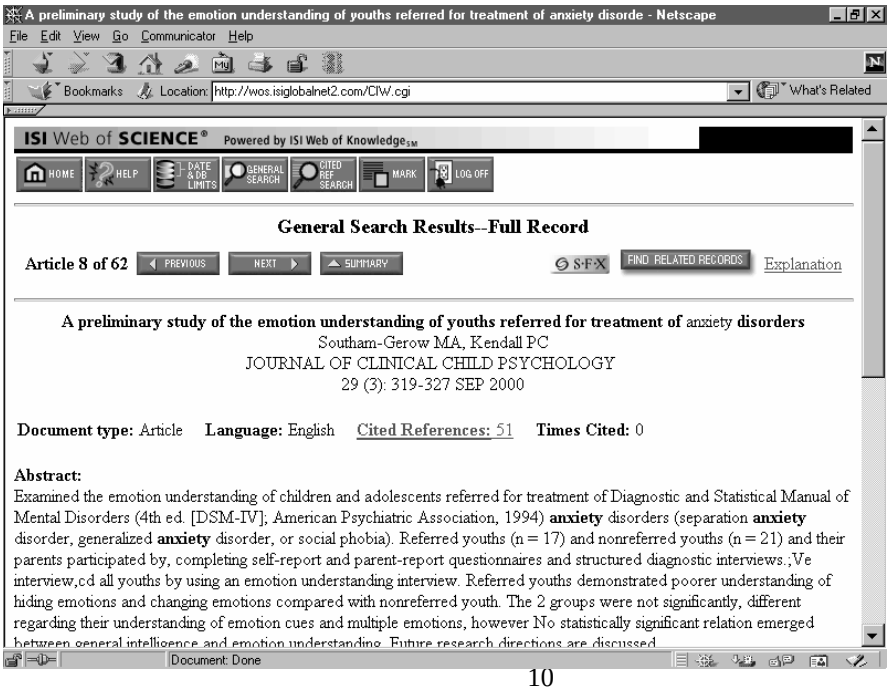
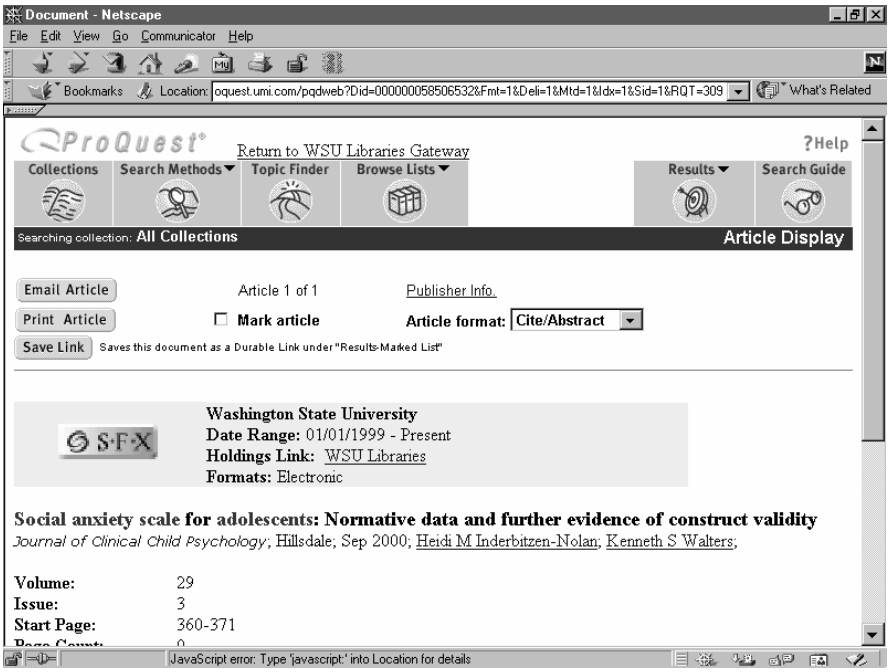
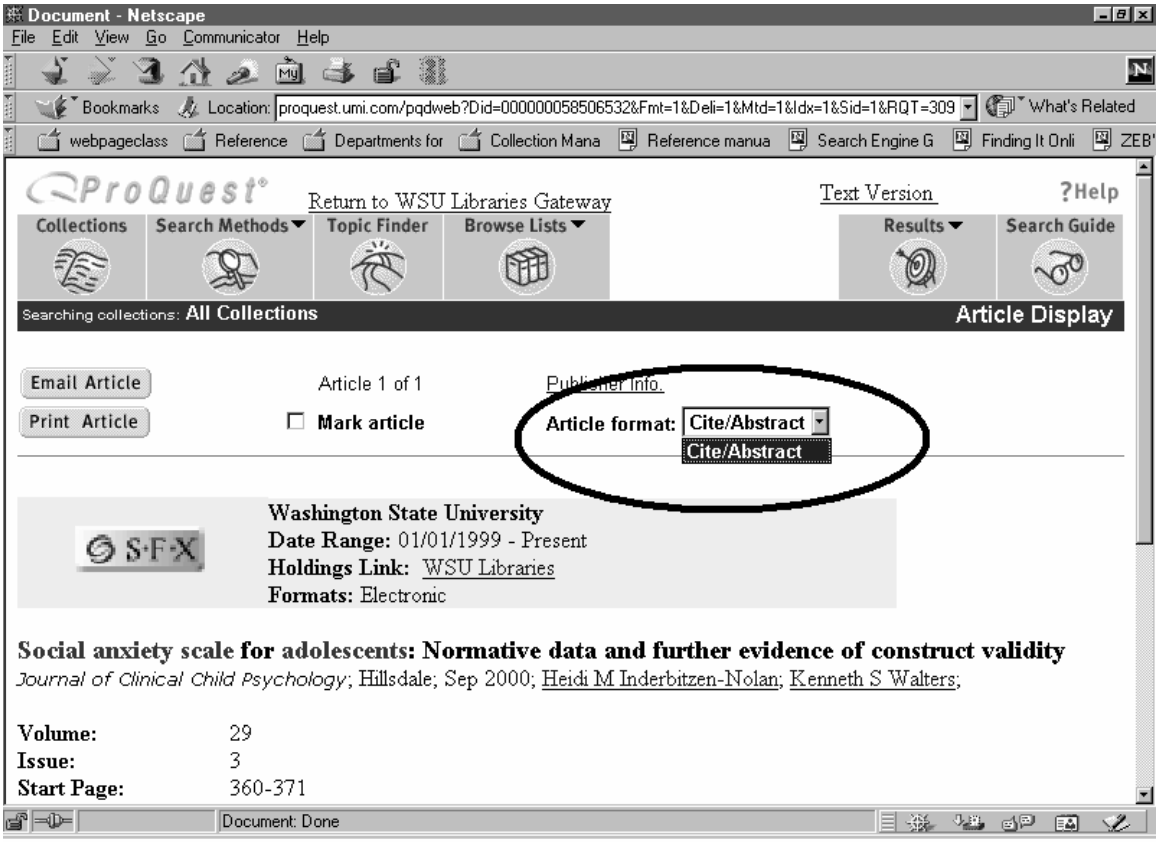


Figure 6
Finding an Article From The Source Database: Proquest



From Proquest, two of the three test participants were able to find and did click on the SFX button, thereby completing the task. One test participant not completing this task was sufficient to indicate that the SFX icon would not immediately be connected in the minds of the library user with the function of finding the document referred to in the source document. The actions of the all the test participants illustrated the difficulty they had. None of the test participants clicked on the SFX button quickly. The first choice for all the test participants was the article format button (see figure 7).

Figure 7
The First Place Test Participants Checked in Proquest Was The Article Format Menu.



Next, they scrolled to the bottom of the screen (see figure 8) and finding nothing useful they scrolled back to the top and looked in various of the menus at the top of the Proquest screen (see figure 9). Only after this, did the successful test participants click on the SFX. The test participants took two and three minutes to successfully complete this task. Ideal results would have seen them take a few seconds to complete this task.

Figure 8
The Second Place Test Participants Checked in Proquest Was The Bottom of the Screen.

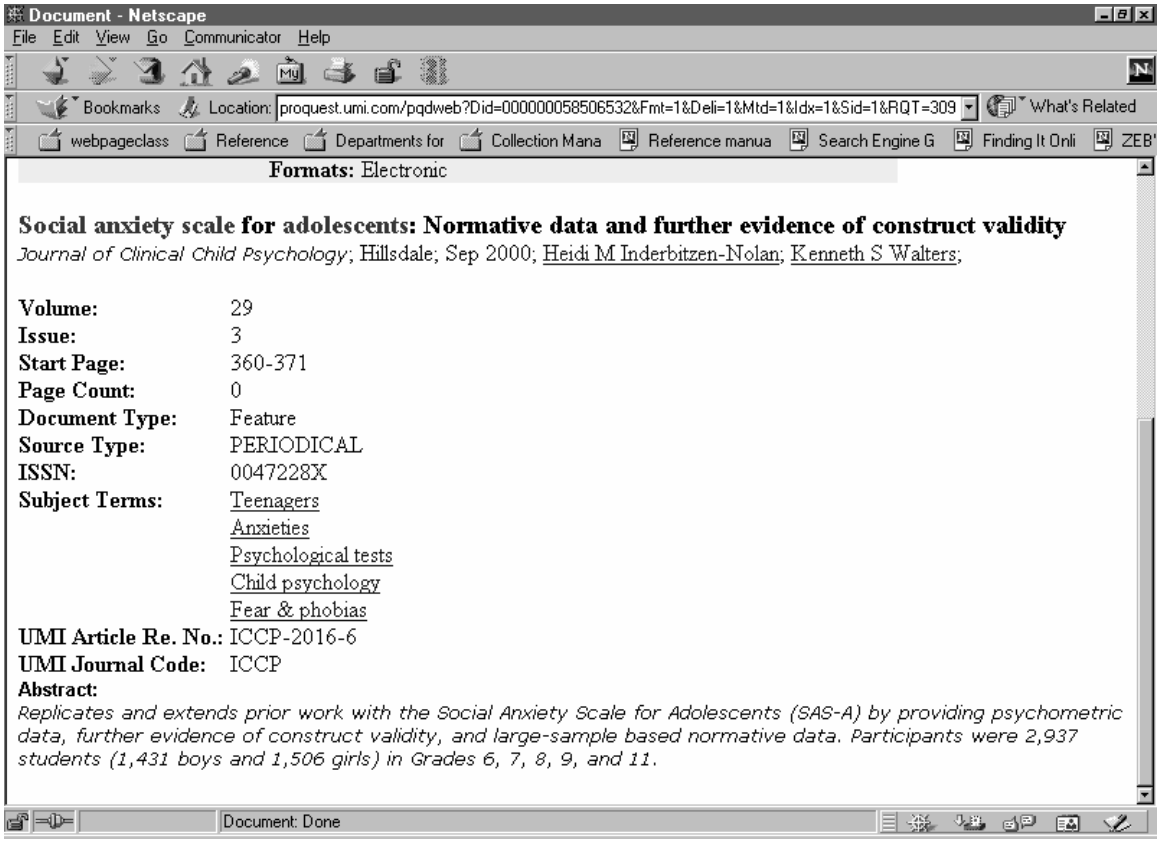
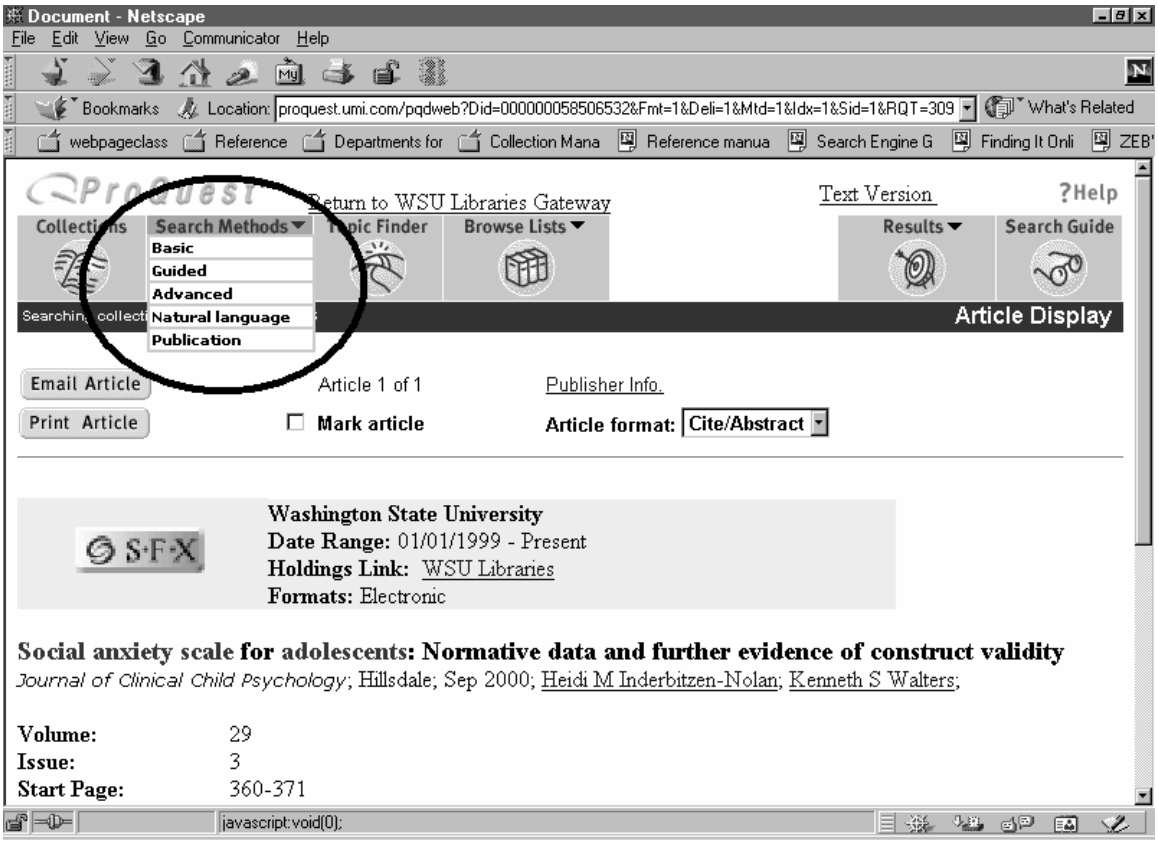
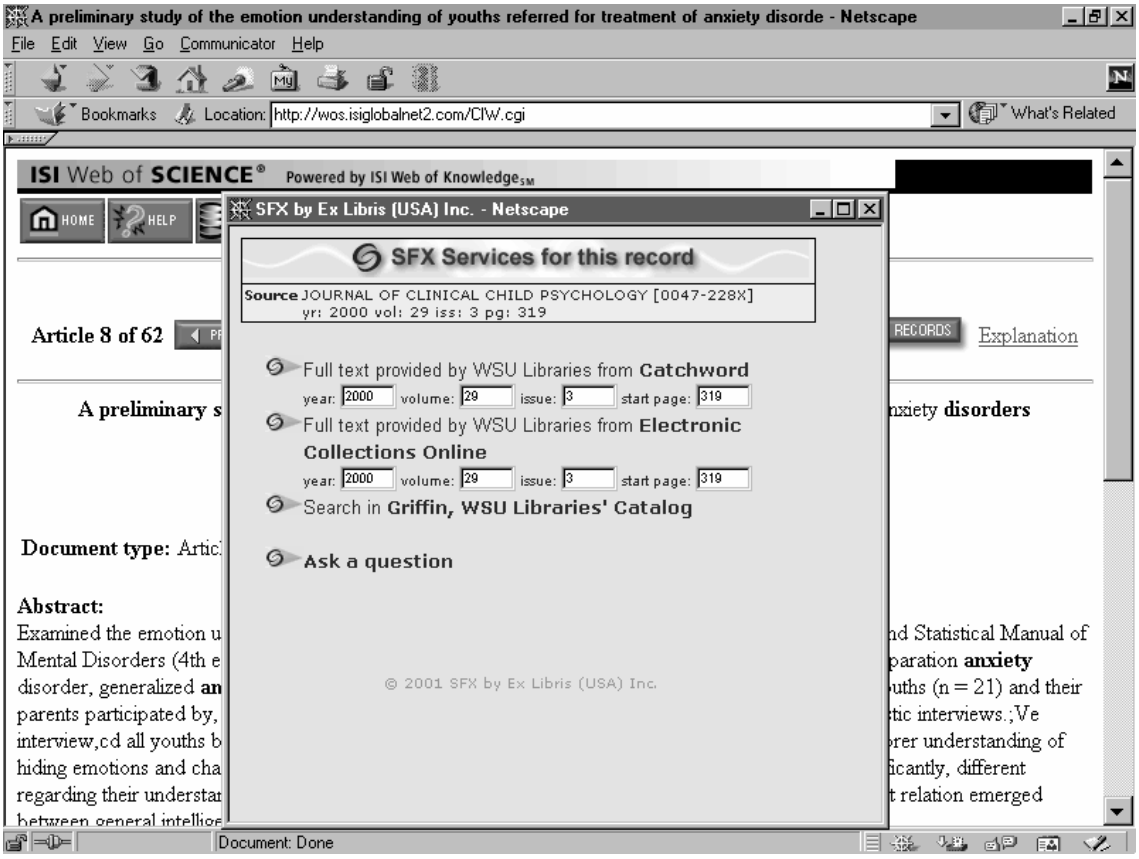


Figure 9
The Third Place Test Participants Checked in Proquest Were The Menus at The Top of The Screen.



In the first Web of Science task , only one person completed the task, and that individual test participant was able to complete the task quickly – in less than a minute. That test participant's verbalized reason for selecting the SFX button was, that he did not know what it did, so he experimented. This test participant suspected that there was a way of finding the full text of an article from the Web of Science because of the question we asked, even though he was unable to see anything on the screen that would have led him to such conclusion alone. Despite this experimental artifact, the other test participants did not complete the task. One of the test participants did click on the SFX icon and after a brief glance at the SFX services menu (see figure 10), closed it down, verbally indicating that it was of no use in completing the assigned task.

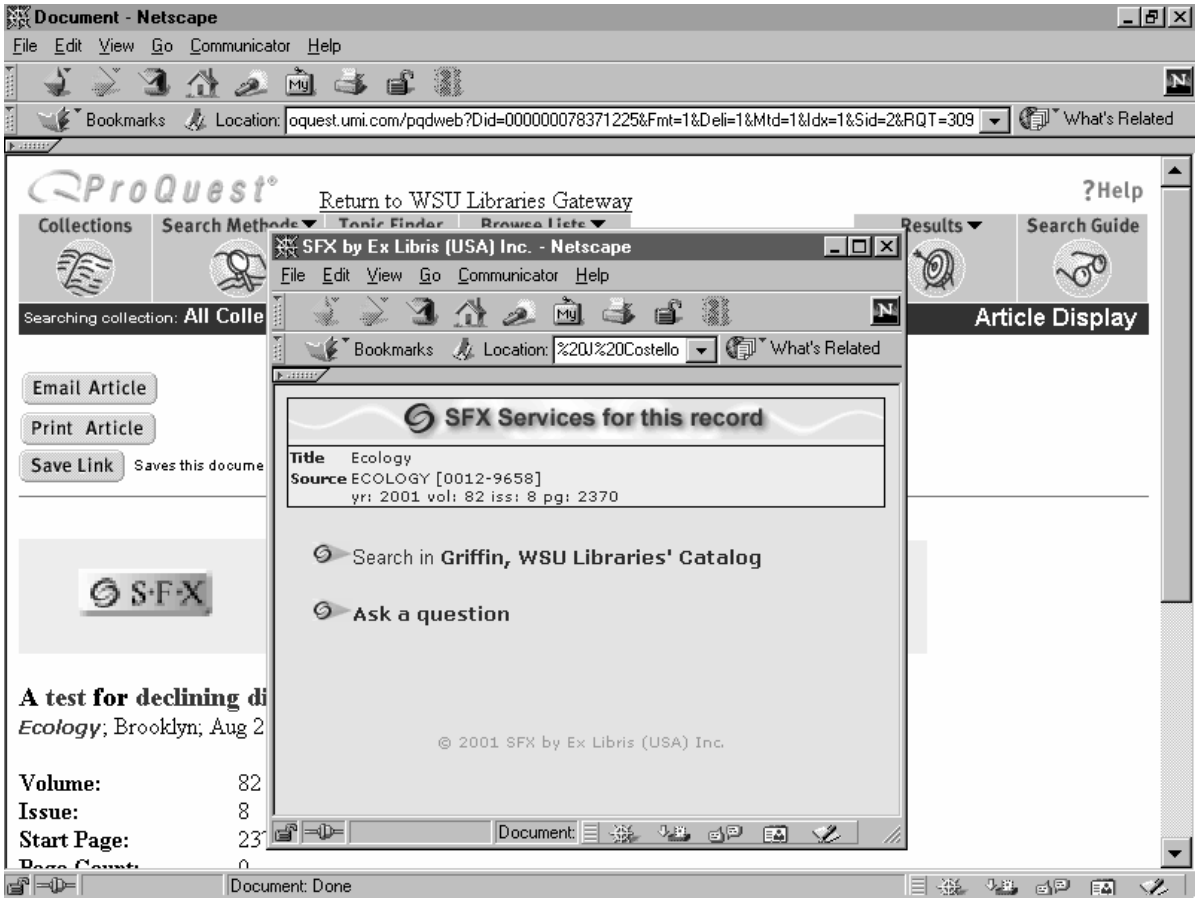
Figure 10
SFX Services Menu Opened From Web of Science.



After the first task was conducted for both the Web of Science and Proquest, test participants were informed that a software product named SFX was being tested, and they read a brief written description about the functions of SFX. Until this point, the test participants had been under the impression that they were testing some new feature of Proquest or Web of Science. In the second task, the test participants were asked to find an online copy of an article in either Web of Science or Proquest. For these scenarios, only one Proquest test participant did not complete the task. This suggests that even library instruction would not be thoroughly successful in connecting SFX with the retrieval of electronic copies of an article in the minds of library users.

The final task assigned to Proquest test participants was to determine if library users would have problems choosing the "Search Griffin, WSU libraries' catalog" option on the SFX services menu. Griffin is the name of the Library Catalog at Washington State University. The question was, "Is this journal, Ecology, available in the WSU libraries?" An SFX services menu was generated from a recent article of the journal Ecology (see figure 11). At that time Washington State University's library users had access to electronic an electronic version of the Journal Ecology five years after the date of publication through JSTOR.

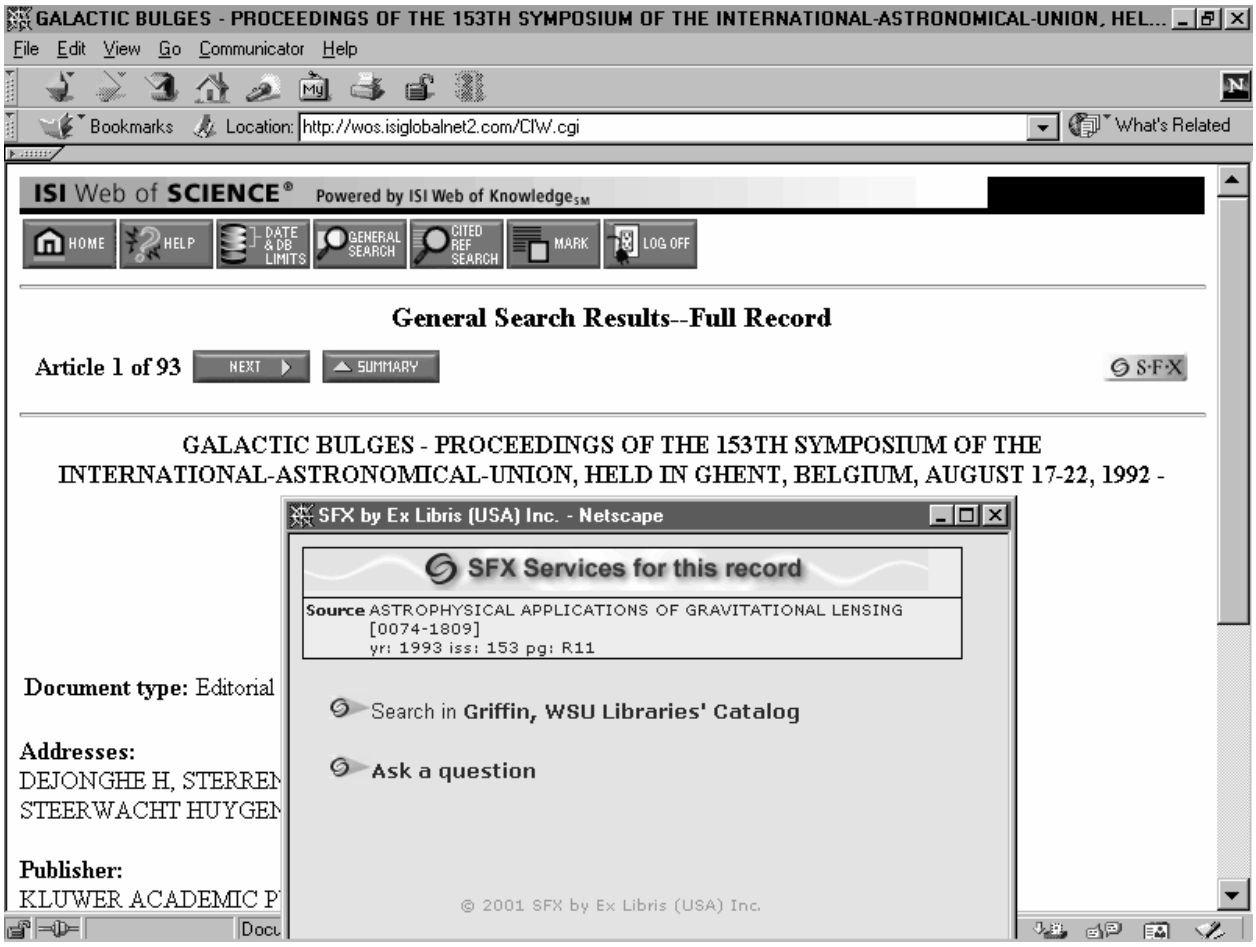
Figure 11
Will Test Participants Use the Ask A Question Service?



The Web of Science question was more direct. It asked the test participant, "Go to the Griffin Online Catalog from this menu." One test participant in the Web of Science test closed down the Services menu, opened a new window, searched in the library catalog. This suggests that even with user education some users will continue to use traditional methods, despite the accessibility of a faster and an easier method of answering this type of question.

The fourth task asked, "This article from the journal Galactic Bulges is not available online or in the WSU Libraries, but it is essential for your research. Is there a way to find out how you would go about getting a copy of this article?" By using SFX, the user would not find a reference to a copy of this article in the WSU Libraries collection in any format. The intention was to test if library users would make use of the "Ask a Question" service that has been included as a default on all of the SFX services menus (see figure 12). Of the three test participants, the only user to select the "Ask a question service" from the SFX menu was also the only user unaware of the library's interlibrary loan services and document deliver services. This test participant took four minutes to successfully complete the task.

Figure 12
SFX Versus View Full-Text in Web of Science



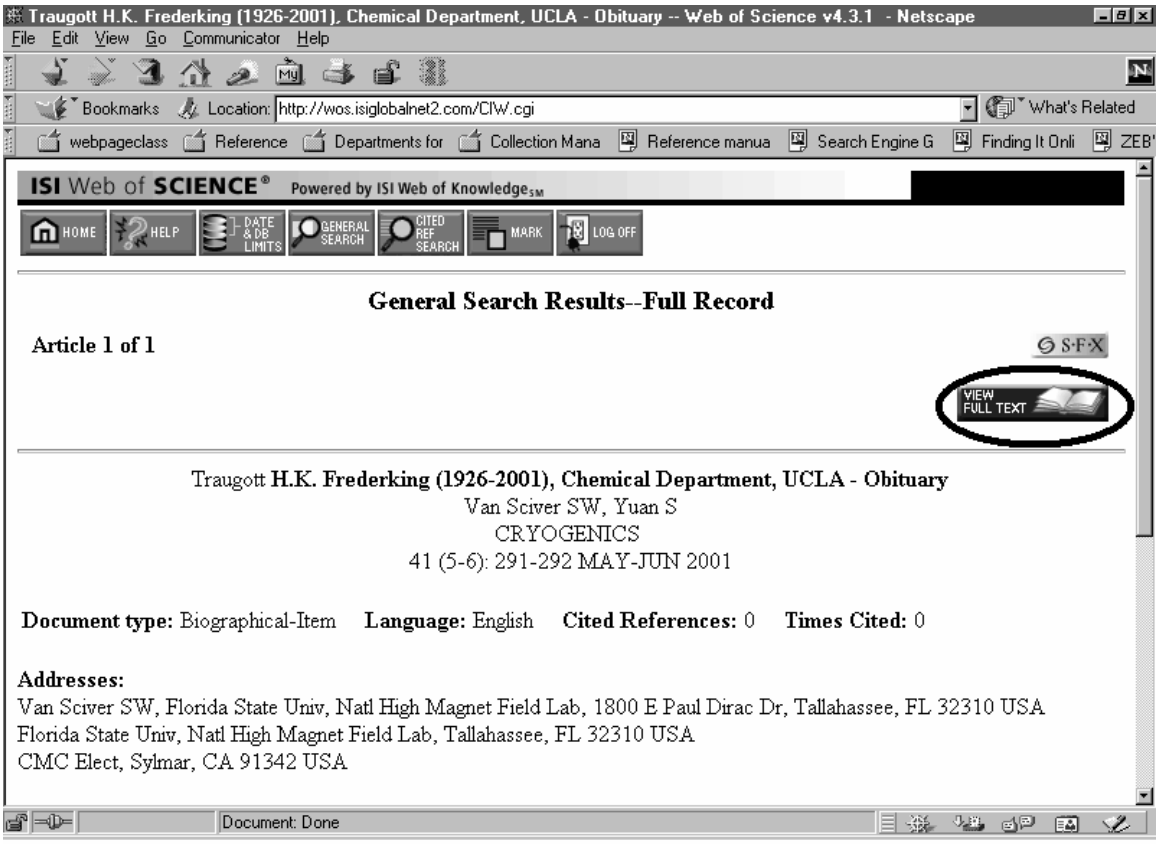
It is worth noting, that while the user would not find a reference to a copy of this article in the WSU Libraries collection in any format by using the SFX services menu, the library does have a copy of this article. The article used in this task was from International Astronomical Union Symposia and they are cataloged individually as monographs. The Search Griffin service uses the ISSN metadata garnered from the source document to search the library catalog. Library staff will check the request against the library holdings for an Interlibrary loan requests, and refer the users to the item held in the collection. For direct document delivery services, the libraries name for its end-user document delivery service, the users are required to check the library collection prior to submitting an order. As a result, one of our test participants would have, based solely on our test scenario, requested, and incurred a cost to the library for material already within the library collection.

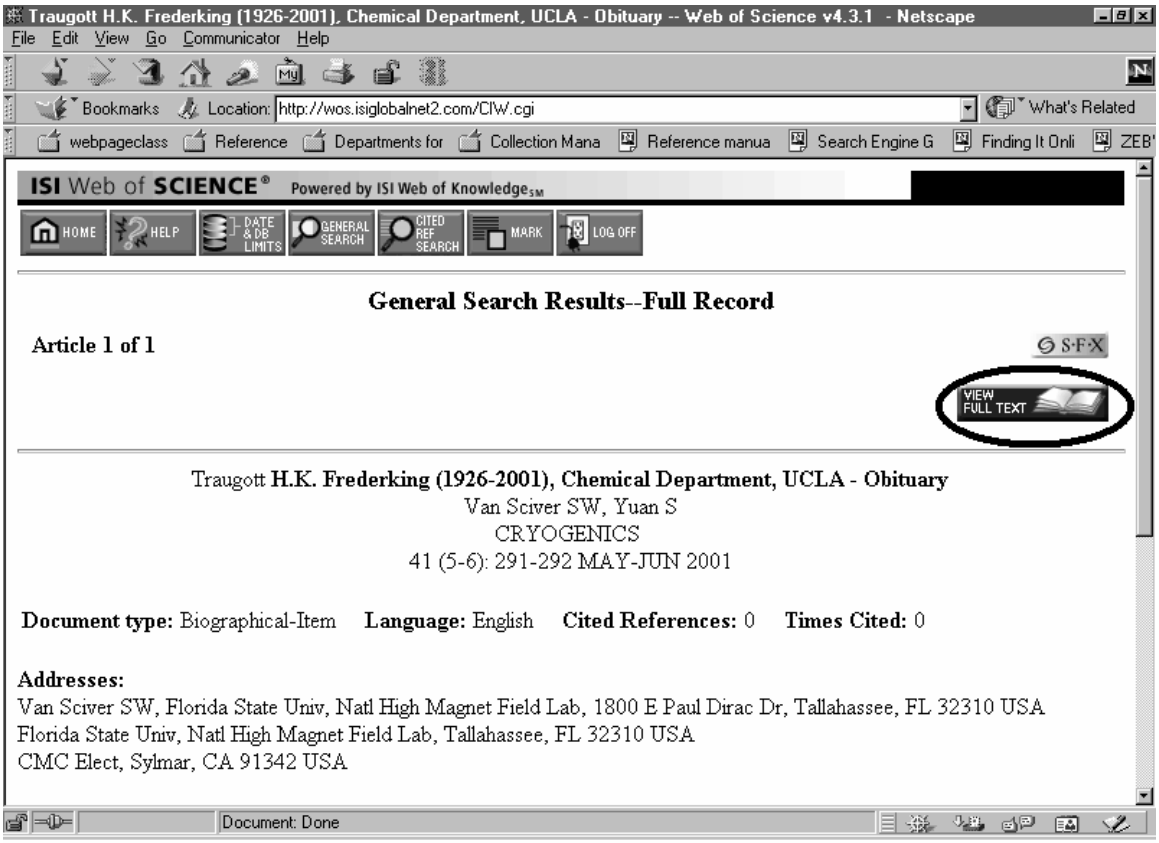
For the fifth question using Web of Science, the test participants were told that "This article from Child Development is not available online. Is the journal, Child Development, available in the WSU Libraries?" One test participant, searched the catalog in a new browser window, instead of using SFX, thereby not completing the task successfully, but finding the catalog record for the desired material and answering the question correctly. The other test participants used SFX and successfully answered the question.

The sixth question using Web of Science as a source asked "You really need this article from Cryogenics that you've found on the Web of Science". Web of Science includes view full text icons for journals (see figure 13), and the final test was to determine if test subjects would use SFX instead of the View Full Text button? Only one test participant used the SFX link instead of the full text link, thereby successfully completing the task. This test participant verbally indicated that he was using the SFX link, because SFX was being tested in the exercise. This indicates that even user education is not likely to sway people away from using the Full-text icon.

CAPTION: SFX Versus View Full-Text in Web of Science

Figure 13





In the exit questionnaire, test participants suggested that the source database icon ought to read "a big click here" or "to find full text, click here". These comments were gathered from the first question on the questionnaire. It asked, "If the SFX button had been labeled Washington State University Libraries, do you think you would have been more willing to click on it even if you had no idea where it might take you?" All but one of the test participants thought the SFX Services menu was reasonably easy to use.

CONCLUSIONS

A set of recommendations were developed from the usability testing and sent to Ex Libris (Chisman, 2001). The SFX button, if used alone in the source document, will require Washington State University Libraries to maintain a continual instruction campaign because the brand name SFX has no meaning in the minds of library users, unless they have been informed or have learned what functions it can perform. Also the student body and faculty at academic institutions are in constant flux. More intuitive labeling might mitigate this need. From comments on the exit questionnaire, it can be concluded that the words "Full-Text," will get the users attention. While full text is not always available, some wording such as "Full Text, etc." would be more salient and effective than a button that merely uses the SFX logo. The decision to use the phrase "locate document" in FirstSearch sources was an attempt to include some sense of the variety of services currently available through SFX, not just getFullText. Including the SFX logo in any source document enables Ex Libris to build brand recognition and Ex Libris' desire to brand its products is certainly a reasonable expectation.

The SFX Services menu suggestions can be implemented by the individual library to some degree. Based on observations, the small graphic link on the menu needs to have the cursor change to a hand when it passes over the graphic, as is convention for links on the Web. The top of the SFX services menus, "SFX Services for this record" is incomprehensible to the library user; the test participants did not know what it meant. Test participants did not to notice the citation displayed on the services menu, on the occasions when the GetFullText service links to the electronic journal, but not direct to the article found referred to in the source document. The test participants all used the to the citation in the source database to help find the correct article. It is the hope that, that if the citation could

be made more prominent on the services menu that it would be used more. It was our impression that the citation would be more salient to the library user if it was visually separated from the menu's banner.

The rapid expansion of SFX use with the activation of FirstSearch as a source demonstrates a great potential for the product, and with more time more users will learn about SFX. As is expected in the research library environment, the requests for full-text articles and searches in the library catalog demonstrate the value of inter-linking the libraries electronic, print and other media with indexes and abstracts. Growth of the SFX use has been demonstrated throughout period of initial implementation and demonstrates its value to library users.

The choice of library users to search the library catalog when full text is available may stem from two factors. First, library users may be used to finding links to electronic journals via the catalog, since the libraries have systematically added 856 links to the OPAC. Second, the libraries have consolidated and switched its serial vendor in the spring of 2002 and during the process a small but noticeable number of electronic journal licenses lapsed temporarily before being re-licensed. SFX provides a convenient method of maintaining a scalable and dynamic system of linking a library's resources and services together. Furthermore, SFX is a relatively easy system for the library user to navigate through to find the information that they are looking for.

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