E-JOURNAL USER STUDY
REPORT OF THIRD (FOLLOW-UP) SURVEY
NOVEMBER 2002

INTRODUCTION

Electronic journals, or e-journals, have become an important tool for scientists and practitioners over the past few years. As Tenopir and King (2001) have noted, nearly two-thirds of all scientific journals are available both electronically and in print, and there are more than 1,000 electronic-only peer-reviewed journals. The overall goal of the E-Journal User Study is to understand the broad range of value that all of this electronic publishing adds across a variety of scholarly activities—including reading, writing, searching the literature, and creative thinking. Through both qualitative and quantitative research,[1] we examine how life scientists and medical practitioners are making e-journals a key part of their scholarly practice. Our research provides a foundation of data and analysis that we hope will help publishers, libraries, and other scholarly institutions to develop more useful e-journals and electronic publishing services.

Our initial survey, conducted in 2001, focused on understanding the e-journal usage of life scientists and clinicians and on their perceptions about the impact of e-journals on their research and clinical practices. The second survey focused on the usage and perceptions of multifeature users, or scholars who generally use e-journals at a more advanced level. Our third survey was a follow-up to our initial survey. This third report focuses on information collected based on new questions in the third survey. Our final report will examine findings from all these surveys and the several qualitative processes pursued in the project (log data mining, interviews, workshops, etc.)

Overview of the Third Survey

Implemented from May through August 2002, this most recent survey collected information about the e-journal usage behaviors and attitudes of a subset of respondents from our first survey. Respondents were life scientists and medical practitioners in U.S. and British scholarly societies. The third survey was conducted one year after the first.

We asked several questions about usage frequency in both surveys and can thus examine changes in frequency of use over time. Most other questions were new in the follow-up survey, however, allowing us to link respondents' answers in the first survey with a new set of variables from their responses in the follow-up survey. Because we asked mostly new questions in the follow-up survey, and because the sample turned out to be demographically representative of the first survey sample, we have devoted this report primarily to sharing the findings from the new questions.

[1] Research tools included ethnographic interviews, expert workshops, expert interviews, data mining, and three large surveys. See *www.ejust.stanford.edu* for the findings of each of these pieces of the project as they are completed.

The specific behaviors and attitudes investigated in the follow-up survey included expenditure on personal online subscriptions, format and searching preferences and behaviors, and use of online-specific features such as e-mail alerts and pay-per-view, as well as frequency of e-journal usage.

The findings paint a picture of some key market and service issues facing e-journals over the coming decade. We share these findings with the public, with users, with publishers, and with libraries, with the hope that they will inform the discussion and debates around the future of journals and scholarly publishing services.

Literature Review

Although many case studies of individual journals have been done, few large surveys of e-journal users have been conducted, and even fewer have collected data on life scientists or data over time. Tenopir and King (2001) conducted the most extensive longitudinal surveys on journal usage more generally among scientists (including but not limited to life scientists), between 1977 and 2001, including some questions on e-journal usage. They focused mostly on the number of article readings over a particular time period—rather than on the frequency of use of e-journals, as in our study—as a usage metric. Rogers (2001) reports on a smaller, three-year study of approximately 600 respondents conducted from 1998 to 2000 at Ohio State University; that study showed increasing use of e-journals over that time period by faculty and grad students—particularly by faculty, who used e-journals less than grad students did in 1998 but who had caught up by 2000. In 2000, 10% of faculty and 4% of grad students used e-journals "daily"; 28% of faculty and 26% of grad students used them "weekly."

A number of smaller studies have provided one-point-in-time looks at various types of e-journal or electronic literature users. CLIR/Outsell (2002) report on a survey of faculty and students at a variety of types of colleges and universities. They focus on library services and perceptions of the library's value and look more broadly at electronic resources, rather than just at e-journals, as part of the academic information environment. Woodward, Rowland, McKnight, Pritchett, and Meadows (1998) report on the Café Jus project at a U.K. university, begun in 1996, which surveyed 75 master's students about the problems they experienced with e-journals and their motivations for using the journals.

Eason, Yu, and Harker (2000) surveyed a subset of the 2,867 academic users of SuperJournal, a two-year test e-journal service in the United Kingdom; Liew, Foo, and Chennupati (2000) surveyed 83 U.S. graduate students about their interaction with PROPIE, a mock e-journal platform; and Rusch-Feja and Siebeky (1999) report initial results from a survey of 1,042 German researchers (mostly in biomedicine and the physical sciences) from the Max Planck Society about their journal use. Brown (1999) surveyed 49 faculty members (astronomers, chemists, mathematicians, and physicists) at the University of Oklahoma about their information-seeking behaviors, including preferences for printed versus electronic formats. Finally, Worlock (2002) surveyed 252 U.K. academic and nonacademic scientists (in the life sciences, medicine, hard sciences, and social sciences) about their access to e-journal articles through pay-per-view and other methods.

Overview of Findings

This survey found that *online journals have become a very common method for article retrieval.* Online retrieval is a daily routine for life scientists and medical practitioners, both in academia and in other institutions. During the year that passed after our first survey, many users of e-journals had become more frequent users, and many nonusers had become users. Taken together with the findings from our first survey, our present findings suggest that e-journals may help make scholarly activities more efficient.

Our findings also show that *online access to journals motivates individuals to join societies and subscribe to journals and also affects print subscriptions.* We found preliminary evidence that membership and subscription behaviors are in part explained by an individual's age: individuals at the peak of their career spend more money on online subscriptions than do those who have less experience or are younger or those who are retired.

We found that most scholars tend to print out e-journal articles eventually, and thus *e-journals need to be both print-friendly and electronically archivable*. We found that a strategy of reading articles all the way through immediately upon retrieval—either quickly or slowly—may make possible a higher volume of reading. We also found that use of HTML suffers from its lack of print-friendly features. Browsability and portability are the top two reasons for scholars continuing to use printed editions.

We found that e-mail alert services are a used and valued feature, particularly electronic Table of contents (eTOC) alerts. We also found that pay-per-view is rarely used, except for urgent needs, largely because prices are perceived as being ridiculously high. Pay-per-view might be used more if prices were reasonable (about $3 per article on average).[2]

Finally, we found that *libraries are facing changing user needs.* Libraries are a main source of online access to journals—and this has become their most important journal-related service. Scholars still commonly visit libraries for article retrieval, but mostly for articles they can't get online. Multijournal search engines with full-text links are the most common search starting point—and most searches are done online, not in library stacks.

[2] For purpose of comparison: among journals that offer pay-per-view among the HighWire Press affiliates, the current average price is $10.75; the highest is $25; the lowest is $5; both the median and mode are $8. These prices may not be representative of the scientific, technical and medical literature.

METHODOLOGY

As noted below, the follow-up sample is a subset of the first survey sample, with similar demographic characteristics.

Sampling Method

First Survey

For the original survey in 2001, we contacted 70 scientific societies affiliated with HighWire Press to request membership information. Twenty societies, broadly representative of the life sciences—biological sciences, health sciences, and agricultural sciences—agreed to release their member information (limited to name, e-mail address, and membership status—e.g., active, student, retired) for the survey. We then sent 108,774 e-mail solicitations to this population, requesting members to respond via a questionnaire on the Web. Approximately 13,903 addresses returned "undeliverable" or "vacation" messages, resulting in a contact group of approximately 94,871. We collected survey data between May 22 and June 20, 2001. During this period, we received 12,453 net responses, for a final survey response rate of 13.14%.

Table 1: Comparison of Demographics

Variable	First Survey	Second Survey
Gender		
% Male	71	70
% Female	29	30
Field/Occupation		
MD	17	17
Biologist	60	60
Age		
Mean	47 years	47 years
Median	48 years	46 years
Job Experience		
Mean	17 years	17 years
Median	16 years	16 years
Country of Residence		
% United States or Canada	74	75

Follow-Up Survey

The follow-up survey contact group consisted of 9,881[3] first-survey participants who volunteered to provide e-mail addresses for a follow-up contact. We received 4,524 valid

[3] Refer to Appendix I for a detailed look at our sampling method.

responses (a response rate among volunteers of 46%). The follow-up survey sample had a less heavy-tailed normal distribution (fewer extreme points) than the first survey sample. Table 1 shows that the mean and median ages were 47 and 46, respectively (versus 47 and 48 for the first survey); 30% of respondents were female and 70% male (versus 29% female and 71% male for the first survey); 17% were medical doctors (same as the first survey); 60% said biology was their primary field of research (same as the first survey); and average job experience was 15 years (same as the first survey). The follow-up survey sample was thus representative of the first survey population on these basic demographic criteria.

Descriptive Statistics for Selected Variables

Table 1 (above) shows descriptive statistics for selected demographic variables from the first and the follow-up surveys.

FINDINGS

E-journals are nearing maturity as a technology among life scientists and clinicians.

Life scientists and clinicians commonly use e-journals to retrieve full texts.

The data show that e-journals are nearing a mature stage among life scientists and clinicians, most of whom use them regularly. Scholars often use e-journals to retrieve articles.

We asked two questions about usage frequency: one about the last time of use and the other about average usage over the past year. About 78% of respondents had used e-journals within the week before responding to the follow-up survey (46% said "yesterday or today," 33% said "last week," and 12% had used them "last month"). Only 2% had never used e-journals, and 8% had used e-journals longer than a month ago.

Table 2: Comparison of e-Journal Usage Frequency

Usage Questions *(unweighted data)*	**First Survey** Full Sample (2000–2001) n=12,453	**Follow-Up Survey** (2001–2002) n=4,524	**First Survey** Matching Subset (2000–2001) n=4,524
Last Time of Use			
Yesterday or Today	37%	46%	40%
Last Week	33%	33%	34%
Last Month	16%	12%	15%
Longer than a Month Ago	9%	8%	7%
Never	6%	2%	4%
Average Use Last Year			
Daily	18%	21%	19%
Weekly	46%	51%	49%
Monthly	20%	18%	19%
Seldom	11%	8%	10%
Never	5%	2%	4%

Over the previous year, 72% had been weekly or more frequent users (21% said they had used e-journals "daily" and 51% "weekly"), and 18% said they had been "monthly" users.

Scholars have increased their usage frequency somewhat over the past year.

During the year since the first survey, the volunteer survey respondents appear to have increased their e-journal usage frequency somewhat, with higher percentages reporting daily use during that year (2001–2002) than during the previous year (2000–2001). Higher percentages also reported having used e-journals the day of or the day before the survey. See Table 2 for a comparison of these two questions in the first and follow-up surveys. Of the follow-up respondents, 29% reported more frequent use over the past year than in the first survey; more than 50% had not changed their e-journal usage frequencies over the year.

The more life scientists and clinicians browse (and read), the more they use e-journals.

High-volume journal browsers made more use of e-journals in their research or clinical practice than did low-volume browsers. Those who had used e-journals one day before or on the same day of their survey response tended to be both high-volume journal browsers and intensive journal readers. On average, they browsed 10 or 11 journals and read 5 or 6 journals to stay current in their own fields (versus the averages for the entire sample of 8.8 journals browsed and 4.7 journals read). Thus, e-journals appear to make reading and browsing journals easier and faster for scientists and clinicians.

Full-text retrieval and searching/browsing dominate e-journal usage.

Of the respondents, 64% said they use e-journals primarily to retrieve full-text articles online. Another 27% said they use e-journals primarily for ease of searching and/or browsing. The majority of respondents thus see online journals as a convenient, time-saving, effort-reducing tool for article location and retrieval—suggesting again that online methods make full-text retrieval and searching easy. Fewer (4%) said they use e-journals primarily to access online-specific features, although other survey questions made clear that online-specific features add value to scientific journals not provided by printed editions. These features are secondary to full-text retrieval, but many are heavily used and found to be useful nonetheless.

Of the respondents, 1.3% cited in an open-ended question some other motivation for e-journal usage. Some cited the ability to share PDF articles easily with colleagues (by posting links on a shared Web site). Others noted that figures can be seen and printed in PDF at any size, whereas library copy machines tend to reproduce figures poorly. Still others used e-journals for reducing costs (personal subscriptions to printed editions were too expensive); evaluating the articles of job and grant application candidates; looking at results or methods cited by other articles; reading carefully articles of particular interest; obtaining daily quick updates on “everything [they] need to know”; seeing an article early (before arrival of a printed edition); reading free or cheap articles outside their field; obtaining electronic figures; obtaining information about other articles that have cited an article; direct linking to reference articles; keeping up with the literature; retrieving older articles; evaluating whether an article is worth printing to keep; seeing one of their own manuscripts; avoiding storing old issues; obtaining free CME (continuing medical education) credits; reducing the bulk of paper (saving space); obtaining images and reference articles for lectures; helping the environment by saving paper; and obtaining articles not available in local libraries. One respondent cited “being on the editorial board of the journal” as a reason for using an e-journal.

With a limited future market share, business models may have to change.

Analyses of several different items in the survey suggest that the future market share may be limited for most e-journal publishers.

The number of individual online journal subscriptions increases with career stage (age)—but only to a point.

One preliminary finding from this survey was that the number of online journal subscriptions per person increases with age—but only to a point; then the number plateaus or decreases. This was also true for the number of society memberships. The graphs in Figures 1–4 show that the ceilings to numbers of subscriptions and memberships are for most respondents two or three journals and one or two society memberships. As scientists and practitioners reach the peak of their career (at 20 to 25 years of experience), their number of subscriptions also peaks and then declines, whereas the number of memberships plateaus around retirement age. Because we have only two data points, very close in time (one year apart), however, we could not do the long-term longitudinal analysis necessary to demonstrate that this is indeed a career stage or age effect rather than a cohort effect.

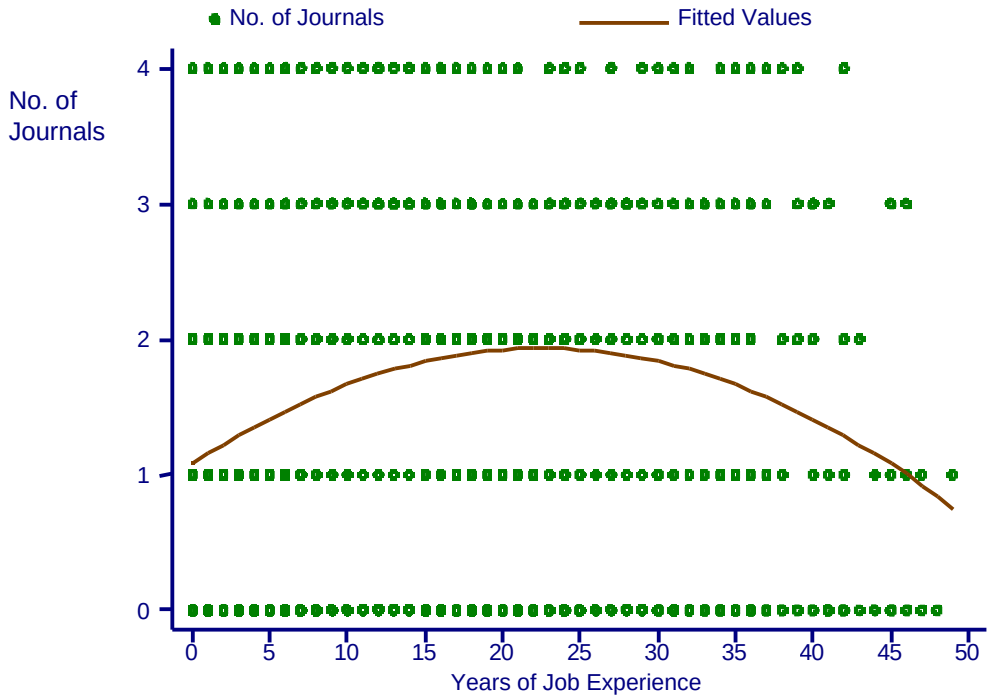

Figure 1
Fitted Curve: Number of Journals and Years of Job Experience

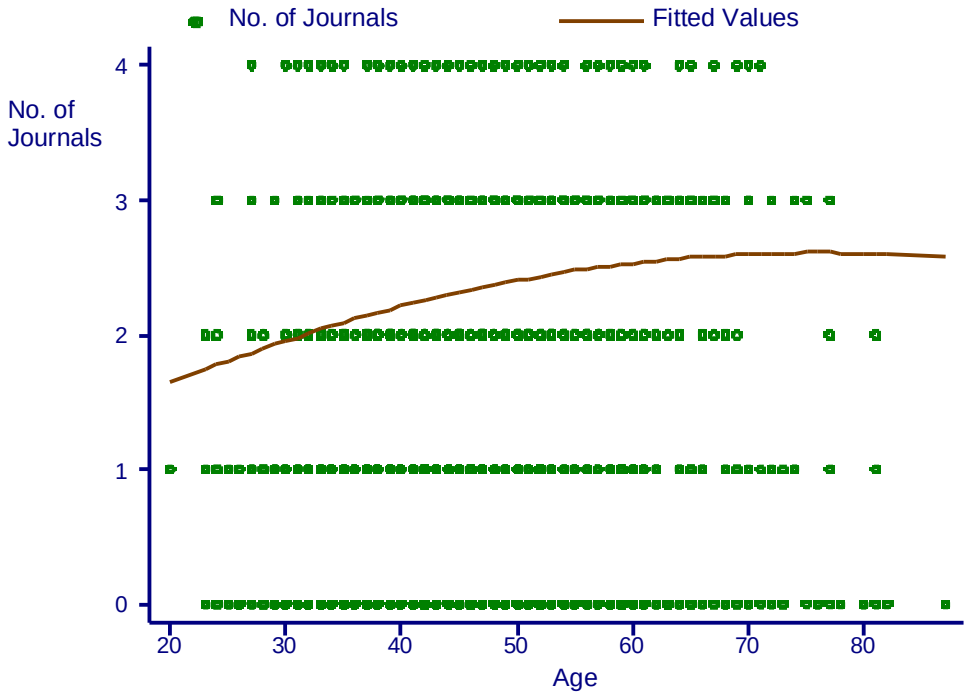

Figure 2
Fitted Curve: Number of Journals and Age

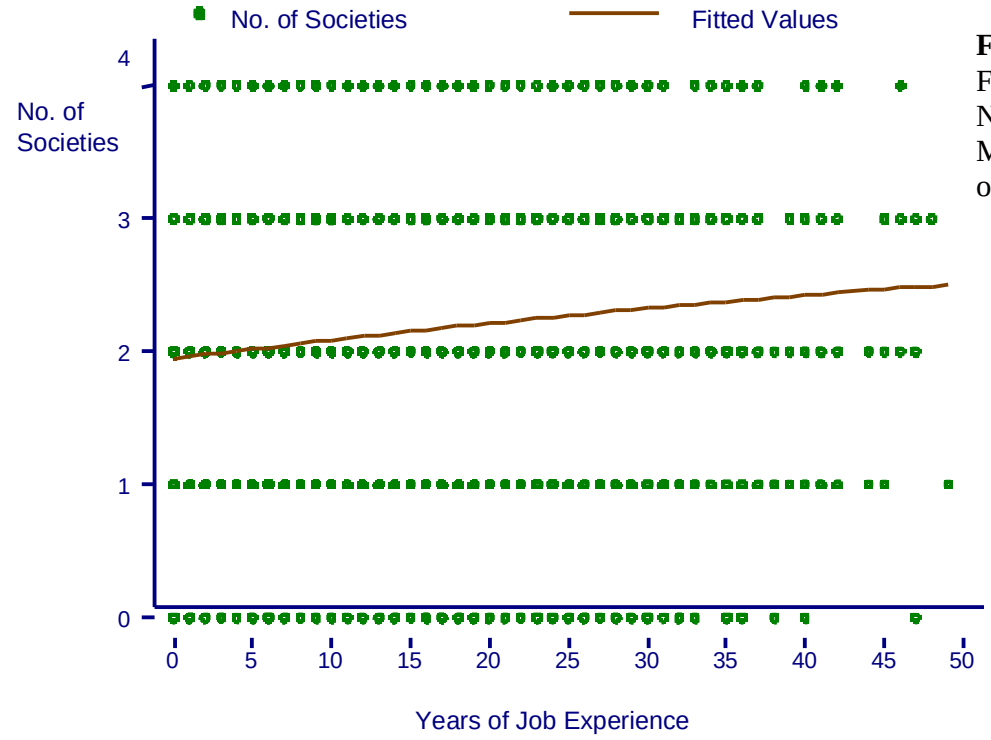

Figure 3
Fitted Curve: Number of Society Memberships and Years of Job Experience

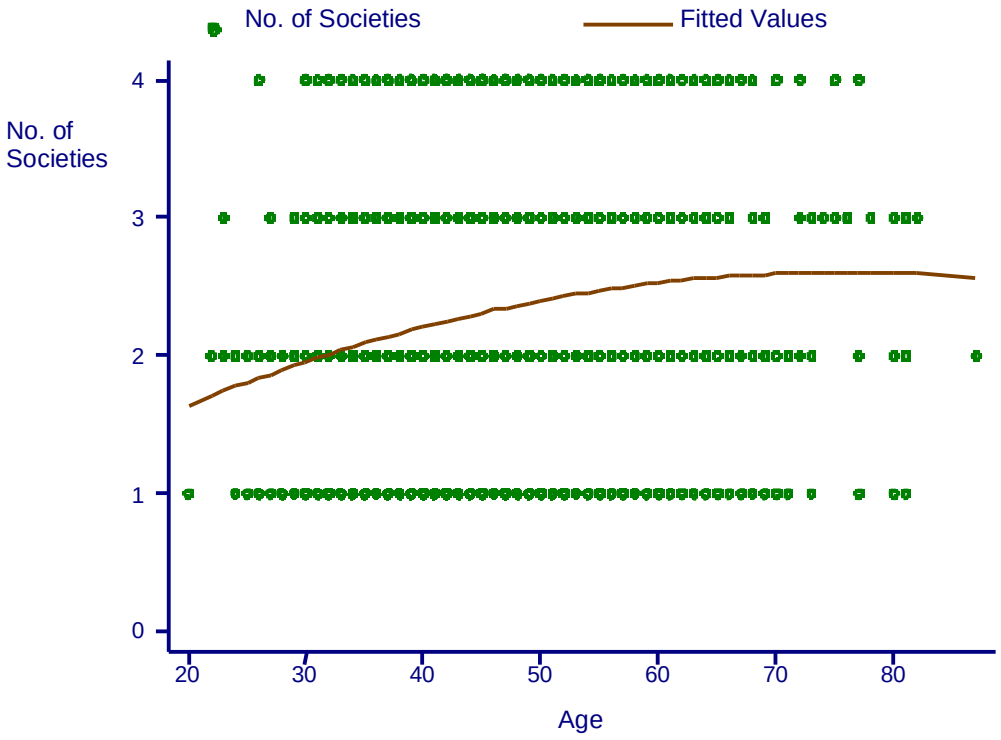

Figure 4
Fitted Curve: Number of Society Memberships and Age

Individual online subscriptions follow a career cycle.

Somewhat stronger evidence comes from the amounts of individual spending for personal online subscriptions. Personal spending for online access to journals increases until 20 to 25 years of experience; then spending decreases (see Figure 5). This supports a marketing strategy of some societies/journals, which offer discounted subscription prices for students. Personal spending decreases after a certain point (age 50 to 55, with 20 to 25 career years) (see Figure 6). The younger and older spend less for online subscriptions than the middle-aged and those who are at the peak of their careers. This suggests an individual life cycle of spending for online subscriptions: scientists and practitioners increase their spending on journal subscriptions as their careers mature and then start to decrease spending as they approach the end of their careers. Personal spending may thus reflect the productivity of individuals at each career stage. Again, however, we cannot rule out the possibility of cohort effects.

If these findings are confirmed, then a strategy of offering greater price discounts for students and retirees might maximize personal subscriptions in a relatively stable market.

Figure 5
Fitted Curve: Amounts of Annual Spending and Years of Job Experience

Figure 6
Fitted Curve: Amounts of Annual Spending and Age

Those who spend more than average for online access spend a lot *more.*

Of our respondents, 41% (1,835 of 4,524 respondents) reported that they spent money on journal subscriptions and society memberships for online access (combined). On average, they spent about $360 per year—a fairly large amount of money; the median spending was $250. The middle 50% of respondents (interquartile) spent between $120 and $400 last year for online access. The payment distribution was skewed to the right: those who pay more than average tend to pay a *lot* more, whereas those who pay less than average pay only somewhat less.

Users prefer different format and payment options depending on frequency of their usage.

The more scholars use e-journals, the more likely they are to stop delivery of personal print subscriptions….

Although 75% of our sample said they plan to continue having at least some printed editions delivered to them personally by post, 21% said they do not plan to continue printed editions, and 3% said they had already stopped. A smaller proportion of frequent e-journal users (70%) than of infrequent users (79%) planned to continue printed editions. The more they used e-journals, the more likely they were to plan to stop print delivery. This potentially limits the future market for personal subscriptions to printed editions. As more scholars become frequent e-journal users, publishers may lose more of their personal subscription market for printed editions.

…But online access motivates both journal subscriptions and society memberships.

Although printed editions will motivate personal subscriptions less often in the future, online access could motivate them more. Half (50%) of all respondents said they personally subscribe to at least one journal or maintain at least one society membership specifically to obtain online access to full-text journal articles. Those who were motivated by online access joined on average two or three societies for this purpose and subscribed to one or two journals.

Users expect online subscriptions to be cheaper than subscriptions to printed editions.

To explore business models that would meet the expectations of life scientists and practitioners, we asked about payment model preferences.

Among those motivated by online access, 64% preferred to “pay a somewhat discounted price” for an online-only subscription, 18% preferred to receive both printed and online editions “for a price somewhat higher” than the regular printed-edition price, and 10% preferred pay-per-view to get online access to individual articles as needed. (We asked respondents to pick only one of these three options—the one they’d most prefer when they need “personal online access to full-text scientific journal articles.”)

Among the 4% who didn't like any of these options, the most frequent comments were these:

> *Payment for the printed edition should also automatically include access to the online edition (for the same price).* [This was by far the most frequent comment.]
>
> *Discounted online access for the most important journals and "pay-per-view" access for the rest of journals.*

Many, like this last respondent, said it depended on the journal—they wanted different payment structures for important journals versus the rest, for journals in their field versus journals outside their field, for key reference journals versus other journals, for journals read versus journals scanned, for generalist journals versus specialist journals, for research journals versus news-and-research journals (printed copies of the latter being essential for reading in bed), and so on.

Many others wanted free or substantially discounted online access, either through their institution or directly, and felt they deserved it.

> *Most journals charge heavily for publishing the papers (page and/or figures) and the online access to all these journals should be free to everybody.*
>
> *I prefer that it be free. After all, I serve as reviewer without compensation.*
>
> *I do not think one should personally pay for scientific journals. It is the duty of the academic institutions to provide access to the journals.*
>
> *To pay a substantially discounted price for online only. It is not like there is printing and mailing involved.*

Many expressed discomfort with both the price and the payment method (credit card online) of pay-per-view and said they would be willing to wait three to six months or longer for free (or heavily discounted) pay-per-view access. Several also said they might prefer pay-per-view over other models if costs were "reasonable" (typically under $3). (See footnote above about current average prices for pay-per-view.) Others wanted online access to be free with society membership.

> *To pay a realistic online retrieval fee, in other words similar to the cost of photocopying that article from a library copy but minus the cost of the paper and ink, which you provide yourself if you need to print out.*

Users are open to new service models.

Several respondents suggested interesting service variations. One popular model was an "online library" with a one-time fee for online access to many journals of interest.

> *I have most access to journals through the university library service. If this weren't available, I would advocate having an ability to receive access to a large*

host of journals through a privately run "internet library," where I would pay a single fee to have access to many. I think this would be very successful, and might make the journals more money overall than getting people to pay for individual journals. (Since these costs are high and you get only access to one, people have a higher tendency to share their access.)

I would prefer to pay a flat fee to be able to access all journal articles. This should be accessible through Medline.

I would prefer to pay a one-time subscription to a clearinghouse that allowed me access to all the major journals that I use. The problem is that no one journal covers a field, and every journal covers multiple fields. Thus, I end up paying for a lot of information that I never use. Currently, the pay-per-view option is outrageously expensive, $10 to $20 per paper is ridiculous and access is time limited. A membership to [a] clearinghouse that contained most or even several of the widely distributed journals in my area could be economical for all concerned.

I'd rather pay a subscription price to a library of journals—I don't read any journal per se; instead, I search using keywords and those articles that appear interesting, I would want to print online and read.

Pay a flat rate for access to a large group of online journals, with pay-per-view for extras.

To pay a yearly subscription for access to multiple (many) journals from different publishers for online access only.

The online library or clearinghouse model would also appeal to this respondent, who may represent a growing trend toward interdisciplinary research:

I would also consider a discounted online-only subscription, but I need to access a wide range of topics, which would involve too many online subscriptions to purchase individually.

Another respondent suggested a time-based service model:

For my unique tasks, I need access to multiple journals for a unit time. Is that something that can be offered? For me to pay to browse per journal is not cost-effective.

One respondent's comment suggests an approach that publishers might take to convince their customers of the value of online services:

I would not expect to pay less for an online journal. However, I would expect to receive more (functionality) for the same price. The full advantage of online is in open linking,

backward and forward citations/cited by features, html, additional color, additional datasets, video clips, etc. How could more cost less?

The desire for anywhere, anytime access to articles suggests that e-journals should be both print-friendly and electronically archivable.

Most scholars eventually print out e-articles for reading, even if they also read onscreen.

Most readers start by glancing through full-text articles—but high-volume readers are more likely to read an article all the way through immediately upon retrieval. Nearly three-quarters (72%) of respondents said they usually glance at the headings and the first few sentences of important-looking paragraphs when they first retrieve or download a full-text article, just to see if the article really matches their criteria.

Only 18% said they immediately read the article all the way through quickly to determine whether they should read it more deeply later. Two-thirds (66%) of these quick readers, however, are high-volume readers (regularly reading more than nine journals), whereas only 55% of scanners are high-volume readers. Looked at another way, 22% of high-volume readers are quick readers, versus 16% of low-volume readers.

It seems that reading articles all the way through immediately upon retrieval—either quickly or slowly—may be a strategy that enables a higher volume of reading.

We also found that printouts are the most common final destination—and the preferred format for reading—for e-journal articles. Scholars develop their own approach of adapting online journals for their research practices (e.g., searching, reading, and archiving). For most scholars, however, all of these different approaches seem to lead to one final destination—printouts. More than two-thirds (68%) of respondents said that they immediately print out a full-text article upon retrieving it online and read the printed copy, rather than first reading it onscreen in PDF or HTML. About one-quarter (23%) read it first in PDF onscreen, and only 10% read it first in HTML onscreen.

HTML needs to be more print-friendly.

These findings suggest why HTML is a less popular format than PDF. PDF is designed for printing, whereas HTML is designed for onscreen reading. E-journal users may choose PDF more often (despite smaller fonts and poor-quality pictures) because the final destination—and the preferred reading method—for the articles is a printout. HTML needs to be more print-friendly to attract wider use. If it were print-friendly, it might become the format of choice.

E-archiving isn't enough for most scholars, who also archive printed copies.

E-journals do not necessarily lead to e-archives. More than half (52%) of our respondents said they usually archive full-text e-journal articles by printing them out and storing them (p-

archiving). Another 28% usually print out the articles *and* save them to a file on their computer (e-archiving). Only 20% said they usually e-archive without storing a printed copy.

Interestingly, frequent e-journal users were more likely than infrequent users to say they usually do both—p-archive and e-archive. They were also less likely to say that they only p-archive (although about equally likely to say that they only e-archive).

Again, this supports the contention that e-journals will increasingly need to be both print-friendly and electronically archivable as more users become frequent users.

Printed journal editions provide portability and browsability—two qualities that electronic editions will have to cultivate if they are ever to fully replace print.

The top two reasons for scholars continuing to receive printed editions were portability and ease of browsing:

- 54% cited portability ("I can easily carry a printed journal issue anywhere to read").
- 46% cited ease of browsing ("Printed journal issues enable me to browse a range of topics for new ideas more easily than I could on the screen").

The next three reasons given for continuing to have printed journal issues delivered were the following:

- 45% cited being automatic ("Printed journal editions come automatically with my membership or subscription").
- 38% cited flexibility ("Having both printed and online journal issues provides me with more choices and flexibility in how I read and browse articles").
- 28% cited readability ("The pictures and images in printed journal issues provide better color resolution and detail").

Few (6%) complained about the unreliability of online access. Some (14%) were motivated by ease in finding articles from a printed-edition collection (compared to individual-article printouts), and some (10%) liked to scan the advertisements in printed editions.

Libraries face changing user needs.

Libraries are a main source of online access to journals—and this has become their most important journal-related service.

For most respondents (more than 75% of both first and follow-up survey respondents), libraries are the main provider of online access to journals (through institutional online subscriptions). Users have changed their expectations of library services regarding journals from the provision of a physical place to locate journal articles to online access to journals.

Scholars still commonly visit libraries for article retrieval, but mostly for articles they can't get online.

Of the respondents, 49% said they visit libraries for journal access "only when journals are not available online and I have no other convenient access to the printed editions." Only 35% said they currently visit libraries to read/copy/browse printed editions of any journal on a regular basis. Sixteen percent said they never visit libraries to access printed journal editions. Respondents from the United States and Canada are less likely to visit libraries than those from other countries. The more online journals are available, the less people visit libraries physically. According to survey data, however, substantial numbers of scholars still visit libraries, whether or not they need to leave offices/labs for full-text retrieval.

Multijournal search engines with full-text links are the most common search starting point—and most searches are done online.

More than three-quarters (77%) of respondents said they usually start their article searches from a multijournal search Web site with links to full text, such as PubMed, Medline, Ovid, Science Direct, or HighWire Press. This is consistent with the finding that ease of searching/browsing is the second top reason for using e-journals. Multijournal Web sites have hyperlinks to the full-text articles of multiple journals, facilitating browsing and searching across different journals.

Only 10% of respondents said they usually start from a specific journal's Web site, and only 8% from an online citation index (such as Web of Science, SciFinder Scholars, or BIOSIS). Fewer than 4% start from general-purpose search engines (such as Google or Yahoo!—3%) or at their local library's reference room or stacks (2%). (See Appendix II, Question 7.)

Searches are conducted primarily online, and links to full-text articles seem to save time and boost search efficiency. All this adds up to changing library patron needs. Libraries need to adapt to understand and meet these needs, including providing access to search Web sites with full-text links.

Certain online features could help to maintain publishers' personal subscription base.

Users are happy with e-mail alerts but may eventually need more sophisticated alert services beyond eTOCs.

Those in the life sciences who receive e-mail alerts definitely use them; that is, these users do not, for the most part, treat alerts as junk mail. Nearly three-quarters (73%) of e-mail alert users review the entire message "most of the time" when they receive an alert. Another 24% sometimes do so, and only 3% say they never do so.

Only 4% of e-mail alert users delete alerts "as junk mail" most of the time. Sixty-four percent never do so, and 32% sometimes do so.

Table of contents alerts seem so far to be the most useful type of alert service. Of our sample respondents, 70% had used at least one of the three types of alerts we asked about (table of

contents, citations of articles on topics of interest, and articles on keyword[s] of interest). More than three-quarters (80%) of the e-mail alert users in our sample said they had found eTOC alerts to be useful.

- eTOC—e-mail table of contents alerts (used by 2,562 of our respondents—or 80% of all alert users)
- article citation alerts—citations of articles on topics of interest (used by 907 of our respondents, or 28% of all alert users)
- article keyword alerts—articles on keyword(s) of interest (used by 877 of our respondents, or 28% of all alert users)

In general, most respondents are content receiving just eTOC alerts. Thus far, more sophisticated alert services—such as citation and keyword alerts—are used less frequently than eTOCs. This might be, however, because these more sophisticated alerts are in their early stages, so not many people have had a chance to use them yet. In contrast, eTOCs have existed for a relatively longer time, perhaps several years longer.

E-mail alert users often hyperlink from the alert to the journal. More than one-quarter (29%) of e-mail alert users hyperlink to the journal site to *review abstracts* "most of the time"; 11% of e-mail alert users hyperlink to the journal site to *read the full text of articles* "most of the time"; and 14% of e-mail alert users hyperlink to the journal site to *print out the full text of articles* "most of the time." Many hyperlink for one or more of these reasons "sometimes" as well (see Appendix II, Question 10).

Members-only personalization appeals to some users.

When asked how they'd like to pay for e-journal use, some respondents used our open-ended comment box to suggest members-only personalization approaches:

> *I prefer to have access to both online and printed articles for the same price but with online articles available only to members, and then members are required to use a password.*
>
> *If I am a member of a society, I'll pay more for a paper copy of a journal but will not pay an additional cost for the same online journal.*
>
> *If I am a member of a society that INCLUDES a journal with the membership fees, then there should be NO EXTRA cost to view issues online. If the society does NOT include the printed journal as part of its fees, then online should be a minimal charge at most since online literature is less costly to develop and disseminate.*
>
> *Just pay dues for societies you need to belong [to] and be able to have access to all online journals…*

My interest is in receiving electronic versions of journals from societies of which I am not a member.

Would like my society membership fees to include online access, as they do now.

Respondents use pay-per-view when they urgently need to retrieve an article from a journal not in their primary field.

Of our sample, 81% had never used pay-per-view. Of those who had used pay-per-view, however, 77% reported using it when they had an urgent requirement for an article. Other reasons for using pay-per-view were much less common.

The 19% of respondents who said they sometimes use pay-per-view preferred it for retrieval of articles published in multifield journals. Respondents expressed in open-ended questions that they would like to use pay-per-view for full-text retrieval from journals outside of their primary fields. Many scholars can afford full journal subscriptions to only about three core journals in their field and would like to use pay-per-view to obtain journal articles from outside their own field as needed.

CONCLUSIONS

As e-journals have matured as a technology, life scientists and medical practitioners have adapted to daily e-journal use and have found creative ways to use e-journals in their research and practices. They have become more demanding about what they want from e-journals, are finding value beyond full-text retrieval in e-journals, and have started to give feedback to publishers and libraries. The high response rates we received for our three surveys are good indicators of an increased interest and proactivity among scholars toward e-journals. This is already affecting publishers and libraries a great deal—around services such as searches and alerts, as well as around subscription price. This study has delivered much pertinent information about e-journal users. We hope it will help publishers and libraries to better understand end users in the life sciences and medicine and will inform current pricing debates.

Life scientists and medical practitioners are tech-savvy and are willing to vote with their wallets.

Libraries, publishers, and institutions all need to understand their life sciences customers (the end users of scientific, technological and medical (STM) e-journals) increasingly well in order to meet their needs and to support the scientific enterprise in the coming decades. This survey and our first survey, taken together, draw a fairly clear portrait of life scientists and medical practitioners as users of STM journals. Overall, this group of users is very tech-savvy; most use e-journals daily or weekly. Most are finding that e-journals offer significant value through features that go well beyond full-text access. When asked to choose, they generally favor e-journals over printed editions because of their greater convenience, breadth, and speed, providing faster access to a broader literature.

These qualities will become even more important to journal readers as a proliferation of articles and journal titles makes keeping up-to-date in the life sciences increasingly difficult. E-journals appear to satisfy scholarly needs and to make keeping up-to-date easier and more efficient. Many scholars spent between $200 and $400 on personal online access to journals last year.

E-journals have not yet crowded out printed editions; the design of electronic pages should take into consideration the design of printed pages.

Some scholars have already given up printed editions for electronic ones as personal subscription prices have increased. This does *not* appear to reflect disenchantment with the printed page or with printed editions, however. Many still want to have printed editions delivered by post because of their portability and browsability.

Our survey shows that users generally archive printed copies of articles (p-archive) after online retrieval. In fact, most electronically accessed articles end up as printouts, and because of this, e-journal users need more print-friendly article formats. Users also p-archive (either printouts or printed editions) more than they e-archive (although frequent e-journal users more often do both). This appears to be why HTML was not as popular among respondents as PDF format for full-text retrieval online. Online journal developers need to take printing format and readability of printouts into consideration.

Libraries face both budget challenges and role challenges.

In the electronic era, libraries have continued to be centers for scholarly communication even as many e-journals have grown more popular than printed editions. The role of libraries as providers of electronic content has in fact become even more critical in scholarly communities. As our study has shown, most users take advantage of their libraries' online journal subscriptions to retrieve full-text articles.

As the Web has become a primary tool for journal access, libraries have had to adjust to new e-journal-related costs, including online subscription costs and technology support (often outsourcing to save money). Libraries have already been struggling for nearly two decades with limited budgets and a proliferation of journal titles, forcing difficult choices and the cancellation of many journal titles. As publishers have experimented with new bundled pricing models to try to maintain income levels from the institutional market and lock in revenue, libraries have been forced to make even more difficult choices and have begun to express serious concern about the potential effect of these choices in the long term (or even in the near term) on the quality of research and on their ability to respond to quickly changing user needs (Foster, 2002).

At the same time, libraries have the challenging opportunity to take on new roles in the electronic information space. They have the potential, several librarian informants noted, to move their function as organizers and interpreters of knowledge forward, using emerging information technologies. A few libraries are beginning to invest in developing and adapting these new technologies for use in helping their patrons and their staff with increasingly complex tasks in the areas of search, selection, intellectual access, interpretation, distribution, and archiving. Thus far, however, progress has been slow, technological obstacles have been large, and budgets have been limited. One informant noted one recent example of this type of challenge, specifically around intellectual access:

> *It's a clear challenge to libraries now, beyond the role of purchasing agent and sort of dynamic gyroscope for balanced spending across multi-disciplines in an institution is a very important role…that of providing intellectual access to content by either acquiring or building smart agents that are exceptionally easy to use.*

When the goal is quality research and practice, journal branding makes more sense than journal bundling.

If scientific and medical end users value high-quality, prestigious journals for article submissions and depend on them for citations, then they need quality (not quantity) of journal access. Both scientists and medical practitioners value journal quality and reputation. They are likely to find much more appealing, then, a customized selection of branded journals (handpicked by their libraries in close consultation with them) than one-size-fits-all journal bundling.

Libraries can benefit from a focus on brands…

Indeed, one of the key roles and responsibilities of libraries has always been to provide scholars with a responsive, customized selection service. The proliferation of titles (and even of scientific fields) concurrent with rising prices and stagnant acquisition budgets has made this selection service harder in recent years, and libraries have been tempted to turn to bundled journal packages (despite their restrictions on choices and cancellation) to save time, money and effort. As cautious commercial publishers try to prevent potential future losses by creating high-priced, inflexible bundles, they threaten to seriously undercut not only library serial collection quality and responsiveness (and thus research quality), but also library budgets for other types of materials. Libraries need to find alternatives to these bundles from commercial publishers by working more closely with their patrons, informing them about price and quality differences among journals, and involving them in difficult decisions about what to keep and what to cut. End users who join forces with libraries may also eventually create more negotiating leverage with publishers, since they provide the articles.

…And society publishers can, too.

Similarly, society publishers have always had a mandate to provide their readers with top-quality journals at a reasonable price. As they struggle to compete with large commercial publishers and stay afloat, doing some bundling could be helpful, but they could also benefit from a focus on branding. If society publishers could brand and market their individual journals more strongly to both libraries and end users in the life sciences, and if libraries could work with them to inform end users about their value, institutions and the scientific enterprise may benefit from clearer choices between journals when tough tradeoffs need to be made, especially in an era of decreasing journal budgets.

With the sharp decline in the number of individual subscriptions per scientist, by about half over the past 20 years (Tenopir and King, 2001), and with the proliferation of journal titles, the market for any one title is unlikely to grow much in coming years despite increases in the number of scientists. As a result, individual subscription cancellations and cancellations of institutional subscriptions by libraries will be painful for most publishers, especially for those with low circulations. As Tenopir and King note, “A journal with 500 subscribers and typical costs must charge at least $800 to recover fixed costs, but the same-size journal with 5,000 subscribers needs charge only about $110” (2001).

Survey data from our second survey indicate that decreasing prices might increase subscriptions, but when high fixed costs make such decreases impossible, staying afloat may require raising brand awareness, particularly for smaller society publishers. Scholars are receptive to value-added e-journal features and already find many of them useful, so adding new online features may help to build journal brands. Collaborations with other small publishers could also be used for brand building. New pricing models (such as lower pay-per-view prices, site licenses, and minibundles of journals for individual subscribers) may also help in the longer term.

Finally, our first survey showed that end users in the life sciences and medicine care a lot about the quality and reputation of the journals they publish in. To succeed at publishing in the best

possible quality of journal, it is in their best interest to have access to high-quality, prestigious journals to cite in their papers. Anecdotal evidence from our interviews with experts, however, suggests that complicated issues around tenure pressures and institutional politics often lead scholars to pressure their organizations to provide access to the journals they themselves have published in—which may not always be the journals from which their peers and the scientific enterprise would most benefit.

As one librarian informant concluded,

> *This period of time is the first wave of activity in this domain. What [society publishers] have been trying to do with their Internet editions is to distribute more content, more broadly, with more features—but still make the money they need to be viable as publishers. I think the trick is for the not-for-profits to realize that they should market themselves, both to authors and to libraries; and that they should do so in ways that effectively compete with the big deals offered by profit-oriented publishers. Another subordinate trick is getting the authors to understand where their best interests lie.*

Publishers need to revisit their current pricing strategies.

Two factors largely determine publishing revenue (and thus, since costs are largely fixed, profit): subscription price and circulation (number of individual or institutional subscribers). Some publishers have recently attempted to keep journal circulation more constant—while maintaining or increasing price—by selling bundled journal subscriptions with prohibitions on title cancellations to libraries. This pricing strategy may eventually backfire, however. According to a recent article by Andrea Foster in the *Chronicle of Higher Education* (2002), some libraries have been contemplating (and in some cases implementing) canceling entire bundles to solve their budget problems. Bundled subscriptions may thus lead to the cancellation of many journals from the same publisher at once. Publishers, whether or not they currently offer bundled pricing schemes, need to revisit and reevaluate their current pricing and marketing strategies.

Our data and that of Tenopir and King (2001) show that scholars are price sensitive and that the numbers of subscribers per title is likely to be relatively fixed over the next decade. Capping personal subscription price increases, while simultaneously offering some new value-added features and more personalized access to content, might help publishers maintain revenue from individuals.

Our study suggests that the business models made possible by electronic publication of scholarly journals have not fully matured. Publishers would benefit from developing alternatives to coercive bundling that maintain as much market share as possible while still serving the higher publishing goal of broad dissemination of quality scientific and medical literature to the world. Without such broad dissemination, their entire enterprise begins to lose touch with its foundations.

Granted that conditions are and will remain for some time extremely difficult for libraries in the United States, continued journal price increases may soon force some other countries entirely out of the commercial journal market, greatly restricting what scholars and practitioners in those countries can access. This clearly hurts journal publishing, whether viewed from a scholarly perspective or a more general socio-political perspective, and exposes all journal publishers to public censure, whether deserved or not. These price increases create both risk and opportunity for society publishers. On the one hand, reasonably priced journals may share the stigma caused by excessively priced journals (as with recent scholarly reactions to the "serials crisis"). On the other hand, publishers that broaden access (i.e., by reducing or eliminating charges for online access) in geographical areas of negligible potential income both fulfill the scholarly mission and create a more favorable public view of their journal, with little or no real impact on revenues.

The ideal of universal access to critical scientific information online is not likely to go away and needs to be addressed if e-journals and science are to prosper. Publishers need to initiate broad and open discussion around creative ways to provide free back issues, free or discounted access to developing countries, and possibly more entirely free e-journals. This relates closely to the previous discussion on branding as a survival strategy.

Further research is needed in the area of business models to explore what libraries and end users in the life sciences really need and would be most willing to pay for. Our final report will discuss some of these issues based on interviews with librarians and experts in e-publishing.

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APPENDICES

Appendix I: Survey Methodology

http://ejust.stanford.edu/method_surveys.html#thirdsurvey

Appendix II: Tables and Charts by Question

http://ejust.stanford.edu/findings3/survey3_charts.html