

**E-JOURNAL USER STUDY
REPORT OF FIRST SURVEY
MARCH 2002**

INTRODUCTION

Online access to scholarly scientific content is growing. Electronic journals (e-journals), in particular, are an increasingly important resource for scholars and play a significant role in scholarly communications. Understanding the evolution of scholarly practices with e-journals—how e-journals are being used, the reasons scholars use or don't use e-journals, and the perceived benefits and disadvantages of them—should help in the development of better online journal services and tools. A deeper understanding of usage patterns and sources of value may benefit libraries, publishers, scholars, aggregators, and software developers.

In the first survey for the E-Journal User Study project,¹ we investigated patterns of scholarly practice among both users and non-users of electronic journals in the life sciences. Specifically, we examined possible determinants of three dependent variables representing three aspects of scholarly practice: (1) frequency of e-journal usage, (2) preferences and reasons for using e-journals versus printed journals,² and (3) perceptions of the impacts of e-journal use, both on personal research practice and on scientific scholarship in general.

Factors Tested

At any particular moment, a wide range of factors may influence scholars in their journal-related practices, preferences, and perceptions. These factors range from basic demographics and available resources to more complex information goals, as well as from the life stage of the scholar to the particular task at hand (such as reading, paper writing, or grant writing).

From among the many factors possible, we chose in this first survey to investigate the effects of demographics (specifically age, occupation, gender, career experience, scientific field, and country of residence); access to resources (defined here as [1] the presence or absence of specific information technologies at home and/or at work and [2] personal and institutional journal subscriptions); frequency of collegial communications (through various methods, including in person and by e-mail or telephone); and publishing effort and success (based on the number of

¹ The Stanford E-Journal User Study includes quantitative research (several online surveys and a data mining effort), qualitative interviews (ethnographic interviews with users of e-journals), and experts' workshops.

² A *journal* is defined here as a peer-reviewed serial publication for scientists or medical professionals. An *e-journal* is a journal available online (e.g., through the Internet). A *printed journal* is a journal available in a printed format and delivered to subscribers by mail.

journal articles submitted and the number accepted for publication). We tested these factors using ordered probit and logistic regression analyses to determine which were significantly linked to our three sets of dependent variables. In addition, we used our first primary dependent variable—frequency of e-journal usage—as an independent variable in the analyses to see if it influenced the other two sets of dependent variables (preferences and perceptions).

The Survey Sample: Descriptive Characteristics

We drew our sample from the rosters of American (and one British) scholarly societies. (See Appendix I for the details of our sampling methodology.)

About 30% of respondents were female and 70% male; average and median ages were 47 and 48, respectively. About 20% of respondents were medical doctors (MDs) and allied health professionals. Approximately 60% of respondents stated their fields as biological sciences, 34% as health sciences, 4% as agricultural sciences, and 2% as other research fields. Approximately 60% of respondents were working at academic institutions, and the rest worked at nonacademic institutions such as private companies, government agencies, and hospitals or were retired. The full list of occupational categories included tenured faculty (26% of the sample), MDs and allied health professionals (20%), graduate students and postdoctoral researchers (12%), untenured faculty from academic institutions (11%), researchers in academic institutions (11%), researchers from the private sector (11%), researchers from government agencies (6%), retirees (3%), and others (1%). The average job experience of respondents was about ten years.

Survey respondents represented 99 countries: 77% resided in the United States or Canada; 11% were from Europe (excluding the United Kingdom); 5% from Asia; 3% from the United Kingdom; 2.5% from Latin America; 1.7% from Australia; and 0.3% from Africa.

Survey respondents used the Internet both for work and for leisure. On average, they used it ten hours per week, excluding time spent working with e-mail. In general, respondents in our sample were relatively familiar with the Internet. (See Appendix II for detailed topline tables of these sample characteristics.)

Communications Context

Electronic journals exist within a larger context of communications tools. In general, sample respondents actively used various communications methods. We hoped to examine the relationship between the frequency of using specific modes of collegial communications (one-on-one in person, one-on-one by e-mail, phone, fax, regular mail, and conferences) and our dependent variables. Because nearly all of our respondents had an extremely high frequency of

collegial communications, however, testing the effects of variation in that frequency was difficult. Of our respondents, 86% had e-mailed colleagues about scientific matters the week before the survey, and 61% had e-mailed the day before. Seventy-two percent had made phone calls to colleagues the week before, and 38% the day before. Seventy-four percent had held informal face-to-face meetings with colleagues the week before, and 42% the day before. Use of fax, use of regular mail, and conference attendance were somewhat less frequent, but even within these methods, 64% of the sample had communicated with colleagues by fax in the past month, 55% had communicated by regular mail in the past month, and 68% had attended a conference in the past month.

Because of this relative lack of variation, together with a lack of consistent direction of correlations between the communications variables and the other variables in the survey, we had difficulty determining the direction of causality for those correlations. We need further quantitative and qualitative research to explore these links more fully. Nevertheless, we did find that those who communicate with colleagues more frequently tend to use e-journals more frequently. A positive correlation does exist between high collegial communications³ and frequent e-journal usage, then, although the direction of causality is unclear. This suggests that e-journals may be closely intertwined with scholarly communications in many ways.

Although scholars may be similar in overall levels of communications frequency, their ways of communicating with each other and their reasons for doing so are diverse. E-journals could support this diversity if the diversity were better understood.

³ We created a variable defining a person as a “high collegial communicator” if the person had communicated with colleagues on scientific matters through “conferences/seminars/workshops” within the last month, through “e-mail” that day or one day before, by “phone calls” that day or one day before, and at “personal meetings” that day or one day before filling out the survey. We did not use this variable in the regression equations because it had inconsistent and sometimes conflicting results and because causality was difficult to determine; instead, we tested for correlation using one-way ANOVA analysis.

PART I. FREQUENCY OF E-JOURNAL USAGE

Our survey results show that e-journal usage is now an important part of the scholarly routine. E-journals are becoming essential for scholars who want to communicate to and share information with the broader scientific community. If providers (such as society publishers, libraries, and aggregators) are to improve their scholarly and technological offerings, they must better understand the factors that affect the frequency of e-journal usage.

Basic Statistics on Frequency of E-Journal Usage

Our “frequency of use” questions focused on how often respondents used e-journals to retrieve, read, and/or download full-text articles. We asked for this information in two ways: (1) What was their *average frequency over the past year* (“How often [based on the past year] do you retrieve, read, or download full-text, peer-reviewed journal articles online or through the Internet?”) and (2) what was their *most recent usage* (“When did you last retrieve, read, or download a full-text, peer-reviewed journal article online or through the Internet?”). More than half of the sample (64%) said that they had used e-journals for this purpose on a weekly basis or more frequently on average over the past year; 18% said daily. Thirty-seven percent of our sample had used e-journals for this purpose either the same day they took the survey or during the previous day, and an additional 33% had done so “within the last week”; in all, 70% of the sample had used e-journals to access full-text articles within the week before the survey. Thus the majority of scholars, doctors, graduate students, and health professionals surveyed said they use journals regularly—weekly if not daily.

We chose to use *most recent usage* as our proxy indicator for e-journal usage frequency, because we think that *average frequency over the past year* is harder to recall accurately. Studies have demonstrated deterioration of recall accuracy over as short a period as six weeks (Smith, Jobe, and Mingay 1991; Pearson, Ross, and Dawes 1992).⁴

⁴ The two variables are highly correlated (.83). Ninety-one percent of the 2,234 “daily average” users also said they had used e-journals for article access “yesterday or today” (9% said “within the last week,” and less than 1% said any of the other categories). Forty-four percent of the 4,643 respondents who said they had used e-journals for article access “yesterday or today” also said they had been daily users on average over the past year, and 52% said they were weekly users; only 4% said they were monthly users, and less than 1% said they “seldom” used e-journals for article access. Similarly, 52% of the 5,757 “weekly average” users also said they had used e-journals for article access “within the last week,” whereas 42% said “yesterday or today.” Seventy-three percent of the 4,103 respondents who said they had used e-journals for article access “within the last week” also said they had been weekly users on average over the past year, with 20% saying they were monthly users, 5% saying they were daily users, and 2% saying they “seldom” used e-journals for article access. *Most recent usage* thus appears to be a reasonable proxy for usage frequency and is the most accurate indicator we have in this survey.

Factors Tested as Predictors of Frequency of E-Journal Usage

What drives this general pattern of e-journal usage frequency? Unsolicited comments from survey respondents (see Appendix III) and our qualitative interviews suggest that many factors may change a scholar's pattern of using e-journals for a particular period of time. These include the stage of the research cycle (beginning, middle, or end), the research task (such as searching for clinical material or writing a review article), or the scholar's particular information need (such as keeping track of the latest published articles on a particular subfield or scanning daily news). Despite these shifts during the research cycle, however, more stable factors are more likely to shape the bigger patterns of frequency and intensity of e-journal usage more dramatically and over a longer period of time. These factors include institutional and demographic characteristics, access to resources, and scholarly effort of the individual.

We used "ordered probit" regression to test the hypothesis that a combination of demographic factors, Internet familiarity, basic information technology (IT) resources, institutional access to journals, personal subscription access to journals, and scholarly effort can significantly explain the probability of higher e-journal usage frequency. Ordered probit is a statistical technique that allows the use of a dependent variable that has ordered categories (in this case, frequency of e-journal usage).⁵

Key Findings from the Regressions: Factors Related to Frequency of E-Journal Usage

According to our findings, younger scholars are more likely to be frequent e-journal users than are older scholars, and those with higher Internet usage are more likely to be frequent users than are those with lower Internet usage. Biologists are more likely to be frequent users than are other life scientists, and non-MDs are more likely than are MDs. Access to institutional journal subscriptions increases frequency of e-journal usage, as does access to a trio of basic IT tools

⁵ The equation for this regression was as follows:

$$P[EJU] = F(\text{DEMO1}, \text{INTERNET}, \text{SUBS}, \text{PAPER1}, \text{FACILITY}, \text{ACCESS})$$

where EJU is frequency of e-journal use, indicated by how recently the respondent used e-journals (measured as: 1=yesterday or today; 2=within the last week; 3=within the last month; 4=longer than a month ago; 5=never); DEMO1 is a set of demographic characteristics—AGE, MD, BIOLOGY, MALE, and USA-CAN—which represent respondents' age, whether a respondent is a medical doctor, whether a respondent's field of research is biology, whether a respondent is male, and whether a respondent resides in either the United States or Canada or in another country (refer to Appendix II, Table 1); INTERNET measures weekly hours spent on the Internet (excluding use of e-mail)—an indicator of Internet familiarity; SUBS measures the number of personal journal subscriptions; FACILITY measures whether or not a respondent has a PC, printer, and Internet access at both home and work—an indicator of available basic IT resources; ACCESS measures scientific journal access through institutions; PAPER1 measures the number of papers submitted in the past year—an indicator of respondents' research productivity; PAPER2 measures the number of papers accepted/published in the past year—indicators of respondents' research productivity. Appendix II, Table 2, shows the EJU question and responses by category. Appendix II, Table 8, shows the results of the regression analysis.

(computer, printer, and the Internet) both at work and at home. Respondents with very few (zero or one) or many (more than five) personal journal subscriptions are more likely to be frequent users than are those with an average number of subscriptions. Those with an average level of scholarly effort (around three papers submitted in the past year) are more likely to be frequent users than are those with very low or very high levels of effort.

Country of residence (United States or Canada versus all other countries) had no statistically significant effect on e-journal usage when all other variables were controlled. Thus, although the first-order correlation shows that scholars from other countries use e-journals slightly more often than do those from the United States or Canada, differences in other control variables likely explain this. Gender also showed no effect: males were no more likely than females to use e-journals frequently, nor was there any first-order correlation between gender and usage.

To explore the most interesting statistical findings more thoroughly, we have clustered findings into three sets of factors: demographics, resources (tools and subscriptions), and scholarly effort and/or success. We report descriptive statistics for each set of factors when appropriate and then explain the link to frequency of e-journal usage.

Demographics

As noted in the introduction, our random sample of scholarly society members was skewed toward men (71% male), possibly because of their higher incidence in some of the life sciences, and toward residents of the United States and Canada (77%), most likely because all sampled societies were based in the United States (except for one British society). Average age was 47. The sample was also skewed toward non-MDs, with only 20% of respondents being MDs and allied health professionals. It was somewhat more evenly divided by field, however, with 60% being in biology and 40% in other fields.

- *The older the respondent, the less frequently he or she used e-journals, ceteris paribus.*⁶ Senior scholars have often developed personal, tried-and-true methods for navigating, archiving, and communicating content. In addition, these scholars may have more resources, staff, and agents to scout and retrieve information for them. As explained in the qualitative report, convenience is a relative term; people practice what they know works for them.

⁶ *Ceteris paribus* means “other things being equal.” The term is used in economic analysis when the analyst wants to focus on explaining the effect of changes in one (independent) variable on changes in another (dependent) variable without having to worry about the possible offsetting effects of still other independent variables on the dependent variable under examination. See Appendix II for full equations for all analyses. All regression results in this report may be assumed to be controlling for all other variables in their respective equations.

- *Medical doctors used e-journals less frequently than others—at least to retrieve, download, and read full-text articles.* Qualitative research suggested that MDs may have less time for e-journal research during the day; that some health care professionals lack dedicated terminals to facilitate usage; and that MDs may use e-journals in other ways—to access treatment protocols rather than full-text articles, for example.
- *Biologists used e-journals more frequently than did other life scientists (health and agricultural scientists in particular).* Further data collection is needed to explain this finding. It is possible that biology is a faster-moving field or that it is more competitive in publications and grants than other fields are⁷ and that biologists thus need to use information more urgently. It is also possible that more e-journals (or more with useful features) are currently available to biologists than to health and agricultural scientists. If this second possibility is true, scientific content online may be skewed toward the biological sciences, encouraging more frequent use.

Resources

Information Tools

Most of our sample respondents reported having many information resources, both at home and at work. Many lagged only in adoption of DSL (broadband transmission): 57% had DSL only at work, 3% only at home, and 23% at both home and at work; 17% did not have access at either location. Fewer than 2% lacked any of the other tools we asked about—personal computers, Internet access, printers, e-mail, or fax.

Seventy-three percent of respondents reported that they had access to PCs, printers, and the Internet—the key trio of tools for using e-journals—both at work and at home. Access to these three key IT resources varied by country of residence. Scholars from both the United States and Canada reported significantly (95% confidence interval) better access to the combination of PCs, printers, and the Internet than did researchers from other countries across Europe, Asia,

⁷ There is some support for this interpretation. Numbers of biology articles published in referred journals have decreased compared to numbers of articles in other life sciences (such as medical research) last decades. The proportion of biology to all life science R&D funding in U.S. academic institutions decreased by 2% from 1993 to 1997, whereas R&D funding in the medical sciences increased by 2% during that period (NSF Science and Engineering Indicators 2000). This indicates that biology may be becoming more competitive in terms of grants than are other fields (such as medical sciences) in the life sciences.

Australia, and Latin America; 77% in the United States and Canada had access to all three at work and at home, compared to 63% in other countries combined.

Journal Subscriptions

Access to journals—both online and traditional paper—through personal and institutional subscriptions may also be a key factor that shapes frequency of e-journal usage.⁸ The majority of respondents reported relying more on institutional subscriptions than on personal subscriptions for their research. A large majority (79%) reported accessing most journals (paper and electronic) through institutional subscriptions. Institutions, through their libraries, still provide the bulk of the literature that scholars need for their research. Respondents access a smaller subset of scientific journals in other ways, such as through personal subscriptions, colleagues' copies, and free online access. Variations across national borders complicate the story of institutional access, however. Respondents from the United States and Canada were more likely than respondents from other countries to report that they access most scientific journals through institutional journal subscriptions. Scholars from other countries were more likely to report that they do not access most of their scientific journals through institutional subscriptions. Within the United States and Canada, access to scientific journals did not differ by type of institution.

Although institutions played a key role in providing access to scientific journals (in any format), 72% of the sample respondents also reported having one to five personal journal subscriptions, with an average of 3.6. Only 7% said they had no personal subscriptions; just more than 20% reported having more than five. Country was not significant in the likelihood that a scholar had personal journal subscriptions. The numbers of personal subscriptions for the many respondents living outside the United States and Canada were not significantly different than those for the researchers inside the United States and Canada. This may be in part because study solicitations were drawn from membership lists of scientific societies (most based in the United States), and all respondents were thus members of at least one professional society and most likely received at least one journal subscription as part of that membership. (See sampling methodology, Appendix I.2.)

Older respondents tended to have more personal subscriptions than did younger respondents, and medical doctors out-subscribed research scientists. If fewer discretionary funds prohibit having multiple personal subscriptions, age and occupation may simply be a proxy for access to funds. (We did not measure financial resources in this survey and thus cannot control for this factor.)

⁸ We refer to the number of personal subscriptions in our tables as “SUBS,” to access to institutional subscriptions (for most journals) as “ACCESS,” and to our index of access to PCs, printers, and the Internet as “FACILITY.”

Access to different resources appears to shape frequency of e-journal usage in different ways.

- *Access to information technology tools shaped usage frequency.* Having a trio of key IT tools (a PC, a printer, and Internet access) both at work and at home boosts e-journal usage. Broadband access (such as DSL) at home also appears to encourage the use of e-journals.⁹ The direction of causality is not clear here, however: Does having DSL at home increase e-journal usage, or are frequent e-journal users more frustrated with slow download times and therefore motivated to get DSL at home?
- *Scholars with access to institutional journal subscriptions used e-journals more frequently.* One of the primary functions of the institution is to provide information in a central repository that surpasses the resources of any individual. We can infer from this that e-journal usage will continue to grow as institutions increase subscriptions to electronic editions.
- *Scholars with very few or very many subscriptions used e-journals more frequently than did those with an average number of subscriptions (about four).* The relationship between number of personal subscriptions and frequency of use was actually curvilinear (modeled by the inclusion of a “squared” term, [SUBS]2). Perhaps those who have no personal subscriptions take advantage of “free” features such as abstracts, and those who have lots of personal subscriptions are more intensively engaged scholars and use all journals, including e-journals, more frequently. E-journals may also help scholars manage multiple personal subscriptions by facilitating content tracking and by alerting scholars to new articles.

Publishing Effort

We tested scholarly effort—as measured by the number of papers submitted in the past year¹⁰—as a predictor of e-journal usage frequency. The average number of paper submissions was about three per year. About 75% of respondents submitted one to five papers per year.

- *Scholars who submitted either very few or very many papers used e-journals less frequently than did those with a more average number of submissions.* This was unexpected. We speculate that those who submit lots of papers are more senior

⁹ We ran a probit analysis that included having DSL at home as an independent variable predicting e-journal usage frequency and found a statistically positive impact on e-journal usage frequency. We encountered a serious multicollinearity problem caused by the inclusion of the DSL factor in the analysis, however, precluding us from using DSL as an independent variable in the final analyses. The other results reported in this section thus do *not* control for having DSL at home.

¹⁰ PAPER1 in our tables in the Appendix II.1.

researchers with multiple coauthors to help them search, retrieve, and read articles or who have already read more articles prepress as peer reviewers. Those who do not submit any papers at all may simply be less intensively engaged in scholarship and use all journals, including e-journals, less frequently.

Discussion

The findings suggest that a variety of contextual factors—including demographic characteristics, IT tools, journal access, and scholarly effort—determine frequency of e-journal usage. They also suggest that expectations of tools, as well as limitations and features of the environment, determine habits and routines for using technological tools. Older scholars, for example, tended to use e-journals less, whereas younger ones used them more. This may be related to formative practices developed early in the scholar's career. Younger scholars developed such practices with personal computers and Internet tools widely available in college and graduate school. Older scholars did not. Particular fields, such as biology, may have distinct rates of innovation and discovery different than those in other fields, which may influence frequency of use.

Our qualitative research indicates that the value of e-journals emerges from interdependence with other tools and media, not in isolation. Other resources that help increase the value of e-journals may support their use in a particular way. Scholars with high-speed color printers or broadband online services (such as DSL), for example, may use e-journals in different ways than do scholars without access to such resources. Institutional resources, such as lab assistants and department staff, can also be important for retrieving content.

PART II. JOURNAL FORMAT PREFERENCES

Retrieving full-text articles is an important information-gathering activity for all scholars. Understanding why scholars prefer (or do not prefer) to retrieve articles using electronic journals rather than printed editions is key to overcoming barriers to their use and developing more user-friendly interfaces and content environments.

Basic Statistics on Journal Format Preferences

We asked respondents directly whether they preferred “online methods over print copy to retrieve full-text journal articles” and why. Topline data show that 75% of respondents said they preferred online methods for retrieval. (See Appendix II, Table 3.) We asked about three possible reasons for having such a preference: (1) Online articles are free, (2) they eliminate photocopying costs, and (3) they are convenient, allowing users to avoid trips to the library. All three reasons were popular, with more than 75% of respondents agreeing to each. Most of the sample (99%) agreed that convenience was a reason for favoring online methods for retrieval. The fact that online journals are “free to me” was the second most common reason, with 85% agreeing. Seventy-seven percent agreed that avoidance of photocopying costs was a reason for their preference. We asked the quarter of the sample who did not prefer online methods for retrieval why not, suggesting three possibilities: (1) PDF technology is troublesome, (2) online content is limited, and (3) printed journal versions are more portable. Portability was the most popular reason for favoring printed over online editions, with 86% agreeing. Limited content (lack of back issues online) was the next most popular reason, with 74% agreeing. Poor PDF technology was a reason for 62% of the sample.

These responses are reported conditionally. Only the 75% who said they favored online journals over printed editions were asked to respond to the first three motivations and were included in the final percentages reported here. Correspondingly, only the 25% who said they did *not* favor online journals were asked to respond to the last three motivations and were included in the reported percentages. Interestingly, however, most of those (5,466) who favored online journals (9,254) answered both sets of questions. This could be interpreted in at least two ways: (1) Perhaps respondents did not strongly prefer either online or printed editions for article retrieval or (2) perhaps they liked or disliked both but for different reasons and wanted to register their objections to (or approval of) all the mentioned motivations.

A closer look at the preferences data (see Appendix II, Table 9) reveals that as the frequency of e-journal usage to access articles increased, the respondent was more likely to agree that limited availability of back-issue content was a reason for disfavoring online editions. This might

indicate that heavy users, who rely on e-journals more than other scholars do, have greater needs and expectations about archived materials. More frequent users were also less likely to complain about lack of portability.¹¹

Factors Tested as Predictors of Journal Format Preferences

We ran several regression analyses (see Appendix II, Tables 8 and 9) to try to find explanations for scholars' preferences for online methods or printed journals for retrieval. We looked at demographic factors (age, gender, occupation, job experience, field of research, and country of residence), Internet familiarity (measured as hours online per week other than for e-mail use), personal subscription behavior (based on number of personal subscriptions), publishing success (based on number of papers accepted in the past year), and e-journal usage frequency. We put these factors into the regression equations to see how well they predicted journal format preference (Table 8) and reasons for favoring or disfavoring e-journals (Table 9).

Key Findings from the Regressions: Factors Related to Journal Format Preference

All factors analyzed as possible predictors of journal format preference were statistically significant, and the results were as we expected. Younger scholars, non-MDs, biologists, women, frequent Internet users, users with less job experience, users with fewer personal subscriptions, users with more published papers, and more frequent e-journal users were all *more likely than their counterparts who don't share these characteristics to prefer online methods for retrieving full-text journals*. Conversely, older scholars, MDs, nonbiologists, men, users from countries other than the United States or Canada, users with less Internet familiarity, users with more job experience, users with more personal subscriptions, users with fewer published papers, and less frequent e-journal users are *all less likely than their counterparts who don't share these characteristics to prefer online methods for retrieving full-text articles*.

The reasons given for journal format preference varied only by demographic characteristics, personal subscription behavior, and frequency of e-journal usage.

Demographics

- *Older scholars and MDs were less likely to prefer online formats for article retrieval.* Older scholars and medical doctors tend to use online journals less frequently and may have other established and effective routines for retrieving articles. They may use online methods for retrieval but do not necessarily prefer

¹¹ See Part II-A for the topline statistics on usage frequency, and note in the Methodology section in Appendix I.B. how usage frequency was included in the equations.

them over other methods, such as looking up articles from printed journals in their own collection or in a colleagues' or asking a coauthor, office staff person, or lab assistant to retrieve an article for them.

- *U.S. and Canadian respondents preferred e-journals over printed editions more than did respondents from other countries.* Whereas scholars from all countries use e-journals equally frequently (*ceteris paribus*), those from the United States and Canada are more likely to prefer e-journals over printed editions. More research is needed to understand the sources and effects of these differences.
- *Biologists were more likely to prefer electronic journal formats than were nonbiologists.* Biologists who disfavored e-journals were also more likely to cite slow PDF technology as a reason for avoiding using e-journals, *ceteris paribus*, although biologists were among the most frequent e-journal users. Patterns of scientific discovery and documentation in biology may demand faster, more efficient retrieval and access to content (perhaps particularly in certain stages of research) than those in other fields. E-journals may in fact help scholars in fields that are rapidly changing and assimilating new ideas, evidence, and techniques but may simultaneously be perceived as losing some of their time-saving potential because of slow PDF technology. Further research is needed to more fully understand how biologists' preferences relate to their research practices.

Resources

- *Frequent Internet users were more likely than infrequent users to favor e-journals over printed editions. Frequent users were also more likely to disfavor e-journals because of limited online access to back issues, ceteris paribus.* Greater online experience may expose frequent users to more limitations of the online environment, including lack of archived content. Such limitations may have greater impact on the day-to-day practices of frequent users.
- *Scholars with very few or very many personal subscriptions were more likely to prefer online formats.* The number of subscriptions had curvilinear effects. Those with few personal subscriptions may be getting free online access through their institutions, making online methods not just preferable but necessary. Those with many subscriptions may find searching through multiple journals and retrieving needed articles and content more efficient online.

Publishing Success

- *Scholars with very few or very many published papers were less likely to prefer e-journals for article retrieval. Those in the middle were more likely to prefer them.*

Usage Frequency

- *Frequent e-journal users were much more likely to prefer e-journals over printed editions for retrieving articles. Through frequent usage, scholars may develop successful and effective practices for using online methods. Knowing how to use online tools such as search engines, particular Web sites, and other advanced features may help make e-journals a preferred method for retrieval.*
- *Frequent users were more likely than infrequent users to say that being “free to me” was an important advantage of e-journals. Frequent users were also less likely to cite avoidance of photocopying costs as a reason for favoring e-journals. They were no more or less likely than infrequent users to cite convenience as a reason for preferring one format over another. Again, frequent users may have developed personal practices that include the effective use of both printed and electronic editions of journal articles to accomplish their work. What is convenient depends on the context of the work and the user.*

Discussion

These findings suggest, as do our qualitative conclusions, that preferences for journal format and the reasons behind those preferences are complex and have multiple drivers. There may be no blueprint to predict choices for using electronic journals over printed journals; rather, changing conditional reasons, contextual factors, and stages of research may affect such choices. Findings also suggest that e-journal users are developing strategies for working around the limitations of both electronic and printed journals and any contextual variables, such as access points or infrastructure (in factors such as work at home, institutional arrangements, or job descriptions). Even when e-journals are weak in one area or another, users develop ways to use them that add value. These users may use other available resources to make up for any weaknesses. With such strategies, scholars develop a pattern of idiosyncratic, contextual usage.

Another significant finding was in the high number of responses citing “portability” as a reason for preferring printed editions over online versions. Those who do not prefer e-journals to retrieve articles cite portability as a reason for preferring print editions. Among those who prefer electronic editions, however, about 25% also say portability is a reason they like printed editions. In other words, those who have e-journal access and printers may still think of their printed

editions as more “portable” than a printout of a bunch of articles. This suggests that portability may mean different things to different people. Our qualitative work suggests that most e-journal users print out electronic articles when they want to engage in intensive study reading. The concept of “portability” for some scholars may cover the portability of content (the ease with which they can assemble a bundle of related high-quality articles), not just the physical portability of the reading medium (the ease of carrying paper versus carrying a computer). From the present data, it is impossible to determine for which respondents this might be the case. The question of formats and portability requires further research.

PART III. PERCEIVED IMPACTS OF E-JOURNALS ON PERSONAL RESEARCH PRACTICE AND ON SCIENTIFIC SCHOLARSHIP IN GENERAL

Electronic journals affect both personal scholarly practice and scholarship in general. To improve the usefulness of e-journals and to get a sense of what their future might be, we must understand whether and how scholars perceive the influence of e-journals both on their own work and on scientific scholarship in general.

A. Perceived Impacts of E-journals on Personal Research Practice

We asked respondents if they felt that e-journals had affected their research activities or productivity in general. We then followed up with specific questions about the concrete ways in which e-journals were having an impact on their personal practice—by shortening retrieval time, allowing them to access more experimental information, increasing the number of papers they published, helping them with archiving, increasing their extradisciplinary reading, and enabling them to exchange more articles with colleagues.

Basic Statistics on Perceived Impacts on Personal Research Practice

Although 60% of all respondents felt that e-journals did affect their research activities or productivity, nearly 40% felt that e-journals did not. (See Appendix II, Table 7.)

The 60% who did see an impact on their personal practice reported faster exposure to a broader literature. The most common reported impacts were on everyday information-retrieval practices: 98% agreed that e-journals shortened retrieval time, 86% that they enabled scholars to obtain more experimental information, 71% that e-journals increased the number of papers they read outside their discipline, and 71% that e-journals enabled them to exchange more journal articles with colleagues. Scholars did not agree as widely that e-journals improved two other aspects of their personal practice—ability to publish papers (42% agreed) and ability to organize information in personal archives (52% agreed). In other words, respondents did not necessarily link faster retrieval time, increased exposure to outside literature, and increased scholarly exchange of information with a rise in their ability to publish more papers or organize information better.

These topline findings varied by country and occupation. Respondents from the United States and Canada were less likely than others to say that their productivity improved because they accessed good papers faster. Better library infrastructures in the United States and Canada may be responsible for this. MDs and biologists were more likely to report improved organization as a result of e-journal usage. These scholars may have more acute needs: MDs may need to access

information quickly for treatment of patients and biologists to cope with the huge amount of new research in their field.

Factors Tested as Predictors of Perceived Impacts on Personal Research Practice

To explain these reported impacts on personal practice, we ran logistic regression analyses. We tested our hypothesis that certain factors could in part explain scholars' perceptions about the impacts of e-journals on their research activities. These factors are demographics (age, gender, occupation, job experience, field of research, and country of residence), Internet familiarity, personal subscriptions, publication success (number of papers accepted in the past year), and frequency of e-journal usage to retrieve full-text journal articles. We tested all of these factors in logistic regression equations to see how well they predicted scholars' perceptions of (1) the overall impact of e-journals on their personal research practice and (2) impacts on specific areas of their practice.

Key Findings from the Regressions

Factors Related to Perceived Impacts on Personal Research Practice

Scholars who tended to agree that e-journals had an overall impact on their personal research practice were younger and were more frequent users of e-journals. They were also more likely to have either very few or very many personal subscriptions and an average number of published articles. Conversely, older, less frequent e-journal users were less likely to agree that e-journals had an impact on their own research, as were users with an average number of personal subscriptions and with either very few or very many publications. Overall, demographic variables and frequency of e-journal usage seem to have the strongest influence on perceptions of the impacts of e-journals on personal practice.

Demographics

Country was a significant factor for nearly all reported impacts. Respondents from the United States or Canada were

- more likely to agree that e-journals improved their ability to obtain experimental process information online and
- less likely to agree that e-journals helped them publish more papers, read papers outside their primary discipline, exchange more articles with colleagues, and become more organized.

Age had an independent effect (controlling for all other contextual factors) on only one reported impact: older scholars were less likely to say that e-journals increased the number of papers they read outside their primary discipline.

Job experience (years from final degree, independent of age) very slightly reduced the likelihood of becoming organized and of publishing more papers based on e-journal usage but had no other effects. Field of study had only one effect: Biologists were more likely than non-biologists to agree that they “became more organized in archiving papers by using e-journals, creating [their] own mini library” as a result of e-journal usage, possibly because of the greater volume of publications available to biologists online.

Resources

Frequency of Internet usage had very significant but small effects, increasing the likelihood of all reported impacts except shortening retrieval time/reducing the number of library visits.

The number of personal subscriptions was again curvilinear.

- Respondents with very many (more than five) and very few (less than one) personal subscriptions tended to believe that e-journals improved the processes of obtaining experimental process information and exchanging articles with colleagues.

Publishing Success

The number of papers published had little if any effect on perceived impacts of journals.

Usage Frequency

E-journal usage frequency had three strong effects on the specific perceived impacts of e-journals. Compared with less frequent users, heavy e-journal users tended to be

- more likely to agree that e-journals increased the number of journal articles they published,
- more likely to agree that e-journals made it easy for them to obtain experimental information, and
- less likely to agree that they read more outside their primary disciplines as a result of e-journal use.

Frequent users may simply be more information hungry in general and use all methods of obtaining content more aggressively than do infrequent e-journal users. They may also have more distinctive patterns of usage and rely on e-journals intensely for certain practices (such as

tracking down experimental information) but less intensely for other practices (such as browsing).

B. Perceived Impacts on Scientific Scholarship in General

We also asked scientists and practitioners about their perceptions of the impacts of e-journals on scholarship in a broad sense. We wanted to see if scholars felt that e-journals had impacts only on their own practice and did not significantly change the status quo of engaging in research—or if indeed these respondents perceived broader, more fundamental changes in the way scientific research is conducted.

Basic Statistics on Perceived Impacts on Scientific Scholarship in General

In many ways, respondents perceived impacts of e-journals on general scholarship just as they perceived impacts on their own individual practices; they believed that e-journals make a broader literature more quickly available to scholars. Two-thirds of respondents (66%) agreed to some extent that e-journal usage increases scholarly productivity (measured in number of grants, patents, articles, and papers). Related to this, 92% indicated that e-journals simplify and speed up current awareness of recent research. Two-thirds (67%) believed that e-journals increase exposure to non-peer reviewed papers.

Strongly negative perceptions of e-journals did exist but were minimal. A full quarter of respondents (26%) agreed that e-journal usage decreases the rigor and quality of literature searches. Even more striking, one-third of respondents (34%) agreed that the unfriendly interfaces of e-journals waste users' time. Particularly older users, MDs, users living outside of the United States and Canada, and less frequent users of e-journals perceive interfaces negatively, according to regression results. (See Appendix II.3, Table 11, Column 5.)

Finally, respondents reported that they believe that e-journals have value beyond providing full-text articles. Eighty-seven percent agreed that e-journals provide other valuable services or features, such as editorial news, hyperlinking, peer reviews, and alerts or notification services. Frequent users have increased demands on and expectations for e-journals. As institutional access becomes more widespread, other users may increase their expectations as well.

Factors Tested as Predictors of Perceived Impacts on Scientific Scholarship in General

We used logistic regression analyses to test whether demographic factors (age, gender, occupation, job experience, field of research, and country of residence), Internet familiarity,

personal subscriptions, number of papers accepted, or frequency of e-journal usage were associated with any of the impacts on scholarship in general reported by respondents.

Key Findings from the Regressions: Factors Related to Perceived Impacts on Scientific Scholarship in General

Scientists and practitioners varied in their perceptions of the impacts of e-journals on scholarly practice in general based primarily on age, country of residence, number of subscriptions, occupation, and frequency of e-journal usage. (See Appendix II, Table 11.)

Demographics

Age had a consistent and statistically significant effect on four perceptions of the impacts of e-journals on scholarly practice, independent of all other contextual factors.

- *The older the respondent, the more he or she was likely to report that e-journal usage decreases the quality/rigor of research literature searches.* Older scholars may think that scholars using e-journals limit themselves to reading only what is available online, rather than going to a library or retrieving a full list of articles found through other means.
- *The older the respondent, the more he or she was likely to report that unfriendly interfaces of e-journals waste users' time.* Older users may have more difficulty with these interfaces than do younger scholars.
- *The older the respondent, the less likely he or she was to report that e-journal usage increases scholarly productivity.* Older respondents may resist seeing this new tool as essential to productivity, possibly because of more experience being productive prior to the introduction of e-journals.
- *The older the respondent, the less likely he or she was to report that he or she would do without or go to the library rather than pay any amount for online access.* Older scholars might be even more willing than younger scholars to pay for online access if their experience of e-journal interfaces and usefulness could be improved, or they might be less comfortable doing without articles and have different definitions of a comprehensive search.

Being a doctor had three different effects on perceptions of e-journal impact:

- *MDs were more likely to agree that unfriendly interfaces of e-journals waste users' time.* MDs may have more difficulty with these interfaces than do non-MDs, or they

may be more time-pressed. This issue will be explored further in the third survey of this study.

- *MDs were less likely to agree that increased online retrieval is related to decreased offline retrieval.* Medical practitioners might be less likely to depend on online retrievals than non-MDs. Doctors in teaching hospitals (60% of our sample of MDs) may have more established and convenient methods for offline retrieval, such as document retrieval services. An alternative interpretation is that doctors are looking for proven techniques and protocols, which might not always be the latest scientific developments found in current e-journal archives.
- *MDs were more likely to agree that they would do without or go to the library rather than pay any amount for online access.* MDs may be more resistant to paying for e-journal access, possibly because they have better access to offline retrieval methods.

Country of residence showed moderately strong effects on nearly all perceived impacts, controlling for all other contextual factors. Residents of the United States and Canada tended to disagree with both positive and negative statements about the impacts of e-journals. Specifically:

- *U.S. and Canadian scholars were less likely to agree that e-journals waste users' time due to unfriendly interfaces.* These scholars may have less difficulty with these interfaces (possibly because they have more up-to-date computer technology and higher bandwidth), or they may be less time-pressed.
- *U.S. and Canadian scholars were less likely to agree that e-journal usage increases scholarly productivity.* These scholars may be more reluctant to see this tool as influencing productivity, possibly because they have had better access to it for a longer period of time and now take online access for granted more than do scholars in other countries. Or this may reflect the fact that the U.S. proportion of the world's growing scientific article output has decreased since the late 1980s, a trend predicted to continue (NSF Science and Engineering Indicators 2000).¹² Respondents may also have had in mind some measure of productivity different than what the study used (based on the number of articles published).

¹² The U.S. share in the world's article output in major scientific engineering journals decreased by approximately 5% and Canada's share by .5% between 1989 and 1997; the U.S. share of the world's biology article output decreased by approximately 7%, health and professional by 6%, clinical medicine by 2.5%, and biomedical research by less than 1%.

- *U.S. and Canadian scholars were less likely to agree that e-journal usage quickly improves awareness of recent research.* These scholars may have more reliable offline resources, making any improvement in awareness through e-journals less dramatic for them. U.S. printed journals take longer (sometimes much longer) to reach subscribers outside of North America than to reach those in North America, for example. More than 85% of respondents, regardless of country of residence, agreed that e-journal usage quickly improves awareness of recent research, however.
- *U.S. and Canadian scholars were less likely to agree that e-journals provide other valuable features besides full-text articles.* These scholars may have less interest in such features than do scholars in other regions, possibly because scholars in other regions may have less access and fewer options to full-text articles and thus may focus more on getting the most out of available features. (The tools come bundled, so they use what is there.)
- *U.S. and Canadian scholars were more likely to agree that they would do without or go to the library rather than pay any amount for online access.* Scholars in other regions may be more willing to pay, possibly because they have less adequate access to offline or free institutional online retrieval methods. U.S. and Canadian scholars may also be more adamantly against paying extra for what they know is available for free elsewhere in other formats. They won't necessarily pay for convenience despite their desire for it. Convenience may not increase value enough to merit paying for it.

More job experience (years since final degree) had negative and statistically significant effects on two perceptions, *ceteris paribus*.

- *Scholars with more job experience were less likely to agree that e-journal usage increases scholarly productivity.* As with age, scholars with job experience prior to the introduction of e-journals may have more experience being productive without them.
- *Scholars with more job experience were less likely to agree that e-journals provide other valuable features besides full-text articles.* These scholars may be more likely to have already-established offline equivalents for these features.

Gender and field had little effect on any of the reported impacts of e-journals on scholarship in general.

Resources

Respondents with more personal subscriptions were more likely to agree that the unfriendly interfaces of e-journals waste users' time and less likely to agree that e-journal usage makes current awareness of recent research easy and fast.

Usage Frequency

Usage frequency had a very strong effect on four of the perceived impacts:

- *Frequent e-journal users were more likely to agree that e-journal usage increases scholarly productivity.* Frequent use may help scholars get more out of e-journals.
- *Frequent e-journal users were more likely to agree that online searching increases exposure to non-peer-reviewed papers.* Frequent users may dig deeper into the literature and be hungrier for all content, regardless of its source.
- *Frequent e-journal users were more likely to agree that e-journals provide other valuable features besides full-text articles.* Scholars who use e-journals frequently may have more time to explore all available features.
- *Frequent e-journal users were less likely to agree that the more they use online retrieval, the less they obtain offline.* Frequent users may be committed to both online and offline retrieval. They may have developed very specific practices that include both online and offline methods of retrieval, recognizing the need for both to support their research needs and scholarly goals.

Discussion

Based on the results from all the regressions on perceptions of scholarly impact, survey respondents from the United States and Canada were more likely than respondents from other countries to see e-journals as convenient tools that help daily routines (as opposed to a fundamental, transformative infrastructure that affects the quality of research and practice). Because these scholars have been exposed to e-journals for a longer time and through a better computing infrastructure, they may be more likely to use e-journals as a regular tool within their communications toolkit in their day-to-day practice.

The regression analyses indicate that frequent users benefit more from e-journals and are more committed to both online and offline retrieval than less frequent users. Frequent users are thus likely to demand more and better services from online journals. An increased usage frequency may help increase demand for features other than full-text article retrieval.

Interpretation of the basic statistic describing the sample majority's belief that e-journals "affect their research practice and productivity" is limited. First, 40% of the sample did not agree with this; second, we don't know from this question whether the perceived impact is positive or negative and in what ways. The detailed questions about the impacts of e-journals on personal practice and on scholarship in general are a bit more revealing. Reported impacts on personal practice seem to suggest that life science scholars believe that their universe of literature is expanding and becoming more diversified and that e-journals are helping to leverage that change. This shows up in concrete ways: access to more experimental information, more collegial exchange of information around journal articles, and more reading outside of a user's discipline. Practically, e-journals have made retrieval more efficient, allowing scholars to do more searching and retrieving and to take greater advantage of this broader literature. Links to increased productivity in terms of publishing are not clear from our results. The impacts seem to fall more centrally on the effectiveness and breadth of information gathering and on communications around that information.

Impacts on general scholarship mirrored impacts on personal practice. While there was some sense that e-journals decrease the rigor of searching (26% agreed), e-journals were perceived to increase exposure to non-peer-reviewed content and to increase and speed access to recent research, changing the flow and circulation of scholarly content and the kind of content. As our qualitative interviews indicate, this does in fact change the way that scholars perceive the practice of science in general. As the interviews suggest, this increased exposure could make science more open to diverse interpretations and raise the level of scrutiny.

The one difference in perception was in productivity. Although respondents felt that e-journals had not necessarily increased their own personal productivity through publishing, they felt that e-journals *had* increased scholarly productivity in general (the number of papers, grants, and articles produced). Scholars thus seem to experience the abundance of content, as facilitated by e-journals and online retrieval methods, yet they do not personally experience that productivity in publishing. They experience it more in their abilities to search and retrieve the content produced by others. Overall, the perceptions of impacts reported by doctors suggest that e-journal publishers and providers need to conduct further research into differences in the clinical environment versus the research lab.

Additional Findings from the Study

We asked a few questions in the survey to obtain additional information that we did not intend to use as factors in the above regressions but that we hoped would add to our basic findings about the perceptions of scholars in the life sciences. Specifically, we asked about criteria for choosing

journals to which to submit publications and about the future of the journal and personal subscriptions.

Publishing

On average, respondents had submitted 3.2 papers (of which 2.7 papers were accepted and/or published) to journals in the past year. Existence of an electronic version was not perceived as an important factor in selecting journals for publication. A mere 3% of respondents considered the hosting of an online journal as a primary factor in their decision to submit papers. Journal reputation was rated highest as a reason for selecting a journal for publication: More than 50% of respondents strongly agreed that reputation and prestige of a journal are the most important criteria for selecting a journal for publication. Other reasons included the fact that a journal has a large/diverse readership (26%), likelihood of article acceptance (19%), and rapid peer review (12%).

The Future of the Journal

The journal will remain an important medium for publication over the next decade, according to survey respondents. Few thought that the journal as a form of publishing would disappear in the next five to ten years. Only 5% strongly agreed that the journal form would become obsolete. Sixty percent strongly agreed that journals would continue to be an essential tool for scientists' communication. More than 90% of respondents believed that journals are and will continue to be primary communications tools in the scientific community.

Most of the respondents (68%) agreed that personal journal subscriptions would become less important to them over time. This may be explained by an assumption (or a hope) that more journal article content will be available free to them through institutional subscriptions. Whereas 43% of respondents strongly agreed that more content would become available to them free through institutional subscriptions, fewer (27%) strongly agreed that personal subscriptions would become less important to them.

CONCLUSIONS AND GENERAL DISCUSSION

Scientists and practitioners believe that journals are and will continue to be primary tools in scholarly communications. They also believe that the burgeoning of e-journals has affected their research routines—shortening library visits, saving time on information retrieval, and facilitating communications with colleagues. They tend to disagree, however, on whether e-journals improve the quality of their research, the number of publications they access, and their organization of articles for future reference.

Furthermore, those who use e-journals do not consider the availability of journals online to be a top criterion for selecting a journal in which to publish their articles. This is significant in light of the current debate (and related pledges and petitions) about providing research findings globally and without charge within a short time after initial publication. It is difficult to reconcile promises to boycott publication in journals that do not make content free online with our finding that scholars generally do not consider the simple existence of online versions to be worth their consideration in deciding where to submit their papers.

Given that publishing articles is an extremely important part of scholarly communications, these findings suggest either that e-journals are still in the early stages of technology adoption, or that most scholars simply perceive e-journals as another Internet-based product that they find useful now but that other technology can replace in the near future.

The study found that users demand more features and services online; the more they use e-journals, the more features and services they demand. Especially biologists have a very high demand for e-journals and online features other than full-text retrieval.

The cost-and-benefit estimation of research library transition from printed editions to electronic journals has been debated; that is, do/will electronic journals save money for libraries? One study (Chen et al. 2001) demonstrated that subscriptions to e-journals made subscriptions to traditional printed journal editions more expensive. Chen et al. evaluate the transition cost based on direct subscription costs without considering the value to users. Our study suggests that cost-and-benefit analysis of library transition should count perceived use values by scientists. The use value could also be measured by how much less it costs scientists and others to obtain information online through libraries than it would cost them if libraries did not provide online access to this information (Tenopir and King 2000). E-Journal User Study will use other surveys and current journal pricing data to investigate this.

We conclude that e-journals provide a variety of features for full-text article and information retrieval and thereby enable scientists and practitioners to increase the efficiency and effectiveness of their research and practice routines. Whether e-journals increase the quality or productivity of research in the life sciences, however, is still in question: They seem to make a difference for some scholars but not for others.

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APPENDIX I: SAMPLE METHODOLOGY

I.1. List of Participating Societies

Members of 20 professional societies in life sciences were sampled for the Scientific Journal User survey May 22 to June 20, 2001. The following table shows the names of societies and sample sizes per society.

Society	Sample size*
American Society for Microbiology	2,279
Radiological Society of North America	1,443
American Society for Biochemistry and Molecular Biology	1,249
American Physiological Society	1,091
Biophysical Society	873
The Endocrine Society	701
American Society of Plant Physiologists	679
American Association of Immunologists	658
American Association for Clinical Chemistry	616
Society for Study of Reproduction	567
American College of Chest Physicians	455
American Society for Pharmacology & Experimental Therapeutics	451
American Society for Nutritional Sciences	352
American Heart Association	350
Botanical Society of America	339
The Society of Investigative Dermatology	168
Genetics Society of America	153
American Psychosomatic Society	145
American Society of Hematology	22
Royal Society of Medicine Press	18

* The number exceeds total sample size (12,465) because some respondents belong to multiple societies

I.2. Sampling Methods:

The first survey was conducted online; data were collected from a Web-based questionnaire, recorded in the form of TSV files, by a third-party specialist firm called Perseus. The purpose of the survey (as described in greater detail elsewhere) was to uncover the perceptions of scientists about e-journals.

Target Population:

Life scientists and medical professionals who read life and medical science journals, especially HighWire journals in either paper or e-journal format (both users and nonusers of e-journals)

Survey Design:

- *Sampling:* We contacted 70 scientific societies affiliated with HighWire Press to request membership information such as e-mail addresses. Twenty societies that broadly represent 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.
- *Online questionnaire:* This is best viewed (though not active for data collection) at <http://ejust.stanford.edu/firstsurvey.htm>
- *Solicitation methods:* We sent 108,774 e-mail solicitations, requesting members to respond via the questionnaire on the Web. Approximately 13,903 addresses returned “undeliverable” or vacation messages, resulting in a contact group of approximately 94,871.
- *Survey implementation and data collection period:* May 22 to June 20, 2001
- *Survey response rate:* 12,453 net responses were received during the period; the survey response rate is 13.14%

Sample Population:

- *Sample size:* The number of sample observations was 12,465
- *Sample distribution (demographic characteristics):*
 - Gender: 30% of the respondents are female.
 - Age: The average (mean) age of respondents is 47; the median age is 48.
 - Research fields: 60% of respondents reported their research field as biological sciences, 34% health sciences, 4% agricultural, and 2% other research fields related to life sciences.
 - Occupation: 38% of respondents are faculty members in academic institutions, 12% students and post-doctorate researchers, 11% researchers in academic institutions, 11% researchers in the private sector, 6% government agency, 17% medical doctors, and 3% retirees.

- Residence: Respondents are from 99 different countries. The majority reside in the United States (72%), and the rest are from Canada and countries in Europe, Asia, Africa, Latin America, and Australia.

APPENDIX II: MODELS AND RESULTS

II. 1. Econometric Models for Analyses

The study has three dependent variables to (1) e-journal usage; (2) scientists' preferences regarding printed copy versus online editions; (3) scientists' perception about the impact of e-journals on their research activities.

Ordered probit regression is used to measure equation (1), e-journals usage, and logistic regressions for equations (2) and (3), preference regarding journal formats and perception about e-journals.

$$P[\text{EJU}] = F(\text{DEMO1}, \text{INTERNET}, \text{SUBS}, \text{PAPER1}, \text{FACILITY}, \text{ACCESS}) \quad (1)$$

$$P[\text{PREF}] = F(\text{DEMO2}, \text{INTERNET}, \text{SUBS}, \text{PAPER2}, P^{\wedge}[\text{EJU}]) \quad (2)$$

$$P[\text{PEJ}] = F(\text{DEMO2}, \text{INTERNET}, \text{SUBS}, \text{PAPER2}, P^{\wedge}[\text{EJU}]) \quad (3)$$

where EJU is a degree of e-journal usage with 5 categories (see Table 2); PREF is a dependent variable, preferences regarding journal format, printed copy vs online versions; and PEJ represents perception about the impact of e-journals on research activities. DEMO1 is a set of demographic characteristics such as AGE, MD, BIOLOGY, MALE, USA-CAN which represent respondents' age, whether a respondent is a medical doctor, whether a respondent's field of research is biology, whether a respondent is male, and an indicator that a respondent resides in either the U.S. or Canada, respectively (refer Table 1); INTERNET is a variable to measure Internet familiarity—weekly hours spent on the Internet; SUBS represents the resources available through personal subscriptions—numbers of journal subscriptions; FACILITY and ACCESS represent available resources such as PC, printers, and Internet access and scientific journal access through institutions; PAPER1, the numbers of papers submitted in the past year, PAPER2, the number of papers published or accepted in the journals during the past year, which measure respondents' research productivity. DEMO2 represents a set of variables in DEMO1 and JOBEXP, job experience measured by years (refer Table 1). $P^{\wedge}[\text{EJU}]$ is a predicted probability of e-journal usage from equation (1).

EJU variable consists of five categorical values (question 2 in Table 2), while values of both PREF (questions 4 and 5 in Tables 3 and 4) and PEJ variables (questions 17, 14, 15, and 16 in

Tables 5–7) are binary. Five categories for EJU are yesterday or today, within last week, within a month, longer than a month, and never. A binary value for PEF and PEJ is “Agree” and “Disagree.” The binary value has created by recoding four categories, “Strongly Agree,” “Somewhat Agree,” “Somewhat Disagree,” and “Strongly Disagree,” into two categories, “Agree” and “Disagree.” Table 2 shows a question on EJU and responses per category. Many different questions were used to analyze preferences regarding formats including reasons of preference. Tables 3 and 4 describe questions for PEF variable. We measured a predicted probability of whether they prefer online to printed editions. Questions in Table 4 are analyzed condition on their responses to whether they prefer online journals to printed versions (Table 3). Equation (3) has been used to measure respondents’ perception about the impact of e-journals on their research activities (questions in Tables 5–7).

II. 2. How to Read the Regression Tables

The signs of the *four cut off points* (a_1 , a_2 , a_3 , and a_4) listed at the top of the column titled $P[EJU]$ in Table 8 change from negative to positive, and their values increase. This first overall test tells us that e-journal usage frequency can be adequately “explained” by the set of independent variables we chose for the ordered probit model: demographic variables (age, occupation, fields of research, country of residence), Internet familiarity, number of subscriptions, number of papers submitted last year, and institutional access to scientific journals (see second column, Table 8).

Moving down the column to the detailed results of this regression analysis, we can see that certain groups of people use e-journals more frequently than others. Because 5 = never and 1 = yesterday or today, the EJU variable actually represents how *little* respondents use e-journals. Thus a positive coefficient for any of the categorical independent variables means that that category uses e-journals less often than the rest of the sample, while a negative coefficient means that that category uses e-journals more often. For continuous variables such as age or the number of subscriptions, if they are positive, then as they increase, e-journal usage frequency decreases; if they are negative, then as they increase, e-journal usage frequency increases.

If a variable is not marked with asterisks, then its relationship with e-journal usage frequency was not large enough to be statistically significant. Because all the variables are entered into the regression equation at once, each effect “controls for” all of the other variables. Consequently, we can say that a statistically significant variable has an “independent effect” on a person’s e-journal usage frequency, *regardless of* that person’s other characteristics.

II. 3. Tables

Please see accompanying documents: *Tables 1-8* and *Tables 9-11*.

APPENDIX III: SCHOLARS AND CLINICIANS COMMENT ON E-JOURNALS

TEN THEMES FROM UNSOLICITED COMMENTS IN REACTION TO A SURVEY OF SCIENTIFIC AND MEDICAL SOCIETY MEMBERS

The first survey of the e-Journal User Study project¹³ was fielded from May 22 to June 20 of 2001. The project sent e-mail to approximately 90,000 members of (mainly American) scientific and medical societies, inviting them to participate in a Web-based survey regarding scholarly journals. We received 12,465 responses, from 99 countries. There was no mechanism within the survey form for respondents to submit comments, yet 107 individuals took time to substantively respond to the “Thank You” e-mail message that automatically followed each survey submission.

Amidst the other short transaction-oriented messages, these 107 responses ranged from testy complaints about technical problems to enthusiastic descriptions of users’ daily practices and attitudes about e-journals.

Without specific data on these individuals and their institutional contexts (aside from the bits and pieces found in the comments themselves which we note below), we are limited to a brief analysis of the themes that emerge from these unsolicited responses. The majority of these spontaneous comments come from respondents who felt strongly about e-journals and were driven to communicate what they worried might be “left out” of the data. Respondents refer to practices and perceptions that were not covered, or were perceived as inaccurately reflected in the survey questionnaire. Thus, the comments can be read fruitfully as a companion to the first survey questionnaire and its results and as an elaboration or echo of many of the themes developed in *E-Journal Usage and Scholarly Practice: An Ethnographic Perspective on the Role and Impact of E-Journal Usage Among Users of Biomedical Literature* (May 2001. Hereafter referred to as “qualitative report” or “qualitative research.”) See the eJUSt web site at http://ejust.stanford.edu/research_findings.html).

- I. A. **THE IDEA OF A TRADEOFF BETWEEN PAPER AND ELECTRONIC FORMATS IS MISLEADING; BOTH ARE IMPORTANT TOOLS FOR THINKING AND WORKING.**
- B. **THE MOST SIGNIFICANT CURRENT SOURCE OF VALUE FROM E-JOURNALS IS IN THE SCHOLARS’ ABILITY TO SEARCH THEM.**

¹³ See the eJUSt web site at <http://ejust.stanford.edu> for background and details. A grant from the Andrew W. Mellon Foundation supports this project.

Several responses supported the idea, discussed fully in the qualitative report, that e-editions rarely completely replace print editions. Rather, print and e-editions of scientific journals exist in tandem and are used for different purposes depending upon the context of use. E-journals are particularly useful for searching and retrieving text. In the words of these respondents:

For retrieval purposes, e-journals are indispensable. However, for browsing through particular journals, the paper version gives you exposure to interdisciplinary topics that might not come up in a search which can be very useful. I do not think that either can replace the other. I subscribe to both methods -paper and electronic for different purposes. The presentation of information is enhanced by having both mediums available (respondent #11).

To me for keeping up-to-date I prefer (and will probably continue to do so) printed versions; for retrieval in any form I prefer and use mainly electronic access. (#64)

I prefer to search on line for journals some times (i.e. when I am looking for a specific article that I want right away—to avoid having to go [to] the library for it) but I prefer to look through journals at other times. For example, I would never want to read a journal on line, I much prefer to browse through Nature, Science, JBC, Molec Pharm and several others as written journals. (#57)

**II. A. NO SINGLE PATTERN OF USAGE PREDOMINATES FOR E-JOURNALS.
B. CONVENIENCE, EFFICIENCY, AND COST DRIVE USAGE OF E-JOURNALS ... AND
THEY ARE RELATIVE TERMS AMONG SCHOLARS.**

As explored in the qualitative report, scholars use e-journals in idiosyncratic and varied ways, based on a host of factors including individual preferences, occupation, stage of career, institutional infrastructures, information task, research cycle, time and place. For instance, a clinician reported frequently using electronic sources, but for purposes other than what he or she considers academic research. He/she therefore approaches e-journals with a different set of information needs.

My only comment is that the survey is written as if doctors looking up articles electronically are doing research. This is far from the reality for many of us. We look up material for educational and clinical reasons more of the time. I was an academic radiologist at the University of Toronto for 10 years, since I returned to a general hospital post in Ireland my academic output has been zero, but I use electronic sources of information far more. (#31)

Diverse use patterns are often underpinned by scholars' evaluations of what is most convenient and efficient. As several of the responses noted, notions of convenience and efficiency themselves are relative and contingent terms.

It can be more time-consuming to download PDF files than to go to the library—because I have to download and print files (on my really slow printer). While my technician/student can take a list to the library. The solution is to share my password/username for the online subscription with the technician/student but I hesitate to do that at this time. (#49)

Here, decisions about the efficiency and convenience of e-journal use are shaped by the individual's access to an assistant, lack of access to adequate printing facilities, and concerns over privacy.

For another respondent, discrete paper editions were “easier” to access than a group of different Web sites, each with their own protocols.

It is still easier to stack up the journals as they arrive and grab them when I want than to remember to log on to 15 different Web sites every X days to check for new content. (#61)

One respondent complained that current efforts to use e-journals for more convenient, more efficient submission of papers were actually costing him or her significantly more time and energy.

One issue that is not addressed in the survey and may be beyond its scope is the concern many researchers have about the changes to publication process with on-line submissions. Ideally, this should save the authors time but in reality we spend enormous amounts of time preparing manuscripts for on-line submission. The assistance from the journals is minimal, we spend a lot of time in preparing the manuscripts and have to become both computer experts and publication editors. I am sure this will improve with time but as the responsibility of publication is now the authors it would be hoped that the cost of publication will dramatically decrease in the future. (#33)

Just as one scientist's efficiency may be another's waste, so do scholars differ in their evaluations of the real costs, financial and otherwise, of e-journals. The following responses represent very different calculations about e-journals' costs and convenience.

The main reason why online journals are a god send to those of us in New Zealand (with the dollar at 42 cents to the US dollar) is that our institutions cannot afford to subscribe to all the journals hard copy. So with e-journals we can see the papers and if we need a hard

copy send to the author for a reprint or print out our own. I think this access is crucial for people not living in major centers. (#23)

I am fortunate to work at a University in a developing country that has access to Internet. But how many are not as fortunate? This is one of my main problems with this electronic publication business: science in the developing world is getting behind at a faster pace now...I wonder what is more expensive: subscribing to a journal or paying the high costs of modern systems of communication. (#92)

You always mention free journals - some journals I wanted to use are NOT free. My institution does not pay for individual e-journal downloading -> use your private credit-card or resign!

. . .instead of saving time, you waste time (searching, downloading), they seem to be free of costs (in reality you have to pay the Internet access, downloading, printing and a complete computer equipment which has to be replaced every few years) and sorting incl. storage of the low quality prints or *.pdf-files is your problem.

In many cases we don't act in that way, we would prefer! University management and policy force us to use (prefer) things which seem to be cheap - it does not matter how useful they are. (#12, Austria)

These scientists' choices about e-journal use are heavily influenced by their institutional infrastructure and their perceptions of what is convenient, efficient, and valuable.

III. INCREASED ONLINE ACTIVITY DECREASES OFFLINE, FACE TO FACE ACTIVITY.

Survey results indicated that 74% of respondents strongly or somewhat agreed that the more they use online retrieval of research content, the less they bothered to obtain content offline. One respondent raised the concern that a decrease in alternative methods of obtaining material resulted in fewer valuable serendipitous, face-to-face encounters.

Going to the library insures to meet

- good friends (and have a coffee with them later)
- some interested students
- the colleague you want to address informally about a formally very important point.
- some of these retired colleagues which may not be at the top of current science but help to place science in a historical perspective (and form somehow a memory)
- and finally, a point which may not be politically correct in the US, a flirt with the librarian. (#56)

IV. PRINTING TECHNOLOGY IS KEY TO E-JOURNAL USE.

As discussed in the qualitative report and by the respondent below, many scientists print e-articles to paper in order to read them more intensively at a later date. Thus printers and printing technologies are a key piece of the technological ecology in which e-journals operate.

All my colleagues who use e-journals PRINT (and store) the results! I do the same. (#12, Austria)

Most of us would like to have quality access to on-line journal articles and most would be willing to pay something for it—if it is good quality print and good quality illustrations, if I can print good quality hard copy using my computer / printer, if I can retrieve articles going back to the stone age (at least 1950), etc., the e-library will be a huge plus to the researchers, clinicians, and a magnum host of scholars. (#93)

Printing technologies, and access to them, have a significant impact on the way that scientists interact with graphic knowledge in e-journals. Using a range of different combinations of computers, printers, and photo-copiers, scientists have very different abilities to use and appreciate graphic data. The comments below give a sense of the spectrum of benefits and problems associated with printing densely colored or highly granular data.

I would just like to add that one of the best reasons to download rather than photocopy articles is that the color pictures come out. (#84)

For a permanent file record, the quality of the printout when printing an online article is far superior on a color printer compared to photocopy of a journal article using a traditional copier. . . And very important, the quality of figures online is often far superior to the print version, and the figures can be blown up for a close look at detail. For journals that insist on publishing micro-images, like *Science*, this is a godsend. Further, online there are now often video clips as supplementary material that greatly enhance the article's impact and believability in many cases. (#96)

In general, because of the desire to keep the file size down, the limitations on graphics resolution has led to figures (especially tone photos) that are remarkably worse than the actual photos journals used to publish. This is not an improvement. (#89)

At present, the quality of on-line images often does not come close to that in a good print of a photomicrograph. Furthermore, many people do not have printers or even computer

screens of high enough resolution to do justice to the images. This is why I try to persuade the library to keep getting the print version (often outrageously expensive - esp. with our dollar having sunk into a deep ocean trench) of certain journals until the on-line versions have good enough images. (#91)

Your form had no place to talk about scientific figures. First they take up many MB and are hard to download. Second they are not as sharp as in the journals. take a look at Anat. Rec. That is one of the oldest journals and is full of illustrations of very high quality. I have thought a lot about e-journals and what with the old ones that are not ever going to be available on that media and the problem of histological and other figures, I am not certain what the real answer should be. I think Science Magazine (AAAS) is OK as an e-journal but its illustrations are not the highest quality or on complicated subjects. (#75)

V. SCHOLARS OBTAIN MORE VALUE FROM E-JOURNALS WHEN THE JOURNAL FEATURES SUPPORT A WIDE RANGE OF INFORMATION PRACTICES.

A few of the respondents took the opportunity to suggest features that would enhance the value of e-journals for them. They suggested that e-publishers “find ways to add value” by providing features that allow them to customize e-journal capabilities across domains or clusters of domains of information tasks (e.g. searching, retrieval, reading, printing, obtaining advance knowledge of research results, paper submission, e-mail) and across discrete units of content (articles, search results, journals, abstracts, citations). The responses below focus on the difficulties of reading online (explored further in the qualitative report), the desire for enhanced e-journal features to address the cluster of searching and retrieving search results, the importance of accessing discrete bits of information within an article, and the value of the abstract as a container for content.

[I want] a dedicated, convenient E-book for reading pdf and other e-documents. I do not want to use my Powerbook for this purpose. It's too heavy and not comfortable to sit and read with. . . . I don't need an expensive, full service, tablet-like computer but rather an electronic book with only limited if any other abilities. (#24, radiologist)

My real hope is a light device about the size of a full size journal in length and width but thin, with a really good high resolution screen and a battery good for 4-5 hours, into which I can download the latest issues of 2 or 3 journals (or, if storage device limits, 20-30 articles) and then can carry on a plane and read while stuck on the runway in O'Hare. When I get back I link to my PC and deal with links and such, save particular articles or a Web link to them in a personal archive, then exchange for a new set. When that happens I'll cancel my personal paper subscriptions to even the core favorites, and be happy to pay for the electronic ones, hopefully cheaper. (#95)

What I wish I had was a good on-line search engine, such as Carl Uncover, which included abstracts and was capable of delivering via e-mail to me the complete search results. I'm willing to pay some money for this (e.g. I bought the complete ESA publication stuff in database format from Absearch), but I won't spend hundreds of dollars on it. Finally, a challenge to publishers of on-line journals. Simply transferring information from one medium to another rarely is successful. You need to find ways to add value. *Imagine a scientific article set up as a hypertext document . . . click on the figure citation to see the figure in a separate box, easily e-mail the authors, click on a reference and you are sent to the reference document, etc.* Also, you can add material that doesn't get included in journals, such as complete datasets (I agree with Dan Janzen that often the data is more important than the analysis), video clips of the study site or study organisms, etc. (#36, italics added)

The ability to find one small detail (e.g. where did they get their materials from) without having to access the whole paper is important. (#69)

Even more frequently we use Medline abstract search as the starting point for researching a clinical problem. Not infrequently the abstract provides sufficient information to answer the current question. We need to teach authors how to write a meaningful abstract. I would guess that 90 percent of people read only the abstract on line. If the abstract is poorly written people will not proceed to download the full paper. (#106 – clinician)

VI. SOME USERS WOULD BENEFIT FROM MORE EDUCATION ON HOW TO USE E-JOURNALS AND THEIR FEATURES.

As noted by the respondent below, scientists in developing countries would clearly benefit from explicit, user-friendly information on how to take advantage of e-journal features and capabilities. Other groups who might benefit from more education are older scientists who may not feel entirely comfortable with rapidly changing information technologies, and clinicians who have less time to spend on research activities.

Like many scientists of my age and especially those living in the transitional or third world countries I experience the problem of how to re-literate myself to the computer age. It took me 20 or so years till I developed my style of handling and retrieving information and on how to "manufacture" a scientific paper. And then in the '90s the computer revolution hit this part of the world; and to master the computer literacy required an additional effort on the part of the established scientists who now have had much less time to invest in themselves by acquiring the new skill of computer literacy. Shall I say that it took me 6 months or so till I got accustomed to the vertical position of my PC screen instead of having the manuscript laying horizontally on the table? Writing on the margins were lost. Underlaying and crossing also, etc.. Many of my colleagues are

reluctant to admit that they have only a superficial hand on knowledge on their PC and that they don't know how to get the best of it.

In conclusion, I think that at least some of the scientists of my age will benefit from an old fashioned step by step self-instruction tutorial on how to master all the possibilities offered by the Internet today. Including on how to read and download the e-journals. Many of the manuals are written with the tacit assumption that the readers already know the basics and this basics are sometimes beyond my actual knowledge. (#37)

VII. THE ONLINE ENVIRONMENT ENCOURAGES A DIVERSITY OF LITERATURE, BUT STILL OVERLOOKS SOME FORMATS.

As discussed in the qualitative report, online scientific information resides within a larger universe of online literature, occasionally bringing scientists into closer contact with non-peer reviewed or commercial "gray literature." Two respondents addressed this issue. The first is able to access a wider, more useful body of literature than was previously possible through his or her institution; the second is concerned about the fate of the printed version of materials that are circulated outside of scientific journals.

The advantage of e-journals is the lack of prestige or rigorous peer review. In agriculture much of the material one needs is not of the nature which gets published in prestigious journals which are the only ones one can recommend to a library to purchase. (#13)¹⁴

The other difficulty is that many important communications are not coming through journals but through newsletters and reports. I remember vividly that a few decades ago all important IBP releases came through their reports. I think we all agree that IBP brought ecology into "Big Science". Nowadays this is similar in certain branches of biophysics and gene technology. Some of them cannot use the Internet because they still need to keep results and topics among themselves. (#67)

VIII. PRICE STRUCTURES MATTER

Perceptions about price, whether accurate or not, factor into individual decisions about how to access and retrieve journal material. Users are accustomed to free access to print-editions from libraries, while at the same time they are aware of the financial intricacies of institutional subscriptions. Putting scientific literature online opens up possibilities for new financial

¹⁴ This respondent is working with a definition of e-journals as non-peer-reviewed literature, which is at odds with the definition used by this study. We define e-journals as peer-reviewed journals available online, whether or not they are also available in conventional, printed form. The confusion about what the term means was not uncommon among those interviewed for the qualitative research and among several scholars who sent unsolicited comments about the survey, which suggests that survey respondents may have been using a range of definitions.

arrangements between individuals, journal publishers, and institutions. For example, some respondents expressed concern that putting journals online was increasing overall subscription costs for certain journals, thus limiting scholars' access to them.

Some journals are starting to charge absurd sums for online access at the institutional level (*Nature* and its subsidiaries, for example) and this is causing our institute to cancel subscriptions. . . This disfavors online access. (#96)

As the following respondent noted, online access presents new complications when users are forced to negotiate different financial and institutional relationships for print and e-editions.

I would also state that how fully we switch over to electronics will depend upon how many journals are available and what the cost is. Also, I hate being coerced by journals that split the subscriptions so there is print personal only and then have Web-only features and articles that I cannot access because we don't have an institutional subscription. (#32)

One international respondent also mentioned the extra costs (in money and time) of accessing materials via the Internet.

For the international research community, all this quarrelling is absurd. We want to have access to the journals "period". At the cheapest cost as possible! We also must have several (mirror) repositories of the world archives. Don't forget that Internet 2 only works in few places yet, and that getting a paper on line can cost anywhere from 30 sec (if I2) to one hour or more when the normal Internet is congested. Having closer mirrors sites would help (In Europe, in Japan etc.) (#35)

IX. TECHNICAL PROBLEMS AND INSTITUTIONAL ACCOUNTING PRACTICES CURRENTLY PREVENT SOME SCIENTISTS FROM PAYING FOR ONLINE INFORMATION.

The results from the survey found scientists nearly evenly split on the question of whether they would be willing to pay for scientific information online or not. Several of the unsolicited responses highlighted important barriers to online payment – institutional accounting practices that conflict with available online payment options, and technical difficulties with online payments.

Right now I have no way to pay for articles except to put them on my private credit card. If I send a student to the library to get an article, it is paid for by my research funds, not my private funds. So right now, because I have no easy way to pay for articles on line out

of research funds, I use students. This does not mean that I am not willing to pay for Internet access to scientific articles. I would be thrilled to give the \$500 or so dollars that I spend each year for journals to an Internet group that gave me access to full copies of all scientific journals. (#44)

Obtaining anything online usually requires use of a personal credit card. One then has to submit paperwork to obtain reimbursement from the company for these expenses, and justify why they were needed. This adds to the time involved in getting an article. This justification step also means that one does not obtain and read articles just because they are interesting, instead one only obtains those that are related to a work project. In the long run this causes one to be too narrow and focused. (#94)

The reason that I do not wish to pay to receive e-journals is not the cost. It is the inconvenience of making small payments by Internet. (#13)

X. SOME SCIENTISTS HAVE ENVIRONMENTAL CONCERNS OVER THE USE OF PAPER

While environmental concerns did not emerge as a theme from the qualitative research (and were not explored in the first survey), six respondents did bring up the issue. Four directly linked the potential benefits of online scientific information to a reduction in the use of paper.

Hard copies of journals (particularly as individual subscriptions) use a large amounts of non-recycled paper, and I really think that the use of e-journals is a great way to decrease this waste of paper, and is a positive step toward stopping the destruction of great amounts of trees. That would be for me a major reason for switching to e-journals subscriptions. (#34)

I now live overseas and I don't want hard copy—it is bulky, takes up lots of storage space and kills trees. (#82)

My primary reason for wanting online full-text journal articles is to salvage an environmental target of this industry: Trees. (#103)

I also think an important motivator for switching is the reduced paper production needed for electronic journals. Although I do not know whether the semiconductor industry uses more or less water than paper mills. (#32)

Since many users of online scientific literature print e-articles to read them in depth, it is unclear whether e-journals use more or less paper. Another respondent feels that e-editions encourage more people to print out article copies, in effect increasing the use of paper.

Another minor point is that when everyone in an institution is printing out papers, it uses up an enormous volume of paper, because of course you only print on one side, whereas journals print on two sides of the page. . . There seems to be a greater temptation to print out articles than to go up to the library and photocopy them from journals. In the library, you can sit comfortably and read papers before making a decision about whether to photocopy them or not. (#91)