

E-JOURNAL USAGE AND SCHOLARLY PRACTICE

AN ETHNOGRAPHIC PERSPECTIVE ON THE ROLE AND IMPACT OF E-JOURNAL USAGE

AMONG USERS OF BIOMEDICAL LITERATURE

Introduction

This report presents the preliminary qualitative findings from the Stanford E-Journal User Study, a two-year Stanford University Libraries project funded by the Andrew W. Mellon Foundation. This part of the study was conducted from November 2000 to March 2001 by researchers at the Institute for the Future, a Silicon Valley think tank specializing in technology and social innovation. The findings here constitute the first stage of the study and will ultimately be integrated with the other research efforts: quantitative surveys, data mining, and expert workshops.

The qualitative method used here, based on in-depth ethnographic interviews, is intended to explore and describe the emerging logic and explanatory frameworks of e-journal usage in scientific scholarly practice among users of biomedical literature. Researchers used nonprobabilistic sampling methods and chose informants based on the overarching criteria of the study: that they be users (defined as readers, authors, and editors) of biomedical literature. To obtain a wide variety of responses, this population included representatives from a range of career stages (graduate students, post-doctoral fellows, junior faculty, and senior faculty) and from a range of institutional settings (universities, academic research institutes, hospitals, and government research institutes).

Seventeen respondents (sixteen American and one British) who met the criteria were interviewed. Of those, seven were self-selected from a personal request issued by the Office of the Stanford University Libraries to the editors of HighWire Press journals with online editions. The remaining ten respondents were selected through snowball sampling and emergent or informal social networks (Schensul, Schensul and LeCompte 1999; Johnson 1990).

The objectives of the interviews were threefold:

1. **To describe the emerging role** and fit of e-journals in scientific scholarly practice
2. **To understand the range** and types of dimensions that shape e-journal usage and to learn how users obtain value from e-journals
3. **To understand the impact** of e-journals on scholarly practice

Throughout this report, we use the term *e-journal* (electronic journal) to refer to a journal that is available online and that may or may not be associated with a traditional printed journal. Other terms, such as *online journal* or *e-publication*, are synonymous with our term e-journal. We use the term *Internet* to refer to the broad public computer-networked environment, whereas *World Wide Web (WWW)*, or *Web*, refers to the graphical interface, hyperlinked computer network residing on the Internet.

Following the Findings in Brief, the main body of the report is divided into four sections related to the usage of e-journals by scholars, each with several subthemes, and a brief methodology section. An appendix with the interview instrument follows.

I. The Role and Fit of E-Journals in Scholarly Practice

- Scientific e-journals are accountable to the worlds of print and the Internet.
- E-journals belong to a cluster of technological innovations that shape the way scholars adopt these journals.
- The most significant current source of value from e-journals is in the scholars' ability to search them.
- Online searching emphasizes the article as container (or structure) of content.

II. Scholarly Usage of E-Journals: Idiosyncratic and Contextually Based Practices

- No single pattern of usage predominates for e-journals.

- Scholars craft multiple routines for using e-journals to support a range of information practices.
- E-journals provide a bridge between publicizing and publishing scholarly work.
- E-journal features get blurred with the features of the broader search-and-retrieval environment.

III. Impacts of E-Journals on Scientific Scholarly Practice: A New Relationship to Information, Knowledge, and Peers

- E-journals improve the efficiency of scientific scholarship.
- E-journals facilitate new forms of scholarly practice through new relationships to information, knowledge, and peers.
- E-journals create new kinds of work in scholarly practice.

IV. Insights on E-Journal Adoption and Implications for the Future

- E-journals are part of a cluster of innovations and technologies that can be leveraged to create value for scholars.
- Scholars work in an integrated media environment, with synergies between paper and electronic journals.
- Scholars obtain more value from e-journals when the journals support a wide range of information practices.
- E-journals offer different types of value for searching, reading, and publishing.
- The zone between informal publicizing and formal publication is a rich and critical area for scholarly communications.
- E-journals challenge the notion of journal brand.

FINDINGS IN BRIEF

Journals that are available and accessible online—e-journals—are still in their early days of development and adoption by scholars. Over the next five to ten years, many new methods of publishing articles and entire journals online will emerge. These new scholarly resources may be very different in form and function than their current manifestations. This report is a preliminary attempt to map out some of the key contexts within which e-journals exist. We examine the emerging role, and fit, of e-journals in scholarly scientific practice; the range of dimensions that shape e-journal usage and provide value for scholars; and the larger impact of e-journals on scholarly practice. The final section of the report presents insights on e-journal adoption, and implications for the future.

I. THE ROLE AND FIT OF E-JOURNALS IN SCHOLARLY PRACTICE.

To understand how new e-journal forms and functions may evolve, the report examines the current role that e-journals play in scholarly work. This may provide some insight as to how e-journals will establish their niche within a broader set of scholarly resources and how they will complement and challenge traditional paper journals.

Scientific e-journals are accountable to the worlds of print and the Internet

E-journals are part of both a tradition of scientific society publishing and an emerging interactive communications and publishing environment: the Internet. Scientists turn to e-journals for the same content they receive from print journals. They approach e-journals with the same set of expectations they have developed for print editions. Therefore, the characteristics, legacies, and user expectations of both paper and electronic domains shape e-journal usage. Scholars develop their preferences and strategies for searching, reading, and publishing in both of these media contexts.

E-journals come bundled with the powers of the Internet (particularly the Web), the computer, and the printer, and therefore cannot be evaluated in isolation from this technological context. Scholars' adoption and usage of e-journals will be driven by their adoption of other features of the Internet environment (such as the Web, e-mail, and other connectivity capabilities), peripheral technologies, and new software.

Respondents suggested that scholars obtain value from e-journals by combining distinct connectivity features and capabilities of the Web, such as search engines and hyperlinks; access to publicly maintained databases; availability of multimedia and other software; and connections to people, places, and institutions through e-mail. E-journals are enhanced by more than their ability to leverage Web connectivity and resources, however. Two overlooked technologies key to e-journal adoption and usage are the computer itself and the printer. E-journals provide information in digital form, and are able to leverage the computational power of the personal computer and even more powerful remote computers. Scholars also talk about the presence or absence of advanced printing capabilities and access to free printing as integral to how e-journals fit into their everyday scientific practice. By linking electronic publications to the power of the Web, the computer, and the printer, publishers can create an environment in which scholars are able to maximize benefits of the media and potentially create new forms of scientific practice.

The most significant current source of value from e-journals is in the scholars' ability to search them

Scholars are often introduced to e-journals via search and retrieval of content. Here they gain their initial experiences interacting with e-journals and establish their first expectations of what an e-journal can do for them. When scholars search online for information, the journal structure—as a container that adds value to content—is less significant. Online searches tend to bypass the journal as container or significant boundary delineating a collection of ideas and content. For example, interview respondents spoke of their searches as strategies to find article content and information related to specific topics, not necessarily from specific journals.

II. SCHOLARLY USAGE OF E-JOURNALS: IDIOSYNCRATIC AND CONTEXTUALLY BASED PRACTICES.

E-journal practices are like individual fingerprints—they are unique to individuals, representing a pattern of strategies and a personal signature. Usage of e-journals is highly contextual, with strategies for using them dependent on many variable factors in the scholar's environment. Routines for using e-journals vary, for instance, depending upon information tasks and objectives. These routines also change over time

and place. Some key drivers shaping e-journal usage and preferences for paper or electronic format include the following:

- *Scholarly goal*: Scholars pursue multiple goals using e-journals: writing a grant, finding a citation, browsing a peripheral subfield, becoming familiar with the work of a particular author, and so on.
- *Infrastructure*: Scholarly infrastructure includes institutional contracts and licenses with publishers and libraries; administrative support and personnel; and available computers, telecommunications technologies, and peripheral technologies such as printers, copiers, and scanners.
- *Time and place*: Scholars have different needs and make different choices depending on whether they are working during the day or after hours, at home, in the office, en route to a conference, at a café, and so on.
- *Professional characteristics*: Usage patterns vary according to a scholar's stage in career and experience base in the discipline; to other scholarly obligations such as teaching commitments, institutional obligations, and laboratory responsibilities; and to the relative volatility of the scholar's subfield. Scholars at the beginning of their careers have different information needs and capabilities, along with less familiarity with the literature, than do older, more experienced scientists. The latter generally have a wider range of publishing and teaching responsibilities as well.

Convenience drives usage of e-journals . . . and it is a relative term among scholars

What is convenient for one scholar is not necessarily convenient for others. With their own idiosyncratic approaches to both print journals and online information, and with their own configuration of professional strengths, histories, and needs, scholars patch together systems that work for them in their context. These individual systems may not appear to be the most efficient, but they are effective for those who create them.

Along with personal history and understanding of technologies, scholars also talked about using whatever is free and easily available at their institutions. Scavenging from their environment, they put together the tools that work most effectively for them. If they can walk across the hall or down the hill to the library, or if their institution is invested in promoting a particular indexing or searching system, this is often what they use. Interviewees also mentioned other factors determining convenience, such as the presence or absence of dedicated computer terminals, access to free printing and copying, library proximity and hours, family demands, and ability to shift some of the burden of work to an assistant.

The idea of a tradeoff between paper and electronic formats is misleading; both are important tools for thinking and working.

As they look for what is most convenient and what makes sense given their particular needs and strengths, scholars don't see separate worlds of paper and electronic formats. They work in an integrated media context. Integration happens differently for different people, but informants were neither paperless or exclusively paper bound. Evaluation of e-journals, then, should be conducted within an integrated media context that includes both hard copy and electronic text and resources.

Scholars craft multiple routines for using e-journals to support a range of information practices.

Scientific scholars develop a portfolio of routines and strategies for using e-journals to gather, manage, and make sense of biomedical journal literature. Six major categories of information practices emerged from our interviews with respondents. Scholars engage in these activities in no particular order, often simultaneously, and cycle back and forth among them. E-journals provide value when they help scholars hone these six domains of information practice, structure knowledge, and achieve scholarly goals.

- *Scholars monitor and review content regularly to keep current:* The goal of this information practice is to cover a broad knowledge domain (or domains) and to get exposure to new and emerging ideas, discoveries, and methods. Reading is less intensive and is done with the idea of covering a lot of material and looking for important descriptors and indicators of relevant content. Respondents use a mix of methods for this practice. They access content in both paper and electronic journals and review material in electronic and hard copy formats. A focus on developing ways for scholars to switch back and forth between paper and electronic formats might contribute to improving the overall ability of scholars to monitor and review content.
- *Scholars conduct direct research for retrieval:* In this practice, the knowledge domain tends to narrow. The purpose of reading shifts from absorbing a wide range of ideas to critically evaluating specific content for retrieval. Directed research is a focused activity in which success is defined by effectively navigating the literature and retrieving particular types of content—full-text articles, citations, author names, data sets, or even abstracts. The ability to develop productive starting points from which many paths can be created is a source of value for scholars. Assessment tools—such as informative titles, abstracts, accessible tables or data, article descriptors, article ranking or rating systems, and other metadata—help scholars evaluate material as they navigate paths and decide

how they will retrieve content. Scholars are likely to highly value and to increase adoption of e-journals with features that support these activities.

- *Scholars study and read intensively to extract knowledge:* Study reading, or intensive reading, helps in the thinking process, the creation of knowledge, and assimilation or integration of new knowledge into existing knowledge bases. Scholars described how they dissect articles, extract knowledge, and make sense of ideas in this mode. Most respondents commented that they prefer to do intensive reading in hard copy format, which allows them to make notations and to move around easily within and between documents. To the extent that publishers want to encourage readers to do more serious reading online, they may want to address these concerns, both by working to provide *paper convenience* in the electronic format and by encouraging scholars to learn to think differently, using electronic conveniences not found in paper.
- *Scholars circulate and exchange content to build peer networks:* E-journals provide many opportunities for scholars to increase information exchange among themselves. Whether for purely transactional purposes or to meet broader social goals, tools such as e-mail with URL or PDF attachments, lab Web sites, and distributed, flexible printing have given scholars a new basis for interacting around journal content.
- *Scholars organize content to create context and relevance:* Organizing and categorizing content typically follows retrieval (and sometimes, intensive reading), and consumes large amounts of time and thought. Respondents described idiosyncratic systems of cataloging, organizing, and filing collected content to create a broader context and help create meaning. In essence, scholars described the creation of personal mini-libraries. These take the form of piles of paper on office floors, e-libraries, paper filing systems, reference manager systems, or a combination of these systems. Cataloging and organizing content is an important activity for respondents because it helps them to place retrieved content into a larger context for scholarly analysis and reflection, draw connections among disparate pieces of scholarly work, build their own knowledge structures, and develop original ideas.
- *Scholars document original content to establish ownership of ideas:* Respondents identified a final practice of scholarly work as documentation of original content. Receiving public acknowledgment as the owner of an idea, as one scholar put it, is an important motivator for documentation. E-journals facilitate documentation in two ways: by seamlessly linking the searching and writing processes and by speeding up the time between submission and formal publication of an article.

E-journals provide a bridge between publicizing and publishing scholarly work.

Scientists publicize their work in person, in print, and, increasingly, in virtual formats—from informal networks to journal clubs, from database postings to conference presentations to peer-reviewed publication. As they tap into the flexibility of online information dissemination and retrieval, Internet technologies such as e-mail, and the computational power of the computer, e-journals enable closer links with a wider variety of publicizing practices than do their print counterparts. In many ways, e-journals shrink the gap between publicizing and publishing, bringing informal and supplementary information into closer proximity with formal, peer-reviewed material. This offers unprecedented opportunities for creative cross-referencing of domains of information, but also creates new tensions between published and unpublished material; between *gray literature* and peer-reviewed literature; between formal and informal material. E-journals and their broader technological context can provide new tools, forums, and forms of dissemination with the potential to significantly shape scholarly communications and publishing practices in the future.

E-journal features get blurred with the features of the broader search-and-retrieval environment.

Scholars often did not distinguish during interviews between the features of an e-journal, those of a search engine, and those of a cluster of journals such as HighWire Press. E-journals appear as constellations of networked information in a larger informational galaxy. Some respondents had no clear sense of what e-journal features might be, beyond simple existence as accessible information. While scholars value the increased ability to manipulate, retrieve, and link information provided by e-journals, these services are also associated with electronic search engines. As a result, search engine features often blend seamlessly into journal Web site features.

III. IMPACTS OF E-JOURNALS ON SCIENTIFIC SCHOLARLY PRACTICE: A NEW RELATIONSHIP TO INFORMATION, KNOWLEDGE, AND PEERS

The impacts of e-journals on scholarly practice extend beyond the increased ease they provide in gathering and managing information. The consequences of more powerful

searches and better access to a wider and more diverse resource base go well beyond the scholar's ability to leverage time and work more efficiently.

E-journals improve the efficiency of scientific scholarship.

Electronic search engines and online access to abstracts and full-text articles clearly speed up the process of searching and retrieving relevant scholarly content. Respondents described the various ways which online searching, browsing, scanning, retrieval, and even submission of articles save them time and make them more productive in their work. Not only do e-journal access and searching speed up the process, they provide access to more articles and content than traditional methods within a single session.

E-journals facilitate new forms of scholarly practice through new relationships to information, knowledge, and peers.

Scholars described how e-journals can expose users to different kinds of articles, in fields that the scholars may not have accessed before. They also explained how science could become more open as different types of information are presented in new formats and new arenas, thereby becoming accessible to more people. New interpretations of online data could stimulate new debates and new paths of inquiry, furthering the scientific process. A plant biologist speculated about the possibility of being able to publish all results, for example, including negative results, not just "best results." Respondents' comments about the scholarly impacts of e-journals reflected their implicit shared values regarding transparency, accuracy, scientific validity, contribution to scientific progress, and nonduplication of scholarship. Respondents believe that the new forms of access and connectivity available in the e-journal environment could enable scholars to meet these more profound scientific goals.

E-journals increase peripheral vision.

E-journals help scholars develop more effective vision at the borders of specific content areas without creating too much work. Increasing awareness at the periphery increases ability to make connections to other fields and helps place research in a broader context. It may also encourage scholars to be willing to take searching and reading risks. As they facilitate both deep, narrow searches of core content areas and

broad searches that cover the periphery of subfields and distinct disciplines, e-journals can act as a microscope and a telescope for scholars.

E-journals facilitate participation in a greater flow of information and scholarly communications.

Many informants felt they had increased the amount of information they pass on to others: using e-mail to send URLs, PDF files, and cut-and-pasted abstracts; handing out reprinted downloaded PDFs; and so on. Greater ability to disseminate information informally among peers creates a new way for scholars to be in relationship with each other and their information.

E-journals provide new ways for presenting scientific results that contribute to new thinking processes.

Scholars mentioned the emergence of new publishing formats (such as film) and of larger data sets that could conceivably change the way scientists think about scientific problems and questions. Not only are computer-generated simulations and models (increasingly common) new ways of presenting the same information; they are in themselves new forms of evidence. Will emerging opportunities for expressing data shape the way experiments are designed in the future? “I think [they’re] allowing us to plan more global experiments, more logical experiments ... more completed experiments,” said a biological chemistry post-doctoral fellow.

E-journals make data more visible and increase evaluation and scrutiny.

For the reader, increased access to evidence promotes scientific transparency, visibility, and accountability. E-journals, with the capability to link to more complete data sets and additional information, potentially could increase the level of scrutiny of scientific results and interpretations. Ultimately, as one scholar told us, people will have to do better science.

With this kind of access to other people’s data, the locus of evaluation may shift toward the individual scholar. When data is less visible, the journal plays a paramount role in the evaluation and verification process. The need for editorial validation could conceivably decrease, as scientists are increasingly able to dig deeper into specific data and results. At the same time, the unevenness of newly visible data is already a source of

some tension. Respondents mentioned the difficulty of knowing exactly when and how different kinds of data should be made available.

E-journals create new knowledge boundaries and domains of equivalency.

E-journals exist in an environment in which it is now possible to make channels between different domains of scientific literatures—peer reviewed and not, conference proceedings and lab Web sites, databases and journal articles, and so on. As electronic peer-reviewed material competes with an increasingly active zone of other kinds of online and/or digital information, the development of boundaries becomes a key issue among scholars for navigation, evaluation, and access to content. New kinds of boundaries, as well as editorial voices, will likely emerge to distinguish between the different kinds of content. Some of these boundaries may be formally established by professional societies, while others may originate from scholars, labs, and other peer groups that have Web capability to make their own links among distinct articles and content.

E-journals create new kinds of work in scholarly practice.

Whereas e-journal use streamlines many information tasks and processes involved in scholarly work, it also creates new kinds of work that scholars need to manage. As more content is co-mingled under various forms of review and professional evaluation, scholars will need to spend more time accessing *and* assessing.

Larger numbers of articles will require that scholars use more sophisticated search engines and more sophisticated searching practices. Scholars also will have more choices about how and where to get access to scholarly content. Searching online is so efficient that it raises the stakes for covering all the bases when preparing and supporting an argument in an article. More work is created for scholars in other tangible ways as well: online searching and downloading from e-journals (and other online sources of content) increase the need for paper and print management. Respondents also commented on the additional work they must undertake to submit articles online. They described the hassles of formatting for multiple journals, preparing citations in distinct formats, and making sure that data standards were compatible across computer systems. Online circulation and sharing of information seems to have a downside as well. Alerts, advance notices, and e-mails from colleagues or labs with URLs and PDF files attached fill e-mail boxes and increase the amount of e-mail screening and management.

IV. INSIGHTS ON E-JOURNAL ADOPTION AND IMPLICATIONS FOR THE FUTURE

Little research has focused on qualitative assessments of the meaning and potential value of e-journals as part of a larger scholarly communications toolkit—the why and how of e-journal usage by scholars. This study is intended to contribute to the discussion of why scholars use e-journals, how they use them, and what kinds of roles e-journals play in overall scholarly practice. The hope is that the study will provide a richer context within which quantitative study results can be interpreted. Together, qualitative and quantitative results may provide a better picture of the distinct value that e-journals offer, and may be of use to publishers and others currently designing and developing e-journals. Following are several insights about the adoption and usage of e-journals by scholars using biomedical literature and about possible implications for the future of e-journals.

E-journals are part of a cluster of innovations and technologies that can be leveraged to create value for scholars.

New sources of value may be created if the e-journal can leverage the other technologies -- printers, photocopiers, organizational software for referencing and citation management, multimedia software and products, database software, and Internet features and functionality -- that are a part of the scholar's technical infrastructure and communications toolkit. Printing, for example, is an important activity critical for study reading, organizing, and cataloging. The development of new printing formats and flexible printing processes linked to journal access may help scholars with the work of printing and paper management.

Scholars work in an integrated media environment, with synergies between paper and electronic journals.

Respondents in this study suggested that paper and electronic content would fill distinct niches in the scholars' broader media ecology and that synergies between paper and electronic journals are likely to provide the most value for scientific scholars. Paper and electronic resources may take on new roles as e-journal features and capabilities emerge. A possibly fruitful area for exploration is how paper and electronic journals can work together, leveraging the distinct qualities and strengths of each. An assumption by

publishers, libraries, and other information service providers that the e-journal will replace the print form may limit opportunities for scholars to take advantage of an integrated and value-added media environment.

Scholars obtain more value from e-journals when the journals support a wide range of information practices.

Adoption and usage of e-journals may increase if publishers and other providers of e-journals focus design and development efforts toward supporting a range of idiosyncratic information practices such as content monitoring, directed research, study-reading, circulation and sharing, content organization, and documentation. Understanding the specific objectives of these information practices, such as the four described in this study related to directed research (establishing a base, creating paths, assessing content, and retrieving for use, see pp. 32-38) may provide a framework for identifying and developing new features and capabilities of e-journals.

E-journals offer different types of value for searching, reading, and publishing.

Respondents suggested that they evaluate e-journals differently depending on whether they are searching, reading, or publishing in a journal. Each activity has distinct value criteria and serves different scholarly goals. Respondents also suggested that searching is currently the most common form of e-journal use. Research that focuses exclusively on searching may be overlooking important contributions and sources of value that e-journals can offer for scholars in their reading and publishing activities, however. Enhancing the readability of journals' content online, especially for study reading, may contribute to their value and flexibility.

The zone between informal publicizing and formal publication is a rich and critical area for scholarly communications.

Respondent interviews suggested a desire for, and movement toward, developing a dynamic middle zone between the unstructured and organic Web environment and the procedural world of formal publishing. E-journals could provide various alternatives in this middle zone and new opportunities for bridging these two extremes. While not replacing traditional, peer-reviewed journals, new forums such as self-organizing (or loosely organized) knowledge communities, lab-based servers, supplemental databases, and other shared knowledge resources could offer scholars new sources of interaction

with their peers around original research and cutting-edge information. E-journals and the connectivity of the Web provide a unique opportunity to support these environments.

E-journals challenge the notion of journal brand.

The study research suggests that e-journal searching emphasizes the article as the relevant container of knowledge rather than the journal itself. E-journal features were perceived as blurred with the rest of the features of the e-journal's search-and-retrieval environment. Journal publishers may want to think about how to extend brand in the online environment across various online activities. Publishers might want to brand different aspects of their journals in addition to quality of content. Important components of brand may include attributes such as searchability, breadth of content, seamlessness with other search environments, ease of use, flexibility of searching within an article, use of content descriptors and metadata for assessment, and online readability. In essence, it may be useful for publishers to think about how to brand the entire experience of e-journals for scholars.

E-JOURNAL USAGE AND SCHOLARLY PRACTICE

AN ETHNOGRAPHIC PERSPECTIVE ON THE ROLE AND IMPACT OF E-JOURNAL USAGE

AMONG USERS OF BIOMEDICAL LITERATURE

I. THE ROLE AND FIT OF E-JOURNALS IN SCHOLARLY PRACTICE

Journals that are available and accessible online—e-journals—are still in their early days of development and adoption by scholars. Over the next five to ten years, many new methods of publishing articles and entire journals online will emerge. These new scholarly resources may be very different in form and function than their current manifestations. To understand how these new forms and functions may evolve, we examined the current role that e-journals play in scholarly work. This may provide some insight as to how e-journals will establish their niche within a broader set of scholarly resources and how they will complement and challenge traditional paper journals.

Scientific e-journals are accountable to the worlds of print and the Internet.

While e-journals are relative newcomers to the scientific community, they are part of a tradition of scientific society publishing that goes back several centuries and forms the backbone of contemporary scientific research. They are also part of an emerging interactive communications and publishing environment: the Internet. The tensions between the established, procedural world of scholarly publishing and the organic, dynamic world of the Internet frame the context for the usage, evaluation, and finally, development of e-journals.

Scientists turn to e-journals for the same content they receive from print journals. They approach e-journals with the same set of expectations they have developed for print editions. A senior clinician described how he sees e-journals as equivalent to print versions.

After all, words are words, and they're the same words on paper as they are on e-journals. It's the same article; it's the same journal, ultimately. The only thing that the e-journal possibly can give you is ability to search a greater percentage of the literature effectively than one can with printed journals.

At the same time, the e-journal format fully realizes its value only within the context of the Internet, where scientists have different expectations about the kinds of information available. One doctoral student commented on e-journal features such as links to the author, for instance.

All that stuff is useful, but at that point, it's almost like every other Web site. Then you're just doing Web standards or the Web-based stuff. There's nothing remarkable about it. Obviously, you should have that stuff on the Web.

Public health doctoral student

The characteristics, legacies, and user expectations of both paper and electronic domains shape e-journal usage. Scholars develop their preferences and strategies for searching, reading, and publishing in both of these media contexts.

Following, we identify some of the most important roles of the traditional paper scientific journal and describe how e-journals are complementing, continuing, or transforming them.

- **Journals keep scholars current with the literature.** Journals provide the framework within which scholars conduct contemporary research and shape and conceive future research. Keeping up-to-date on literature prevents duplication of experiments and research. *E-journals can disseminate information about scholarly research faster and in earlier stages of the publication process. E-journals may shape research directions and choices earlier in the research process.*
- **Journals filter and evaluate content.** Journals evaluate scientific results and act as a first level of content filtering and organization in a world where the amount of scientific information far surpasses any individual's ability to organize and manage it. The structure of the printed journal and the selection and review process are two mechanisms that provide filtering and evaluation. *Journals available on the Web must also filter and evaluate content. E-journals work in conjunction with many kinds of search engines in addition to offering search capabilities of their own. While editorial committees still do the important work of filtering and evaluating scientific results published in e-journals, the journal structure itself may be less visible in the search-enabled Web environment*

- **Journals create archives.** The journal is a key organizing medium in scientific practice. As the only permanent record of scientific discoveries and results, journals document scientific progress. *E-journals offer new possibilities for abundant, cheap storage of content, 24-hour, seven-day (24/7) access, and new channels for searching and retrieving content in an efficient manner. Concerns of permanence and reliability are key issues among scholars, however.*
- **Journals present editorial vision and support scientific community.** Journals provide editorial vision and shape scientific disciplines in particular ways. They reflect and define scientific communities. *E-journals offer new ways of defining community and presenting editorial voice. Online searching and retrieval of journal content reduces identification of the journal itself as a package with a distinct brand and voice. Scholars may increasingly determine their own editorial vision from individual articles.*
- **Journals generate funding and support research and also support tenure and promotion.** Journals are integrated into the funding and research cycle: research drives publication, which drives funding, which in turn drives more research. In terms of tenure, promotion, and funding, journal articles are the most meaningful structure through which results are presented and evaluated. *By making results available more quickly—and to a wider, more global audience—e-journals may bring more and different kinds of scholars into the funding, research, and publishing community.*
- **Journals support scientific societies.** Journals represent and in some cases financially support societies. *Scientific societies will have to generate new financial models for e-journals. In turn, online scientific information may provide a forum for new kinds of scientific communities, such as sponsored scientific knowledge environments.*

As e-journals (and paper journals) evolve in an integrated media context, scholars may develop new expectations of the journal's form and its role as part of the scholarly communication and publication toolkit. The rest of this report describes observations about the usage and role of e-journals today that may provide insight into the emergence of e-journals as an increasingly important scholarly resource. E-journals belong to a cluster of technological innovations that shape the way scholars adopt these journals.

E-journals come bundled with the powers of the Internet (particularly the Web), the computer, and the printer. They cannot be evaluated in isolation from the technological context in which they reside. Scholars' adoption and usage of e-journals will be driven by their adoption of other features of the Internet environment (such as the Web, e-mail, and other connectivity capabilities), peripheral technologies, and new software.

Respondents suggested that scholars obtain value from e-journals by combining distinct connectivity features and capabilities of the Web, such as search engines and hyperlinks; access to publicly maintained databases; availability of multimedia and other software; and connections to people, places, and institutions through e-mail. These other technological components of the e-journal cluster add value to e-journals themselves. For instance, a senior plant biologist talked about the variety of ways that online work is integral to his scholarly research.

We can't exist without our computers in terms of managing DNA. So we do use all the databases. Now ... for nucleic acids and proteins and things ... and we share software—we're doing these kinds of things online, on the campus, by a site licensed for scientific software that's shared.

Senior plant biologist

E-journals are enhanced by more than their ability to leverage Web connectivity and resources, however. Two overlooked technologies key to e-journal adoption and usage are the computer itself and the printer. As the biologist just quoted suggests, the presence of the computer behind the screen is a distinct difference between e-journals and print publications. With the e-journal, information is provided in digital form, and the full computational power of the personal computer and even more powerful remote computers is leveraged. Digital information lends itself to standardization, and standardization facilitates cross-tabulation, comparison, and reinterpretation. The more that e-journals are able to present standardized digital data, the more that data is open to manipulation, regraphing, and reinterpretation by anyone, anywhere, with access to a computer.

Finally, for many scientists, e-journals are inextricably linked to printing technologies. Scholars talk about the presence or absence of advanced printing capabilities and access to free printing as integral to how e-journals fit into their everyday scientific practice. In an interview interchange, a recent Ph.D. in biological chemistry and

his faculty advisor compared new printing technologies to the older technological combination of print journals and photocopy machines.

Recent Ph.D.: It's easier to e-mail articles to your peers. It's also a lot easier to print out. It used to be with the paper copy ... you had to xerox it. [The professor] never xeroxes anything. Because xeroxing is a pain.... Having everything on a computer and having access to a printer—and we have double-sided printers—is really fast. It's a lot easier to share paper copies of the information with everybody else.

Professor: That's true. Also, now you can print out and take with you color copies. In a lot of our things, the data are represented in color, and we have color printers. So we print the things out in color. And the only other choice would've been to ... rip the pages out of the journal. But then you only have one copy.

By linking electronic publications to the power of the Web, the computer, and the printer, publishers can create an environment in which scholars are able to maximize benefits of the media and potentially create new forms of scientific practice. The entire cluster of technologies surrounding e-journals significantly shapes how and why scholars adopt e-journals and how they evaluate the role and benefits of e-journals.

The most significant current source of value from e-journals is in the scholars' ability to search them.

Scholars evaluate e-journals and *e-articles* differently, depending on what kinds of activities they are engaged in at any particular moment. Goals are distinct depending on whether the scholar is searching, reading, or publishing an article. The role of the e-journal, then, shifts in each of these contexts, as does its ability to support each activity. A separate process of adoption, usage, and evaluation of e-journals takes place in each of these activity domains. Success or effectiveness of an e-journal to scholars must thus be evaluated according to criteria in each of the three activity contexts.

Interviews suggested that searching may be the most common activity through which scholars currently encounter e-journals and develop their initial patterns of usage. Through searches, scholars experience e-journals most directly and potentially gain the most immediate value.

I sort of scan a number of journals—I would say probably ten to 15. I have paper subscriptions to several journals, and I use them, but once they've gone off my desk, they're basically lost.... So the real information retrieval occurs through access ... online. Particularly when I'm writing a paper or writing a grant, being able to rapidly search the literature, download those articles, is very important.

Senior gastroenterologist

Scholars are often introduced to e-journals via search and retrieval of content. Here they gain their initial experiences interacting with e-journals and establish their first expectations of what an e-journal can do for them. Online searching emphasizes the article as container (or structure) of content.

When scholars search online for information, the journal structure—as a container that adds value to content—is less significant. Online searches tend to bypass the journal as container or significant boundary delineating a collection of ideas and content. Identification with the journal by name and association with the journal brand may be less apparent when scholars are searching online and scanning, reviewing, and evaluating content. The focus is on the article—its title, author, abstract, keywords, and other article descriptors. Interview respondents spoke of their searches as strategies to find article content and information related to specific topics, not necessarily from specific journals.

When asked how many journals he reads regularly, a third-year doctoral student stated that he does not “look” at journals, but rather that he searches journals for articles. He refers to “reading” or “looking at journals” as a document-retrieval process. He has a very online-oriented practice of research and searching. For him, the unit of analysis or relevant container is the “cluster of journals” provided by various publishers. The journal as the boundary that defines content is less relevant. Here the cluster and the article surface as the important containers of knowledge.

Interviewer: How many journals do you read regularly?

Respondent: I don't look at journals. What I do is ... use journal search engines. There are a number of compilations, like [Elsevier], and a number of larger publishers that have large compilations of journals that cover the fields I'm interested in.

I wish I could remember all the names. I kind of forget. They all have marketing names like Science Direct. They're compilations of life, science, or medical-type journals—a number of them. In these clusters, they tend to have 100-odd journals.
Public health doctoral student

A first-year doctoral student described how online journals lose relevance for her when she is searching on the Internet. She refers to the journal container as amorphous.

Online, I think of [the journal] more as a list of—a collection of articles—like a list of things, instead of a bound sort of sheaf of things.... I think of it now as something that comes out—it's a group thing. Like you have a little [collection] of articles that comes out each week, or each month, or whatever. But online, I can see that being really [amorphous]—it's just, here's an article, there's an article. Maybe a journal issue wouldn't be really the same kind of thing. But right now, I just see them [as] episodic—or not episodic, just as issues.

This student continued, comparing articles in journals to songs on records and to the use of Napster to search and download songs irrespective of the album title or container. You may lose opportunities by not being aware of other songs (or articles) in the collection, she noted, but this is a tradeoff with the ability to search rapidly and locate specific articles.

It is less clear how online reading and online publishing shift the predominance of the journal as a container of knowledge. Online reading is a diverse activity. It spans a range of modes (browsing, scanning, and studying) for which scholars have different value propositions. The journal's value as a container for reading has to do with how well it facilitates scanning, browsing, and intensive studying. This relates to scholars' idiosyncratic preferences and habits, which have been shaped through formative media experiences with paper journals and online publications. Enhancing online readability may increase the value of the e-journal as a container of content. (Enhancing online readability is discussed more fully on pages 26, 27 and 49.)

Online publishing is also a complex activity. It involves concerns for impact, exposure to target audiences, scope of dissemination, economic reward, and prestige. Journal impact derives from several mutually reinforcing factors, including quality (or reputation for quality) and exposure to the target audience. The importance of the journal as a value-added container for online publishing will likely be strongly connected to how publishers develop brand in the online environment and how new sources or forms of impact factors emerge online. As one scholar put it succinctly:

It's not how it's published, but what the impact on the field will be. We're chasing impact factors.

Senior neurobiologist

II. SCHOLARLY USAGE OF E-JOURNALS: IDIOSYNCRATIC AND CONTEXTUALLY BASED PRACTICES

To say there is a preferred method for using e-journals would be to ignore the diversity of scholarly work contexts and the nuances of scholarship. E-journal practices are like individual fingerprints—they are unique to individuals, representing a pattern of strategies and a personal signature. Scholars may share common objectives for using e-journals and may have access to the same tools and features, yet the way an individual combines e-journal features and uses them in the broader technological context forms a distinct practice reflecting specific preferences, abilities, and contexts.

No single pattern of usage predominates for e-journals.

Usage of e-journals is highly contextual, with strategies for using them dependent on many variable factors in the scholar's environment. Routines for using e-journals vary, for instance, depending upon information tasks and objectives. These routines also change over time and place. Some key drivers shaping e-journal usage and preferences for paper or electronic format include the following:

- *Scholarly goal:* Scholars pursue multiple goals using e-journals: writing a grant, finding a citation, browsing a peripheral subfield, becoming familiar with the work of a particular author, and so on.
- *Infrastructure:* Scholarly infrastructure includes institutional contracts and licenses with publishers and libraries; administrative support and personnel; and available computers, telecommunications technologies, and peripheral technologies such as printers, copiers, and scanners.
- *Time and place:* Scholars have different needs and make different choices depending on whether they are working during the day or after hours, at home, in the office, en route to a conference, at a café, and so on.
- *Professional characteristics:* Usage patterns vary according to a scholar's stage in career and experience base in the discipline; to other scholarly obligations such as teaching commitments, institutional obligations, and laboratory responsibilities; and to the relative volatility of the scholar's subfield. Scholars at the beginning of their careers have different information needs and capabilities, along with less familiarity

with the literature, than do older, more experienced scientists. The latter generally have a wider range of publishing and teaching responsibilities as well.

Scholarly activities provide context for gathering information and using e-journals.

Respondents described a range of scholarly activities that shape their information needs and the way they use e-journals. When writing grants, theses, articles, or textbook chapters or when preparing lectures, for instance, scholars need to summarize historical trajectories or general changes, or represent the current state of a particular field. This means retrieving, organizing, and citing a wide range of references, as well as searching specifically for well-known authors in the field. On the other end of the spectrum, a bench scientist might need information on a particular protocol or method and might then search back along a string of articles to try to locate the origins of the method.

Two respondents described how they approach scientific information in the form of journals, textbooks, and e-journals differently, depending on their activities.

Especially now, when you can get things online, it's easier to pull it up again than search through the pile of paper that you have. But it kind of relates to different information retrieval needs. Sometimes you very specifically know that you need paper X by so and so, published in the JBC [Journal of Biological Chemistry] last year. Other times, you're just looking for what have been the general changes in this area.

Senior gastroenterologist

A lot of what has been in the textbooks is somewhat old. And textbooks tend to come out once in ten years, whereas if there is a fine-tuned work ... published in some [e-] journal, you just go into that journal on the Net, you just print out the methods and material there, and follow that technique; it helps you improve.

Biological chemistry post-doctoral fellow

Convenience drives usage of e-journals ... and it is a relative term among scholars.

What is convenient for one scholar is not necessarily convenient for others. Convenience is determined by personal technology histories and habits, by time and place, infrastructure, and professional characteristics. With their own idiosyncratic approaches to both print journals and online information, and with their own configuration of professional strengths, histories, and needs, scholars patch together systems that work for them in their context. These individual systems may not appear to

be the most efficient, but they are effective for those who create them. A senior clinician prefers to leave his office and use an offline database for literature searches, rather than using MedLine (a search database of most major life science journals), for instance, even though the latter is available at his desk.

I know how to use the [offline] system. I know that if I put time and effort into something—if I choose to put time and effort into something—that it will give me an effective result. ... So my system works for me, and it's pretty efficient. I don't waste a lot of time.

Senior clinician

A post-doctoral fellow is simply “used to” his own search routine, even though he is aware of other options.

Interviewer: *But let's say you're in MedLine; you've got your list of citations, your list of titles. Then do you have links to the journals directly from the titles?*

Respondent: *Melvyl doesn't. There's also another search engine you could use; it's connected with NCBI, the National—it's a national database, and you can get links to journals with that. I don't know. I'm used to using Melvyl.*

Structural biology post-doctoral fellow

Along with personal history and understanding of technologies, scholars also talked about using whatever is free and easily available at their institutions. Scavenging from their environment, they put together the tools that work most effectively for them. If they can walk across the hall or down the hill to the library, or if their institution is invested in promoting a particular indexing or searching system, this is often what they use. A senior plant biologist described how institutional infrastructure framed his electronic search process and access to e-journals. The university subscribed to a particular search engine that was not yet fully implemented though it did have some hyperlinks directly to e-journals. Like many scholars, he had to move in and out of a variety of systems to access e-journals and their articles. Doing so made sense, he explained, because the system “was the only one we really have access to that I know of.”

Also [the university] has a couple of different subscription packages. I don't fully understand why it's organized this way, but it's clear that some of the journals are in different sites, available through different sites than others. I assume that's got something to do with economics of publishing. The journals must be packaged for sale to the university in a certain way.

So the list of the journals that I have access to actually continues to grow, and I'm continually discovering ... it's actually rather imperfect, all this stuff, the mechanisms for finding which ones we actually have a site license for and which ones we don't.

Senior plant biologist

Interviewees mentioned other factors determining convenience, such as the presence or absence of dedicated computer terminals, access to free printing and copying, library proximity and hours, family demands, and ability to shift some of the burden of work to an assistant. Senior clinicians and practitioners, professors, lab directors, and editors often rely on administrative staff to retrieve journals or specific articles located in library archives. Younger scholars do not have this option. When people work at home, on weekends, or later at night, the value and convenience of online access increases, because availability is 24/7 rather than limited to library hours. And institutional arrangements such as document delivery services preclude the need for some scholars to complete searches entirely on their own. One senior practitioner explained that he searches and identifies articles online using MedLine, but then uses a library service for retrieval and delivery, even though he could access the article from his computer. He believes this practice saves him time.

The idea of a tradeoff between paper and electronic formats is misleading; both are important tools for thinking and working.

As they look for what is most convenient and what makes sense given their particular needs and strengths, scholars don't see separate worlds of paper and electronic formats. They work in an integrated media context. Integration happens differently for different people, but informants were neither paperless nor exclusively paper bound. Evaluation of e-journals, then, should be conducted within an integrated media context that includes both hard copy and electronic text and resources.

In the following example, a professor of plant biology explained how paper journals support his browsing in knowledge areas that are related, but not central, to his field. When he concentrates on literature in his field, he switches to the electronic format, which is more efficient for him.

I think the usefulness of the paper journals for me is to inform me about things that are not directly related to what I do. For what is very close to my field, I'll read the electronic pub, and it's more than sufficient. But for my own experience, having only the electronic copy [in front of you] more or less discourages you from looking at things that are not directly in your field.

Plant biologist

Scholars craft multiple routines for using e-journals to support a range of information practices.

Scientific scholars develop a portfolio of routines and strategies for using e-journals to gather, manage, and make sense of biomedical journal literature. They get value out of e-journals by selecting and combining specific features and applying them to *specific information needs or tasks* that help them structure knowledge for a particular subfield, topic, or discipline. This is especially important for scholars using biomedical literature, where the volume of information is growing rapidly. Knowing the structure of knowledge, as described by this professor of biology, helps scholars locate information and develop it into applicable knowledge from which they can create their own contributions to scholarly fields.

I'll never forget the opening lecture in my math [class]. I was an honor math student, and [in] the opening lecture, the professor said, "You know, you poor children, it's hopeless; there's no hope. Mathematics is 300 years old; there's 10,000 pages published every year. You can never learn this, you know ... how are you ever going to make any progress here? So the only thing that you can really hope to do is to understand the structure of knowledge so that when you want something you can either re-create it or you can find it." In fact, that's been my mantra since then, in terms of how I deal with knowledge.

I know the structure of knowledge in my areas of interest. Of course, ultimately, that knowledge resides in some form in the library—not necessarily as knowledge, but it's information that I can translate into knowledge.

Senior plant biologist

Six major information practices emerged from our interviews with respondents, in which e-journals play an important role in helping scholars structure knowledge. These categories represent how the respondents break out the various kinds of information work they do every day. Scholars engage in these activities in no particular order, often simultaneously, and cycle back and forth among them.

- *Scholars monitor and review content regularly to keep current.*
- *Scholars conduct direct research for retrieval.*
- *Scholars study and read intensively to extract knowledge.*
- *Scholars circulate and exchange content to build peer networks.*

- *Scholars organize content to create context and relevance.*
- *Scholars document original content to establish ownership of ideas.*

E-journals provide value when they help scholars hone these information practices, structure knowledge, and achieve scholarly goals.

Scholars monitor and review content regularly to keep current.

Respondents acknowledged the rapidly expanding body of literature that they are responsible for tracking. To maintain a high standard of scholarly practice, scientists are expected to stay up-to-date with the current knowledge evolving in their field. Regular monitoring and review of the literature is an ongoing, critical activity. The goal of this information practice is to cover a broad knowledge domain (or domains) and to get exposure to new and emerging ideas, discoveries, and methods. Reading is less intensive and is done with the idea of covering a lot of material and looking for important descriptors and indicators of relevant content. Respondents referred to this practice as “keeping track,” “reading without a specific purpose,” “browsing,” “scanning the table of contents,” or “flipping pages.” Respondents use a mix of methods for this practice. They access content in both paper and electronic journals and review material in electronic and hard copy formats.

One scientist described his routine for browsing via electronic access and scanning, and actually reading hard copy, which can be conducted in a variety of locations. He regularly reads “about ten different journals,” both inside and outside of his field, including *Nature*, *Science*, and *Journal of Neuroscience*. Except for *Science*, he accesses these publications electronically, scans for “interesting” material, and prints out hard copy to read “in the office, at home ... I take it to the café on Saturday mornings when the family is still sleeping, on the plane when the computer has to be turned off.” When the hard copy of *Science* comes every week, he “browses it and throws it away.”

A postdoctoral researcher distinguishes between “picking up” paper journals and “looking through” them when he has time, in order to stay current, and searching to “stay up on” his particular topic or find a specific article.

On a regular basis, I look through Science, Nature of Structural Biology ... those are the ones I just look through. Other than that, I do it by searching on the [Melvyl] for my topics, things that I'm working on or interested in. ... Mostly, I pick them up when I have a little time, so I'm not necessarily at a computer to do that. If I want to make a copy of an article, I might go online instead of looking for a back issue. [Snaps fingers.] It's there. ... [Paper journal reading is] more to try to keep up with what's happening; so technically, I rely more on searches—library searches—to stay up on my topic.

Structural biology post-doctoral fellow

Electronic scanning is useful for the following professor of medicine, who teaches and runs a research lab. In addition to regular paper journal monitoring, she scans a few journals online to keep current.

Nature, Science, the cell physiology section of the American Journal of Physiology, Gastroenterology, Journal of Allergy and Clinical Immunology, Journal of Immunology, the FASEB Journal [published by the Federation of American Societies for Experimental Biology]. That may be about it for paper. And then I scan several of the sections of the American Journal of Physiology online. The Journal of Biological Chemistry I try and keep up with, but it's so massive that that tends to be more targeted. I mean, I could just spend my whole life looking at the table of contents.

Senior gastroenterologist

Both paper and electronic journals are important tools for browsing content related to core fields of research that are outside the scholar's area of specialty. A focus on developing ways for scholars to switch back and forth between paper and electronic formats might contribute to improving the overall ability of scholars to monitor and review content.

Scholars conduct direct research for retrieval.

Respondents made a sharp distinction between monitoring and reviewing content and researching directly to locate and retrieve specific content, even if they were using the same media for both activities. They referred to the latter practice as “real information retrieval” used “when ... trying to answer a question.” In this practice, the knowledge domain tends to narrow. The purpose of reading shifts from absorbing a wide range of ideas to critically evaluating specific content for retrieval. During directed research, scholars make hard choices about the value of content. They ask questions such as, Is this article worth studying, printing out, copying? Does it apply to my topic or particular scholarly activity at the moment? Is this what I was looking for? Will it work for what I

had in mind? Respondents identified four core objectives in their use of e-journals to support directed research (see Table 1).

*Table 1
Four Core Objectives of Directed Research*

Objectives	Why Scholars Use E-journals
Establish a base or starting point	To get into the literature from a base that provides options
Create paths and stay oriented	To flexibly navigate a growing body of literature
Assess content for use	To triage content and identify relevance using article descriptors and meta-data
Retrieve content for application	To have flexibility of format for retrieval based on scholarly goal

Source: Institute for the Future

Scholars experience the various features of e-journals, general search engines, and the Internet as they try to meet these objectives of directed research. In a sense, these objectives are important criteria for evaluating the success of e-journals and for determining the functionality that scholars are likely to value and adopt.

A clear sense of desired outcomes and results guides directed research. Online searching and the availability of online articles and journals support this activity very well. Searching online supports the following professor’s directed research—his “real professional activity,” for example. He has a specific information objective in mind and expects to get a result: articles to study.

The electronic [format] is so much more powerful. ... When I really need the journals, okay, all this scanning stuff is just for my curiosity about what's going on. It's actually not my real professional activity.

My real professional activity is when I need to know something or when I question; then the electronic journals are vastly more powerful. The ability to find the relative papers in a database search and then bring the papers up on my screen immediately without having to take a trip over to the library: that's huge.

Senior plant biologist

A post-doctoral researcher in neuroscience said he always has “authors and papers in mind” when he is searching. And a doctoral student described using keyword searches to focus on his particular topic area and to locate new articles. His objective here, as compared to a general browsing practice, is to end up with articles.

I will go online and screen, based on keywords. I want to know: “What articles are there now about genetic testing?” “What are people saying about genetic testing?” So it’s a way for me of just staying on top—and I have a number of different keyword searches. I know broadly what will capture topical information for me. Then, ideally, if we have a really good subscription, you can then PDF it and I’ve got the article in my hand. It’s a way for me to stay current on the issues that I think are relevant in my research.

Public health doctoral student

For some researchers, the key to a successful search is establishing a base from which to branch out to other sources, or *snowball*. Starting points are chosen depending on the purpose of the search, such as a topical search, an author search, or a search for a particular citation or discrete piece of information. A good starting point “starts to show you the light.” The following doctoral student starts with a good article or two that can be mined for ideas, citations, and linkages. This student explained how he typically starts with keyword searches, looking for titles to find a starting point.

[I start with] title abstracts. Usually just the title alone—that’s the other value of journals ... things tend to be titled fairly clearly. It isn’t pop media, where you’re wondering what the article is. So that’s helpful. But the point being, what’s different between looking at 50 and looking at 200? Obviously, as you start to narrow your net, you have a chance to lose things. It’s a very subtle thing to describe. How important is this information? How can I read and make a reasonably good effort at a starting point? Usually ... you’re just trying to get something, because if you get that something, you can snowball it. What did this something use to make that point? So it’s a sort of snowballing thing people often do. You just need to find an article or two that at least gets you into the literature. It starts to show you the light or how [you] can ... get into this issue.

Public health doctoral student

On the other hand, some scholars consider Web sites good starting points for directed research. This scholar compares the HighWire Press Web site and the *Journal of Biological Chemistry (JBC)* Web site, both good bases for beginning directed research.

I would go to the Journal Web site. I could go to the HighWire home page, where all the journals are listed that HighWire publishes—there are lots of them—and then there you can do a selected search of a subset of these journals for a topic. I don’t normally do that because of the way that HighWire is set up. If I search the JBC site, I can extend that search to other journals, again, from a menu; so I accomplish the same thing.

Senior biological chemist

Starting points help reveal the structure of the knowledge area being investigated. Web sites that present summaries of issues and reveal the range of issues related to a particular topic are helpful bases, as described by this epidemiology researcher.

This hasn't been as fruitful, but sometimes I've gotten information just by going to a search engine on the Web. Oh, I use ... [Medcrawl]. ... It searches from a bunch of different search engines, like Yahoo! and Lycos. So I might type something ... more general into the browser and see if there are any sites set up that kind of summarize the issues.

Epidemiology researcher

In addition to electronic sources, colleagues also make good starting points for creating a search base. A graduate student described the order in which she would use various sources to establish a starting base. "If I can't find anything," she commented, "I'll e-mail a professor." And a senior clinician in neurology mentioned that an important place for him to start is with other knowledgeable colleagues who are experts in a particular field. He calls these colleagues to get a few key references for particular articles or authors and then begins his search process.

During directed research, scholars create several paths through diverse search environments—journal Web sites, library Web sites, citation indexes, abstract databases, articles, and broader domains of the Internet. Hyperlinks from article to article, as in the HighWire system, help scholars create navigable paths and follow leads through a growing body of literature. A doctoral student explained how such a capability can help:

The other thing that is useful is sometimes ... the reference section for certain articles ... will have links to other articles. I'm not clear how that works. I think it's articles that are available in that database or things that have been licensed. So that actually can be another very helpful thing. Rather than having to go look for the next reference, I can link right to it. That's more where a thing like Lexus Nexus is valuable, because if you want the law or something, they actually do have all those links. You can launch to different things. So that actually can be a very good feature when it's available.

Public health doctoral student

This same student continued to identify other capabilities useful for creating paths, such as links from an article to more work by that author and the capacity to narrow a search so it includes only review articles.

Often they'll actually have a link for the author, so you can go to the author's other works ... or potentially you can. It depends. That's where the university system is really solid. The journal one, the information's probably out there; you're just not quite clear. Is this all their stuff? Is it only this stuff that's available through this publisher? But I'd say the typical thing is simply to be able to use the more advanced search

features as opposed to a simple search. For instance, maybe saying, “Show me only review articles.” Little clicks like that. So a good search engine and then obvious

linkages are helpful.

Public health doctoral student

Creating a backward path is another important element of directed research; one that e-journal searching facilitates relatively well. E-journal searching and retrieval loses its effectiveness, however, as backward searching leads to content archived only in paper. The depth of backward searches depends on particular subfields and on the intended purpose of the article. A scholar’s search for a methods article may be sufficiently addressed online; but classic articles that present the emergence and early development of a discovery may not be available online.

Orientation is another important aspect of creating paths. Scientists don’t want to get lost while they are doing their research. (This may be less important during a less focused browsing or review mode.) “I don’t want to be challenged by my search engine,” said one doctoral candidate, condemning search engines that take her on a path to nowhere, with no way to retrace her steps. The format of the e-journal page and the structure of the particular search engine are useful for helping scholars stay on a path—and not get lost. The graduate student who made the following point finds that keeping important information on one page helps her stay oriented. Another strategy she uses is to keep several windows open at once so she can retrace her steps backward.

Ease of use.... [It’s important that] most of the information you need fits on one screen.... Like with the Melvyl, the thing that I hate so much [is that] you can’t see all of your search terms if you get too many of them.

Sometimes I’m the big proponent of opening more and more windows, because I don’t like to lose what I originally had. It’s hard—you can’t really get a breadcrumb—they call those things breadcrumbs. It’s hard to do that because most of the articles have “See Related Articles.” And you click on that and you lose wherever the hell you were. So I usually open those and more windows.

Environmental health doctoral student

Directed research relies on careful screening and assessment of content. Several features and capabilities help scholars to assess articles and content: article titles, dates, abstracts, article ratings, searchability within the article itself, author or lab name and reputation, and technical features such as availability in full text (PDF or HTML format). A biological chemist talked about how she uses the abstract as an important screening tool for assessing the structure of an article, the value of evidence presented, and the

soundness of the argument in the paper. As she said, the abstract establishes the bottom line, from which a downloading decision can be made.

The thing is, the abstract really tells you what is the bottom line. And I really want to know what the bottom line is. It could be anything. But I think the bottom line really sets you up to read the paper. Because now you know, this is what they're going to try to prove. And then you can go into the details, go through. Are you convinced? Do you think there is enough evidence? Do they need more evidence? Then it gives you the judgment. So I almost always read the abstract.

Biological chemistry post-doctoral fellow

Being able to search the article itself is an important assessment tool for the following researcher. He prefers to browse the contents of the article in HTML before downloading the paper.

I look at the table of contents and if things look interesting, then I look at them in a little more detail. So there's one of the journals that I read regularly, Development, and I think it's a real deficiency that they only allow you to look at it in PDF format; they don't have an HTML format. I think it's a big plus to have the HTML format. You can first browse something before you decide to download it. With Development, you always have [to] download it to look at it.

Senior Researcher

Another biologist described how being able to view a few figures to assess quality and content helps establish the value of the article.

[I wouldn't read] the whole thing, but I normally look at the abstract and maybe a couple of figures. If it looks like it's something interesting to me, I would download the PDF file and then typically print that out.

Plant biologist

Retrieval is a critical objective of directed research. The ability to access and retrieve online 24/7 is a clear benefit for scholars, particularly when they are engaged in directed research that is outcome oriented.

Particularly when I'm writing a paper or writing a grant, being able to rapidly search the literature [and] download those articles is very important. ... [It takes me] nights and weekends. The library isn't open, but I can just access those papers, and they're right here. In fact, there's nothing worse than finding myself here on a Sunday morning working on a grant and saying, "Oh my God, I really need to see that paper."

Senior gastroenterologist

Retrieval outcomes vary. Sometimes the desired outcome is not a specific article for study. The following respondent, for example, downloads full titles and abstracts to put in his reference manager files to build his own knowledge structure. Retrieval remains an all-electronic activity for this scholar.

About once a week or so I do a keyword search for Arabidopsis (a plant used for genetic research) on PubMed. Anything I see that I think is interesting, that I would want to read either now or sometime in the future, I download.

Plant biologist

When material retrieval is for intensive reading of dense data or graphic-rich articles, this respondent prefers to retrieve in hard copy—either by printing or by going to the actual paper journal copy and seeing the graphics in professionally published form.

So there are journals like Nature, Science.... those are things that I would always read on the Net.

There are very few [journals for which] I actually go down, look at the hard copy of the journal. Those would be very data heavy, or pictorially they're harder to print out. Or they're just dense with material, and I need to really sit down, spend some time ... [if] it's a particular article that I would like again to go look at. ... Some journals have a weird format for their figures, for example, that makes printing harder. So the only way you can deal with these is, you actually go get a physical journal and look at them.

Biological chemistry post-doctoral fellow

In sum, directed research is a focused activity in which success is defined by effectively navigating the literature and retrieving particular types of content—full-text articles, citations, author names, data sets, or even abstracts. The ability to develop productive starting points from which many paths can be created is a source of value for scholars. Assessment tools—such as informative titles, abstracts, accessible tables or data, article descriptors, article ranking or rating systems, and other metadata—help scholars evaluate material as they navigate paths and decide how they will retrieve content. Scholars are likely to highly value and to increase adoption of e-journals with features that support these activities.

Scholars study and read intensively to extract knowledge.

Respondents also described a mode of reading that is distinct from browsing or scanning. Study reading, or intensive reading, helps in the thinking process, the creation of knowledge, and assimilation or integration of new knowledge into existing knowledge bases. Respondents described this reading mode as “really reading” or “trying to think about something.” Scholars described how they dissect articles, extract knowledge, and make sense of ideas in this mode. The following scientist spends a lot of time in her lab directing and conducting lab experiments. For her, intensive reading is a way to fit the insights from her bench work into a broader scientific context.

When you start doing experiments, you get so embroiled in them; it's really hard ... it's a production to take yourself out of that. ... You pull yourself [out] and really think about your work, read more, and really put it in context.

Biological chemistry post-doctoral fellow

Most respondents commented that they prefer to do intensive reading in hard copy format but that sometimes, out of necessity, they resort to intensive reading online. One reason for the apparent preference for hard copy reading over screen-based reading is that articles can be written on or annotated in hard copy. The following respondents discussed this desire and their hope that e-journals could address it.

If I'm going to read it, I want to be able to write on it. You can only make so many notes on your monitor.

Public health doctoral student

Hopefully it's going to be possible to come up with a format [so] that you can actually read an article online and make remarks directly on that manuscript online. Now you can mark up a manuscript (that is printed) out in the margins, so hopefully there will be [an] electronic format where you can actually make margin comments online. I don't know what form it would be. I'm sure clever computer scientists are going to figure out something.

Plant biologist

Other important qualities also make printed journal articles preferable for reading. For respondents in this study, readability was clearly linked to document mobility—the extent to which scholars could move around within and across articles. E-journals that address scholars' needs for *intra- and inter-document mobility* will enhance the online intensive reading experience.

Scholars value intra-document mobility, the ability to move around within documents at their leisure. They read different parts of an article at different moments and for different reasons—habits formed over years of practice. Flipping pages lets people refer back and forth to the parts they want, making quick comparisons.

The way I read articles is, first of all, I skim the article. Secondly, I usually go to the discussion at the end of the article about the results. I then go back and look. And I don't read articles in the way they're published. [This method of reading is] very difficult to do on a screen. It's much easier to just flip a page back and forth, particularly for going backward, but even for going forward.

Senior clinician

Scholars also value inter-document mobility, the ability to move between documents with ease. People need to compare across data and arguments. Whether the scholar is working from file folders or from stacks on the floor or spread out across the

desk, activities that demand wide-scale literature reviews require instant access to several entire documents at one time.

To the extent that publishers want to encourage readers to do more serious reading online, they may want to address these concerns, both by working to provide *paper convenience* in the electronic format and by encouraging scholars to learn to think differently, using electronic conveniences not found in paper. Some of the scholars we interviewed were thinking along these lines themselves. One biologist described a scenario wherein paper and electronic journals took advantage of scientists' reading practices, building on the strengths of each format.

And I actually think that could be a paradigm for electronic publishing. Eventually there [could] be two versions of each manuscript. ... I think in print there should be things [that] are just two or three pages long which are really accessible to everybody, [and] that have only the key points in there. The key panels from figures would be in there so that anybody remotely interested could actually read and understand it and then have electronically the bulk of the data for all the experts in the field. ... More and more journals are having at least some supplementary data on the Web, but I think that could really be expanded. It certainly would make the publishing process a lot more difficult if you said, Here are two versions of an article: here's something that will be in print, and here is the stuff that will be on the Net. I think that would be a good way to really enhance print publishing.

Plant biologist

Scholars circulate and exchange content to build peer networks.

E-journals provide many opportunities for scholars to increase information exchange among themselves. Whether for purely transactional purposes or to meet broader social goals, tools such as e-mail with URL or PDF attachments, lab Web sites, and distributed, flexible printing have given scholars a new basis for interacting around journal content. One respondent stated that the purpose of the journal is to bring authors and readers together. The e-journal, in its enriched Web context, offers a new forum for accomplishing this goal.

Circulation and sharing still occur in hard copy format, facilitated by both print and e-journals. As indicated by the following respondents, sharing articles within a lab supports that community.

If there's a paper that's [of] particular interest to me, I'll have my secretary xerox it, and then I pass it on to the rest of the lab.

Senior gastroenterologist

But if I find an article—and I do this all the time—if I find an article and I think, “Oh this would be interesting for Billy, Bobby, Janie, and Jill,” I just print out five copies. ... Hit a button, it collates it; [then I] staple it together [and] put it on a person’s desk.

Biological chemistry Ph.D.

Sharing papers is an important vehicle for establishing presence among peers in a particular field. The following third-year doctoral student explained his need to establish credibility in several fields addressed in his dissertation research. One way he accomplished this was to check in periodically with his network and collaborators via e-mail and mention important articles that they might find useful. The article thus became for him a vehicle for building a professional social network. He used both electronic and postal mail for this task.

I’d say something involving a few e-mails might develop twice every three weeks ... fairly regularly. If something hasn’t happened for a while, then [I’ll contact others and ask], “Have you seen this recently?” After a couple weeks, if I haven’t heard from people, I’ll just sort of send something out: “By the way, there’s this interesting article. I’ll put a copy in the mail.”

Public health doctoral student

Scholars organize content to create context and relevance.

Scholarly research does not end with retrieving content. Organizing and categorizing content are also significant information practices among the scholars interviewed in this study. These practices typically follow retrieval (and sometimes, intensive reading) and consume large amounts of time and thought. Respondents who did not describe the intricate systems they use to organize and make sense of their collected material told stories about how they should be more diligent in this area or about how they plan to organize their content in the future.

Respondents described idiosyncratic systems of cataloging, organizing, and filing collected content to create a broader context and help create meaning. In essence, scholars described the creation of personal mini-libraries. These take the form of piles of paper on office floors, e-libraries, paper filing systems, reference manager systems, or a combination of these systems. One scholar crafted an entirely electronic personal library, or knowledge structure, for his research. He combined the storage capacity of his laptop, keyword searches, and his EndNote reference manager to create a mini Web-based library on his own computer that he accesses and reads when he is on the plane or not connected.

I also use EndNote as a reference program, and I download always all the references from PubMet that have Arabidopsis [in them], so again, when I travel and I'm not connected to the Internet, anything that has Arabidopsis, at least I can read the abstract. Again, that's fifty megs or so, that file with six-thousand-some references in it.

I actually was playing around to set something up [that would] link in EndNote—you can directly link to PubMed from EndNote. ... [I've] almost figured how to do it, to directly launch PDF files that are on my laptop. So I can go directly from looking up a reference to reading it on my own computer. So basically it works like on the Internet, but I don't have to connect to the Internet.

Plant biologist

Some organizational systems in paper format are just as idiosyncratic and sophisticated as their electronic counterparts. This doctoral student described a personal filing system that uses author and subject indexing to facilitate reuse of articles and to create an overview of his own research knowledge base.

Respondent: What I try to do with all these articles is to catalog them in some way. ... It's an important part of what I'm doing. They don't just end up in the pile. I do try to catalog them systematically in a way that I can then draw on in the future to cite for my research.

Interviewer: Is that catalog in paper form or electronically?

Respondent: Paper for the most part. I actually have an author index, so the cover sheet would go into a three-ring binder alphabetically by author, and then a subject index. The author thing is great, because if you see something by an author and you don't already have it, you can quickly look it up. So the point is, I go into these subject files. They can be there for a variety of reasons, one reason being, here's another article that talks about this toxic chemical and genetic testing in the workplace. Just for the purposes of the academic exercises, it's important to have all these things cited ... not using them directly, but by way of ... informing a sort of research enterprise. Here's a thoughtful review of the literature. So ... those are nice to have.

Then there's the other-level thing, which is, "Wow, this is really interesting," and "This person is saying something fairly different." I want to unpack what they're saying. I really want to read this hard. This data is really interesting. I want to stare at this data; maybe they mean something different than what the author thinks. This is interesting data, or this is an interesting thought. So a successful search might be, I found a gold nugget here; I can make something of it.

Public health doctoral student

Cataloging and organizing content is an important activity for respondents because it helps them to place retrieved content into a larger context for scholarly analysis and reflection. Organizing material along the criteria of personal libraries helps scholars draw connections among disparate pieces of scholarly work. Organizing systems

helps them to build their own knowledge structures and to develop original ideas that could be contributed to the larger scholarly community.

Scholars document original content to establish ownership of ideas.

Respondents identified a final practice of scholarly work as documentation of original content. They described documentation, particularly through formal publishing methods, as a way for scholars to contribute original ideas and discoveries to the evolving structure of knowledge in a particular field and to receive credit for that contribution. Receiving public acknowledgment as the owner of an idea, as one scholar put it, is an important motivator for documentation. E-journals facilitate documentation in two ways: by seamlessly linking the searching and writing processes and by speeding up the time between submission and formal publication of an article.

Writing often cycles scholars back to the search process—either to fill a research hole, to retrieve a missing citation, or to locate some specific piece of information to complete a document. E-journal usage can facilitate this activity and thus speed up the writing process.

[Recently] I was trying to write a paper ... and a lot of times ... I needed to cite, to put into context the work, or the information that was already available. ... So you would refer to someone. So now of course you would need to go back and really read that piece and figure out the details. And to do that, you would again use the Web. ... So when you get to PubMed, then you describe the name of the author, or you can type the name of a specific issue that you're asking about. And that will bring up all the articles related to the author, or from the author's lab.

Biological chemistry post-doctoral fellow

This capability can be particularly useful for writing review articles, as the following scientist indicated. Using e-journals allows him to cover sections of knowledge quickly (in this case, the literature related to a specific gene) and to gather key articles to cite in his review article.

While I was writing this review article ... a review of the current status of the field ... there was a whole section of the review on a very small section of the field, and I wanted to get all of the published articles that related to that. So I got on the Internet at work [and] went to, where you can search for keywords. And I searched for a keyword that happened to be a gene name, a gene that was involved in the process I was talking about. And I searched for that gene name and up came maybe 20 to 30

articles, most of which I knew by heart, some of which I'd forgotten about—or forgotten that they were individual articles. But I still remembered what the point of the article was. And for the ones I needed to reread, I linked to the e-journal Web site, if [they were] current—that was maybe four out of the 20 or 30. The other 20 or 30 I had paper copies of that we had xeroxed a long time ago.

Biological chemistry Ph.D.

E-journals help to streamline the writing process in another way as well—in the scholar's ability to integrate articles with reference manager software such as EndNote. Scholars reported the management of references as busy work that often took too much time, especially when different journals require different reference formats. The following scholar praised the benefits of EndNote software for managing and formatting references.

It's an absolute boon. Writing references is a nightmare, especially formatted for different journals. Everybody has a completely different format. So you need to have this. It's such a savior, because you can just download the information from the Web, create your own little library, and then reformat it to the journal that you were interested in sending it to.

Biological chemistry post-doctoral fellow

The combination of e-journal flexibility and reference manager software creates a value-added set of features that support documentation.

Finally, e-journals help to shorten the perceived time lag between submission and publication. For some scholars, time lag seems to be a significant barrier to achieving their scholarly publication goals. For others, it is more an annoyance than a perceived obstacle to quick dissemination of their original research. Many practitioners, clinicians, and nonacademic researchers, such as government practitioners, do not follow aggressive publishing schedules, and some may not even have publishing requirements, though publishing may be encouraged. For scholars in competitive or relatively volatile fields, however, documenting an original contribution is a way to “own the idea” and establish presence in the literature and the scholarly community.

The time gap between the submission and the publication of the paper is, I think, very important. And that could be cut down. ... Some journals are notoriously bad. Some are excellent. ... It could take you anywhere between eight and 14 weeks before you hear anything. And once you hear, it's two months before it gets into a journal. It's accepted for publication. And assuming the whole process is really smooth, to and fro. Then there's a lag time of another month, I think, even after you get the preprints.

So [for] the labs that are in the forefront, really trying to beat competition, this is a huge time lapse. And this can be seriously cut down ... I think ... maybe by having them publish on the [Internet], or just eliminating hard copies. A printer doesn't have

to make mistakes, and it doesn't have to be bound in a particular issue, and stuff like that. Definitely, with some of these journals, it is an issue: the gap between [submission and] publishing.... It would be nice if they could be published sooner.

Biological chemistry post-doctoral fellow

Speed of publishing and dissemination also concerns scholars as readers. Earlier access to article titles and content helps scholars reassess their own work and shape its direction. Interviewees suggested the importance of being able to foresee and actually preview content about to be published. Early listings of future articles (in the form of tables of contents, abstracts, and so on) help to provide a sense of the new contributions to a particular field. Early versions of entire articles provide even greater insight into the thinking and contributions of other scholars and labs.

One possible mechanism to facilitate a more rapid dissemination of content, suggested by a respondent, was a system of lab-based alerts within an institution and beyond, between “friendly labs.”

If I were, say, interested in the work of A, B, C, and D labs, and if I could somehow have a notification when a paper was being published from those labs ... that would be better than having to sit down and search for it.

Biological chemistry post-doctoral fellow

Such alerts would increase the pace of information flow among scholars who agree to participate. Often, scholars know exactly which labs they want to track.

Despite comments about the abundance of knowledge and the difficulty of managing it, respondents value the ability to have advance notice concerning the direction their research area is taking and to disseminate their original contributions quickly. E-journals were perceived to be helpful in facilitating the writing process and, potentially, in increasing the pace of dissemination, both formal and informal. This suggests a new role for e-journals in bridging the relationship between informal and formal dissemination of scholarly work.

E-journals provide a bridge between publicizing and publishing scholarly work.

Journals are tools for facilitating and representing scientific practices. They are important for making scientific results available to others, within a wide spectrum of publicizing and publication practices. Scientists publicize their work in person, in print, and, increasingly, in virtual formats—from informal networks to journal clubs, from database postings to conference presentations to peer-reviewed publication. E-journals

provide scholars with a new range of opportunities for publicizing and publishing, offering new alternatives to open up the research and publication process. Respondents described a range of activities that help them publicize their work (see Table 2).

Table 2
A Continuum of Publicizing and Publishing Activities

◀ Publicizing Publication ▶		
Conferences	Online seminar proceeding	Traditional journal articles (both paper copies and their electronic versions).
Institutional seminars/talks association meetings		Conference proceedings
Lab meetings journal clubs	Lab Web sites for protocols, techniques, papers, lab-based alerts.	
Informal networks	E-mail and other correspondence. Databases for genetic sequences, structures, etc., that include data and unpublished information about the data.	
Teaching	Online course materials and lectures	Textbooks

Source: Institute for the Future

As they tap into the flexibility of online information dissemination and retrieval, Internet technologies such as e-mail, and the computational power of the computer, e-journals enable closer links with a wider variety of publicizing practices than do their print counterparts. In many ways, e-journals shrink the gap between publicizing and publishing, bringing informal and supplementary information into closer proximity with formal, peer-reviewed material. This offers unprecedented opportunities for creative cross-referencing of domains of information but also creates new tensions between published and unpublished material; between *gray literature* and peer-reviewed literature; between formal and informal material.

Two respondents described experiences with online information that highlight these tensions. In the first example, an author had presented certain data as supplemental

material, which the respondent felt created some misunderstandings of the main article and led to referencing discrepancies.

Actually, they [the authors] put some things in the supplementary material they didn't put in the article. I thought it wasn't an appropriate use of the material ... because it felt like they tried to say more in the supplementary material than they actually said in the article. ... [Then] they thought that we didn't reference enough what they had put in their supplementary material ... that was supposedly equivalent to the published material.

Structural biology post-doctoral fellow

The second example has to do with public gene databases, which provide a forum for presenting information about genes (such as their function, name, and other descriptive information) prior to publication. The respondent felt that this was a powerful source of content that could influence the direction of research.

You're allowed to submit a gene name ahead of publication. You can say, "There's a gene that is unidentified." And you can submit it and say, "We've figured out a function for this gene, and we're naming it gene blah blah blah." But that's unpublished.

But it's made public through this database. And we've actually not really been completely misled, but have been somewhat misled by information that we've gotten through that source where there is a gene that we worked on, and someone said, "Oh, there's this other gene which affects its function." And we're thinking, "Wow, that's great. We've been looking for the gene that affects its function for years and years and years, and now these people have found it."

But we didn't have access to the actual data. It was just like, "Here's our result in words." So if we had access to the actual data in the form of a peer-reviewed journal article, we wouldn't have assumed what we did. So it wasn't deliberately misleading, but we were misled. And not horribly, but just a little bit.

Biological chemistry Ph.D.

E-journals and their broader technological context create a dynamic middle zone between publicizing and formal publishing. They can provide new tools, forums, and forms of dissemination with the potential to significantly shape scholarly communications and publishing practices in the future. Scholars in two roles seem to value this middle ground:

1. Readers and researchers who want early leads in their research through access to more kinds of content
2. Authors who want feedback and direction on their original work

E-journal features get blurred with the features of the broader search-and-retrieval environment.

Scholars often did not distinguish during interviews between the features of an e-journal, those of a search engine, and those of a cluster of journals such as HighWire Press. E-journals appear as constellations of networked information in a larger informational galaxy. Some respondents had no clear sense of what e-journal features might be, beyond simple existence as accessible information. While scholars value the increased ability to manipulate, retrieve, and link information provided by e-journals, these services are also associated with electronic search engines. As a result, search engine features often blend seamlessly into journal Web site features.

Another reason e-journal features get buried within the broader search environment and process is that the increase in creative, archival, journal-to-journal cross-referencing makes scientific articles powerful search tools themselves, means as well as ends. One scholar described the way articles work as search tools.

It's easy to go backwards ... checking the references in the most current thing you can get to find out what you're really interested in. Oftentimes it'll be a method, and methods are seldom republished; they're always by citation; so you'll find that in a current paper, a method will have been used, but they cite an earlier paper. You go sometimes to the earlier paper and find out they cited an earlier paper, too, and you've got to track it back; and sometimes that can lead you ... back fairly far in years.

Senior biological chemist

While print journals conventionally have been used this way as well, the electronic medium radically reduces the energy barrier to this kind of citation mining. Scientists who access e-journals during a search process take advantage of e-journal features, such as citation hypertext links, to *burrow* down and out across the literature—and they do so without necessarily separating e-journals conceptually from the same kinds of linking and cross-referencing features offered by search engines.

While respondents may not have had a clear sense of which features belong to e-journals and which to search engines, however, they did describe a range of valuable

characteristics that take advantage of the e-journal format. We identify here some of the attributes that scholars value.

Features that are “seeing-eye dogs,” helping scholars follow knowledge paths: hypertext links from search engines to journal articles, hypertext links between journals, links to authors

Features that help rank or rate information: sorting functions, search engine functions, customized alerts

Features that allow scholars access to information outside of the conventional publication cycle: preprint articles, articles in print

Features that allow scholars to evaluate information online as quickly as possible: Web site availability of both HTML and PDF files, abstracts, good article descriptors

Features that allow scholars to preview the knowledge horizon: alerts, tables of contents

Features that help scientists place their work in larger contexts: citation indexes, forward referencing features, customized alerts, lab-based alerts that provide early warnings of research about to be published by other labs.

III. IMPACTS OF E-JOURNALS ON SCIENTIFIC SCHOLARLY PRACTICE: A NEW RELATIONSHIP TO INFORMATION, KNOWLEDGE, AND PEERS

The impacts of e-journals on scholarly practice extend beyond the increased ease they provide in gathering and managing information. The consequences of more powerful searches and better access to a wider and more diverse resource base go well beyond the scholar's ability to leverage time and work more efficiently. Respondent discussions identified both efficiency and scholarly impacts from continued adoption and usage of e-journals. Interviewees shared an assumption that e-journals, in some evolved format, would be widespread in the next five to ten years. While not all believed that e-journals would replace paper products, the vision of the medium as important in the future of scholarly communications and publication was clear. Respondents believed that new information and communications practices would affect how scientists communicate and share their work and perhaps ultimately would affect the nature of that work. As one neuroscientist put it, "People would have to do better science."

E-journals improve the efficiency of scientific scholarship.

Electronic search engines and online access to abstracts and full-text articles clearly speed up the process of searching and retrieving relevant scholarly content. Respondents described the various ways which online searching, browsing, scanning, retrieval, and even submission of articles save them time and make them more productive in their work. Not only do e-journal access and searching speed up the process, they provide access to more articles and content than traditional methods within a single session.

One doctoral student succinctly described this benefit as the ability to work in "real time" and exhaust all resources at the moment. E-journals and search engines allow him to maximize his resources, he said, greatly improving his efficiency at any single research session.

The first-order thing would be PDF available, click here. Because [in] some journals, you can get that. ... Again, I can get it through some other source, but that takes time. If I want to work in real time and get that information now, and keep moving—I want to exhaust my resources at this moment in time, so I've done everything I can on this topic. So a PDF [file] obviously is going to be a huge draw, because then I can look and immediately have something to work with.

These benefits are valuable, given that scholars' work involves more than just searching, retrieving, reading, writing, and publishing. Scholars' many other obligations include doing administrative work, participating in academic and professional committees and associations, teaching, and directing or participating in laboratories. When respondents were asked what activity they wished they had more time for, not one of them mentioned searching. Searching is something they want to be efficient, requiring minimal time. The more efficient their search time is, the more time they have for other important activities such as reading, reflecting, teaching, conducting research and lab work, and interacting with students and other peers. Clearly, scholars benefit from the time saved by more efficient searching, quicker submission to publishers, ease of scanning, and so on.

E-journals facilitate new forms of scholarly practice through new relationships to information, knowledge, and peers.

Increased efficiencies can bring about consequences and possibilities for new scholarly practices. While e-journals today may not encourage in-depth online study, they present scientists with a host of new possibilities—many in their infancy—for reading, thinking, and especially publishing. They place scholars in new relationships to information and to their peers, which have the potential to change the nature of scholarly practice. Not surprisingly, perhaps, some of the core values of scientific scholarship can be found embedded in these new relationships.

Scholars described how e-journals can expose users to different kinds of articles, in fields that the scholars may not have accessed before, thus increasing their vision of the edges of their discipline. They also explained how science could become more open as different types of information are presented in new formats and new arenas, thereby becoming accessible to more people. New interpretations could stimulate new debates and new paths of inquiry, furthering the scientific process. A plant biologist speculated about the possibility of being able to publish all results, for example, including negative results, not just “best results.” This would lead to new discussion, interpretations, and possible discoveries. It would also help other scholars avoid repeating similar mistakes.

I think there are real opportunities. For example, these days, when something gets published, it says—[and] I'm not saying my lab is any different—it says, “This is a

typical result”—which means, “This is the nicest and best result we ever got.” With electronic storage space being so cheap, you could basically publish all your data that go with a manuscript. So you could put everything online, which would really be quite different.

Plant biologist

Respondents’ comments about the scholarly impacts of e-journals reflected their implicit shared values regarding transparency, accuracy, scientific validity, contribution to scientific progress, and nonduplication of scholarship. It is important that research not be needlessly reproduced, that experiences be shared to the benefit of the scholarly community, and that results be made available as quickly as possible to those who might need them on a practical basis. Respondents believe that the new forms of access and connectivity available in the e-journal environment could enable scholars to meet these more profound scientific goals.

E-journals increase peripheral vision.

Respondents often described a tension between searches for core content in sources they knew would be fruitful, and ventures away from customary sources for content that might or might not provide valuable information. They wanted focused searches that provided articles relevant to their core interests, yet they didn’t want to miss opportunities to find insightful content lurking at the edges of their research domain. E-journals can facilitate both deep, narrow searches of core content areas and broad searches that cover the periphery of subfields and distinct disciplines. In a sense, e-journals can act as a microscope and a telescope for scholars.

This respondent described a situation in which e-journals allowed him to search with a focus, but in broader, more tangential areas. He described his efforts as casting a wider net, yet finding a few fish that were relevant, rather than an abundance of material that was not relevant.

If you’ve done the broad searches over time, and now you’re only looking at the last three months, it allows you to do very generalized searching, because you’re only looking at three months’ worth of stuff. So what it actually enables you to do is—if you weeded out all the good specific stuff and you’re only looking at the stuff since the last time you searched—your cumulative time is giving you a return now, because now you can start really being sloppy with what you’re doing. But it doesn’t matter, because the tool has a memory. The tool allows you to filter things down to a different level of utility. If you narrow it down to a small enough point in time, you can be

very general.

It allows you to be less targeted, but that's okay. I'm reading the last ten years on this topic, and before, if it was too general, you just wouldn't have time to ingest it all. But now I'm better able to capture stuff I might have not captured before because I had to be a little more efficient about it. So I may pick up something in a business journal that wouldn't have [crept] in before. So it gives you a broader net, and your net doesn't get too full of fish.

Public health doctoral student

E-journals help scholars develop more effective vision at the borders of specific content areas without creating too much work. Increasing awareness at the periphery increases ability to make connections to other fields and helps place research in a broader context.

I acquire a lot more information these days. But since the barrier has come down, it's really easy to access [information] online. Many of the articles I look at, I would not have looked at in the old days, because the effort to get them would have seemed so much higher than the chance there actually would be something meaningful. So now I'm much more likely to look at things that are really peripheral, because very little energy is required to actually track them down. So I think in terms of scholarliness, it really is a big advantage to have this access, because I think you're much more likely to look at peripheral things.

Having access to the electronic version allows you [to] read more widely, but it's reading more widely for a purpose. So if you're working on a specific problem, and you do a literature search and come across something that looks peripheral to your research, you're encouraged by the electronic medium to look at [it]. You wouldn't do that in the paper medium. But at a much earlier or basic step, in terms of day-to-day reading, I still think paper copy really encourages [you] to read things that are out of your field.

Plant biologist

A more effective awareness of the edges of content areas may encourage scholars to be willing to take searching and reading risks. The availability of e-journals, in combination with print editions, encouraged the scholar above to follow leads that directed him away from core content, for instance, but didn't cost him too much time or effort. He was able to "read more widely with a purpose" and improve his scholarship by looking for information peripheral to his area of interest, but meaningful, rather than accepting only material associated directly with his domain.

E-journals facilitate participation in a greater flow of information and scholarly communications.

In addition to making search and retrieval of information easier, e-journals simplify dissemination of that information. Many informants felt they had increased the amount of information they pass on to others: using e-mail to send URLs, PDF files, and cut-and-pasted abstracts; handing out reprinted downloaded PDFs; and so on. Greater ability to disseminate information informally among peers creates a new way for scholars to be in relationship with each other and their information. As mentioned earlier, scholars use articles as a basis to create interactions among themselves—among lab members, remote collaborators, or colleagues. One graduate student mentioned scanning in his own publications, which weren't available online, so that he could send them to people who requested them. This capability is significant in that it allows scholars themselves to control and direct how their work is publicized through new forms and forums.

E-journals provide new ways for presenting scientific results that contribute to new thinking processes.

Scholars mentioned the emergence of new publishing formats (such as film) and of larger data sets that could conceivably change the way scientists think about scientific problems and questions.

Up until now, there hasn't been a format for large data sets that really support the conclusions, and so editors have been obliged to accept papers without the supporting data sets. But now, because it's possible to store the data, the standard is changing, so [in] the journals I'm associated with, you just can't publish things without this underlying data set.

Senior plant biologist

The electronic format facilitates the evaluation and circulation of much more detailed data. Not constrained by the physical limitations of print journals, e-journals are theoretically unlimited in the color and complexity of graphs they can contain, or the amount of data that can be attached or linked to an article.

Scientists commented on how decisions about where to publish shape the structure of an article, its length, and the presentation of data. To some extent, scholars shape the results of their research to fit different publishing criteria. Not only are

computer-generated simulations and models (increasingly common) new ways of presenting the same information; they are in themselves new forms of evidence. Will emerging opportunities for expressing data shape the way experiments are designed in the future? “I think [they’re] allowing us to plan more global experiments, more logical experiments ... more completed experiments,” said a biological chemistry post-doctoral fellow.

Some kinds of pictorial information or formatting, for example, are difficult to print on conventional printers. E-journals offer a better representation of these images.

Some of the figures have a lot of detail in them and are scanned in or are photographed at very high resolution, and you almost never can print them at a high enough resolution to see everything. So in that case, seeing [the figure] on computer is better because the resolution on the screen is better.

Biological chemistry Ph.D.

The electronic format also encourages new kinds of publishing ventures that complement traditional databases. A senior plant biologist, for example, was working on an updated version of a book hypertext-linked to a major database. The print version of the book was “obsolete as soon as it hit the shelf,” was limited in terms of color plates and amount of data, and was tremendously expensive. The electronic medium, on the other hand, allows this scholar and his colleagues to keep text current: “There’s no upper limit on the amount of data that’s associated with it, and it is available for free.”

E-journals make data more visible and increase evaluation and scrutiny.

For the reader, increased access to evidence promotes scientific transparency, visibility, and accountability. E-journals, with the capability to link to more complete data sets and additional information, potentially could increase the level of scrutiny of scientific results and interpretations. Ultimately, as one scholar told us, people will have to do better science.

It makes science more open and open to a lot of different interpretations. And that’s very valuable. ... So I would make one argument based on a [set of] data. But somebody else can come to a completely different conclusion, which may be totally valuable to deciding how this is going to progress. ... I think it’s going to come to a point where you’re going to be able to access anybody’s notebooks on the Net.

With this kind of access to other people's data, the locus of evaluation may shift toward the individual scholar. When data is less visible, the journal plays a paramount role in the evaluation and verification process. The need for editorial validation could conceivably decrease, as scientists are increasingly able to dig deeper into specific data and results. At the same time, the unevenness of newly visible data is already a source of some tension. Respondents mentioned the difficulty of knowing exactly when and how different kinds of data should be made available.

E-journals create new knowledge boundaries and domains of equivalency.

When scientific journals become digital information on the Internet, they are, in effect, entering a new informational domain. As singular articles or whole journal editions, they are no longer contained within the walls of the science library, the medical library, the lab, or a specific society. The Internet fosters a kind of equivalency of access to a much wider range of materials than one would find within those traditional walls, resulting in what one senior journal editor described as “a much more active non-peer-reviewed gray literature.”

E-journals exist in an environment in which it is now possible to make channels between different domains of scientific literatures—peer reviewed and not reviewed, conference proceedings and lab Web sites, databases and journal articles, and so on. Scientists have traditionally relied upon the peer-review process as a crucial way of forming boundaries around valid and invalid research results, good science and bad science. Peer review flags content. A senior scientist who does not read journals online described some of his worries about the medium.

I come from an archival mentality; put things on paper and [they are] archived in the library and they are available years later. If you think of [it], the whole academic process depends on archival publication, and there's a whole business of how universities manage themselves with questions of tenure and promotion. The value they placed on referees and references. The stuff going on, on [the] Internet, is rather unregulated, to say the least.

Senior neuroscientist

The following senior biochemist talked about some of the questions that scientists now face.

The problem most people have with it—there's no real quality control, no vetting process. When you read a journal, you at least have the confidence that someone has looked at this critically, and it's credible. It may not be right (it is most of the time, but not always), but at least it's had a credible review.

[With] pre-print servers, there's no such control. And God knows what gets published. You don't know whether to believe it or not. It's like reading a newspaper article, right? Who knows whether it's true? So, I think there's been a lot of resistance to doing it.

Senior biological chemist

Another senior scientist expressed similar concerns, with the hope that they would be resolved.

Respondent: How [we are] going to do the same rigorous review process with electronic publishing takes some thought.

Interviewer: Does that worry you?

Respondent: Well, I haven't figured out how. I haven't given it some thought to think of how that could or should be done. But I think if you could do that, personally, all my reservations about that process as a major venue for scientific work ... vanish. ... You'd need some way to even control it without hackers getting into it, and that could be a tricky process.

Senior neuroscientist

At the same time, the existence of the Los Alamos “e-print archive” server (www.lanl.gov) used by certain physicists suggests that some scholars welcome the challenge brought by the electronic, Web-based platform to peer review-bound knowledge environments.

As electronic peer-reviewed material competes with an increasingly active zone of other kinds of online and/or digital information, the development of boundaries becomes a key issue among scholars for navigation, evaluation, and access to content. New kinds of boundaries, as well as editorial voices, will likely emerge to distinguish between the different kinds of content. Some of these boundaries may be formally established by professional societies, while others may originate from scholars, labs, and

other peer groups that have Web capability to make their own links among distinct articles and content.

E-journals create new kinds of work in scholarly practice.

While e-journals may have the potential to open up science and empower scholarly researchers to communicate and disseminate their knowledge in new ways, they also create new kinds of work for these scholars. Increasing transparency, for example, creates increased accountability and broader scrutiny by the scholarly community. Greater information online along the publicize/publish spectrum also requires scholars to do more of the peer review and evaluation themselves. As more content is co-mingled under various forms of review and professional evaluation, scholars will need to spend more time accessing *and* assessing.

Larger numbers of articles will require that scholars use more sophisticated search engines and more sophisticated searching practices. “The literature is bursting,” commented one postdoctoral biochemist. Even if search tools improve scholars’ capacity to narrow down fields and filter more sensitively, decisions will still have to be made about downloading, saving, and reading—and about ultimate relevance to scientific objectives. Better search engines won’t do all the work. An editor and professor of biology lamented the abundance of citations that current search engines produce.

I'd sift through the way-too-many citations that I got back to see if I could find a better one, the pertinent ones, or somehow redefine the search.

Senior biological chemist

Scholars also will have more choices about how and where to get access to scholarly content. The complexity of decisions regarding where to start and how to establish a search base may increase the work of searching. An elusive and illusory desire to “get it all” may exacerbate this. As some informants mentioned, e-journals and electronic searching may sometimes create a false sense of completeness. Searching online is so efficient that it raises the stakes for covering all the bases when preparing and supporting an argument in an article.

More work is created for scholars in other tangible ways as well: online searching and downloading from e-journals (and other online sources of content) increase the need

for paper and print management. With more articles available online in full text, printing loads and the number of hard copy articles may increase, requiring more management.

Finally, respondents commented on the additional work they must undertake to submit articles online. They described the hassles of formatting for multiple journals, preparing citations in distinct formats, and making sure that data standards were compatible across computer systems. Online circulation and sharing of information seems to have a downside as well. Alerts, advance notices, and e-mails from colleagues or labs with URLs and PDF files attached fill e-mail boxes and increase the amount of e-mail screening and management.

For example, Scripps Research Institute now has gone away from sending out its weekly seminar list [by mail] to sending it out as a PDF. But it's this huge file. And the way that my e-mail is configured, I can delete the e-mail, but then I have to go in and find the attachment and delete it separately. So purging my attachment folder is something that is a real pain.

Senior gastroenterologist

Whereas e-journal use streamlines many information tasks and processes involved in scholarly work, it also creates new kinds of work that scholars need to manage.

IV. INSIGHTS ON E-JOURNAL ADOPTION AND IMPLICATIONS FOR THE FUTURE

Much discussion revolves around the promises of the e-journal as a form of scholarly communications and publication and around its impact on scholarly publication. Most of this discussion, however, focuses on the impacts the e-journal may have on current journal business models and on economic frameworks for establishing access to online and print content. Studies on usage are limited and tend to focus on quantitative assessments of e-journal article downloading and citations. Little research has focused on qualitative assessments of the meaning and potential value of e-journals as part of a larger scholarly communications toolkit—the why and how of e-journal usage by scholars. This study is intended to contribute to the discussion of why scholars use e-journals, how they use them, and what kinds of role e-journals play in overall scholarly practice. The hope is that the study will provide a richer context within which quantitative study results can be interpreted. Together, qualitative and quantitative results may provide a better picture of the distinct value that e-journals offer, and may be of use to publishers and others currently designing and developing e-journals.

Following are several insights about the adoption and usage of e-journals by scholars using biomedical literature and about possible implications for the future of e-journals.

E-journals are part of a cluster of innovations and technologies that can be leveraged to create value for scholars.

This research pointed out that e-journals are linked to other technologies and capabilities such as printers, photocopiers, organizational software for referencing and citation management, multimedia software and products, database software, and Internet features and functionality. New sources of value may be created if the e-journal can leverage these other technologies that are a part of the scholar's technical infrastructure and communications toolkit. Printing, for example, is an important activity critical for study reading, organizing, and cataloging. The development of new printing formats and flexible printing processes linked to journal access may help scholars with the work of printing and paper management. Similarly, new e-journal design and functionality—with attention given to how scholars use multimedia software, organizational software, and database software—may provide opportunities for scholars to link seamlessly between these systems.

Scholars work in an integrated media environment, with synergies between paper and electronic journals.

Scholars search, read, and publish in an integrated paper and electronic world. Respondents in this study suggested that paper and electronic content would fill distinct niches in the scholars' broader media ecology and that synergies between paper and electronic journals are likely to provide the most value for scientific scholars. Paper and electronic resources may take on new roles as e-journal features and capabilities emerge. A possibly fruitful area for exploration is how paper and electronic journals can work together, leveraging the distinct qualities and strengths of each. This kind of synergistic approach to the development of the journal as a container of information could create a more coherent and seamless knowledge environment for scholars. An assumption by publishers, libraries, and other information service providers that the e-journal will replace the print form may limit opportunities for scholars to take advantage of an integrated and value-added media environment.

Scholars obtain more value from e-journals when the journals support a wide range of information practices.

E-journals support a wide variety of scholarly activities and specific information practices. Adoption and usage of e-journals may increase if publishers and other providers of e-journals focus design and development efforts toward supporting a range of idiosyncratic information practices such as content monitoring, directed research, study-reading, circulation and sharing, content organization, and documentation. Features designed to support these practices are likely to provide scholars with the flexibility necessary to craft personal information practices that match their context and scholarly goals. Understanding the specific objectives of these information practices, such as the four described in this study related to directed research (establishing a base, creating paths, assessing content, and retrieving for use; see page 20) may provide a framework for identifying and developing new features and capabilities of e-journals.

E-journals offer different types of value for searching, reading, and publishing.

Respondents suggested that they evaluate e-journals differently depending on whether they are searching, reading, or publishing in a journal. Each activity has distinct value criteria and serves different scholarly goals. Respondents also suggested that searching is currently the most common form of e-journal use. Research that focuses

exclusively on searching may be overlooking important contributions and sources of value that e-journals can offer for scholars in their reading and publishing activities, however. Enhancing the readability of journals' content online, especially for study reading, may contribute to their value and flexibility. In particular, scholars identified inter- and intradocument mobility as important aspects in their reading practice. Increased facilitation of mobility could be a rich area for feature development of e-journals. Likewise, the evolution of other forms of publishing—perhaps more informal forms that scholars could self-organize—could provide new forums for scholarly exchange.

The zone between informal publicizing and formal publication is a rich and critical area for scholarly communications.

Respondent interviews suggested a desire for, and movement toward, developing a dynamic middle zone between the unstructured and organic Web environment and the procedural world of formal publishing. E-journals could provide various alternatives in this middle zone and new opportunities for bridging these two extremes. Many opportunities exist for e-journals to support collegial interactions and peer exchanges of scholarly content that are self-reviewing and self-organizing and that provide value for scholars. While not replacing traditional, peer-reviewed journals, new forums such as self-organizing (or loosely organized) knowledge communities, lab-based servers, supplemental databases, and other shared knowledge resources could offer scholars new sources of interaction with their peers around original research and cutting-edge information. E-journals and the connectivity of the Web provide a unique opportunity to support these environments.

E-journals challenge the notion of journal brand.

The study research suggests that e-journal searching emphasizes the article as the relevant container of knowledge rather than the journal itself. E-journal features were perceived as blurred with the rest of the features of the e-journal's search-and-retrieval environment—that is, with general search engines and other Internet and Web functionality. During a search, scholars suggested, the journal does not stand out as a framework in its online context. Journal publishers may want to think about how to extend brand in the online environment across various online activities. As scholars use e-journals for various information tasks, certain aspects of journal brand may need to be highlighted. Publishers might want to brand different aspects of their journals in addition

to quality of content. Important components of brand may include attributes such as searchability, breadth of content, seamlessness with other search environments, ease of use, flexibility of searching within an article, use of content descriptors and metadata for assessment, and online readability. In essence, it may be useful for publishers to think about how to brand the entire experience of e-journals for scholars.

APPENDIX A: METHODS

Purpose of Ethnographic Interviewing

Qualitative methods such as in-depth ethnographic interviews are intended to explore and describe the underlying logic, conceptual domains, and implicit beliefs and values that structure people's behaviors. Together with quantitative methods, the qualitative method helps to frame survey hypotheses as well as to define key areas of research interest for further exploration.

Instrument

A team of researchers designed an ethnographic interview instrument to help them gain knowledge about the following core issues:

A rich understanding of how science and medical professionals use e-journals to support their work.

- What conditions are important for their choice of paper versus electronic journals?
- What features and functionality are most valuable to them in support of their work?
- What are potential barriers of using e-journals?

A sense of how e-journals have changed the notion of *scholarly publishing* and communication among science and medical professionals.

- What are implicit values of *scholarship* for this group?

Knowledge of whether e-journals, and which dimensions of e-journals, improve the ability of science and medical professionals to *do good science*.

- What are the implicit values of good science as expressed by respondents?

The research instrument incorporated descriptive, structural, contrast, and predictive ethnographic questioning techniques as developed by James Spradley (1975)

to specifically address each set of objectives. The instrument was piloted with three respondents and was revised accordingly.

Sample

Researchers used nonprobabilistic sampling methods and chose informants based on the overarching criteria of the study: that they be users (defined as readers, authors, and editors) of biomedical literature. To obtain a wide variety of responses, this population included representatives from a range of career stages (graduate students, post-doctoral fellows, junior faculty, and senior faculty) and from a range of institutional settings (universities, academic research institutes, hospitals, and government research institutes).

Seventeen respondents who met the criteria were interviewed in sixteen interviewing sessions (one session interviewed two respondents at the same time). Of those, seven were self-selected from a personal request issued by the Office of the Stanford University Libraries to the editors of HighWire Press journals with online editions. The remaining ten respondents were selected through snowball sampling and emergent or informal social networks (Schensul, Schensul and LeCompte 1999; Johnson 1990). Fifteen of the respondents worked in California; one at a teaching hospital in New England, and one at a teaching hospital in England. Of the seventeen, we interviewed five women and twelve men.

Interviews

Structured interviews were conducted on-site by Andrea Saveri, Director, and Lyn Jeffery, Research Affiliate, both with Institute for the Future. Each interview took from 75 to 100 minutes and was recorded on tape for verbatim transcription.

Analysis

The ethnographic interviews resulted in approximately 1,200 pages of transcript data, which were coded by the team. Researchers used ethnographic narrative analysis (Denzin and Lincoln, 2000) to explicate the categories and domains of meaning through which respondents made sense of e-journal practices.

References

- Denzin, Norman L. and Yvonna S. Lincoln, eds. *Handbook of Qualitative Research*. Second edition. Thousand Oaks, CA: Sage. 2000.
- Johnson, Jeffrey C. *Selecting Ethnographic Informants*. Thousand Oaks, CA: Sage. 1990.
- Schensul, Stephen L., Jean J. Schensul and Margaret D. LeCompte. *Essential Ethnographic Methods: Observations Interviews, and Questionnaires*. Walnut Creek, CA: Alta Mira Press. 1999.
- Spradley, James. *The Ethnographic Interview*. New York: Holt, Rinehart and Winston. 1979.

APPENDIX B: ETHNOGRAPHIC INTERVIEW INSTRUMENT

Practices Using E-Journals - A Focus on Science and Medical Professionals

Interview Research Objectives

There are three core objectives the ethnographic interviews will achieve:

A rich understanding of how science and medical professionals use e-journals to support their work.

- What conditions are important for their choice of paper versus electronic journals?
- What features and functionality are most valuable to them in support of their work?
- What are potential barriers of using e-journals?

A sense of how e-journals have changed the notion of *scholarly publishing* and communication among science and medical professionals.

- What are implicit values of *scholarship* for this group?

Knowledge of whether e-journals, and which dimensions of e-journals, improve the ability of science and medical professionals to *do good science*.

- What are the implicit values of good science as expressed by respondents?

Introduction

This interview is part of a larger study for Stanford University Libraries on e-journals. The study will include a quantitative survey, analysis of usage logs, and other research efforts. The first step in the process is to conduct a series of interviews, like the one we will do today, with science and medical scholars about their journal usage.

NOTE: We will use a brief screener to get some basic information when we schedule the phone call to save time during the interview.

I. Individual background (5 minutes)

[Objectives: professional mobility, scholarly networks/fields]

1. What your current position is at this institution and your responsibilities?
PROBE: Research, teaching, publishing, participation in committees/task forces?
PROBE: Have you held other positions here? What were they?
2. How long have you been at your current position?
3. How many universities or institutions have you worked at before coming here?
PROBE: Which ones? Multiple positions? Appointments?
4. Are you a member of any professional associations /organizations?
PROBE: How many? Which ones? Position?
5. How would you characterize this particular moment or stage in your career?

II. Scholarly activities and community (15 minutes)

6. I'd like to get a sense of your professional activities day to day, week by week, month by month. If I were to follow you around for a month, how would I know you were working? (Get specific, concrete examples of activities.)
PROBE: Teaching—undergraduate/grad students? How many classes? What level? How often do you teach?
PROBE. Research—what kinds? Where do you do your research? Lab? Library?
PROBE. Writing/publishing—How often do you publish? Goals?
PROBE. Meetings of editorial boards, committees, professional conferences?
PROBE. How do you prioritize these activities? Is there any one of these that you wish you had more time for? Which one? Why? What would help you?
7. Do you work independently or would you say you are part of a community of colleagues or peers?
PROBE. What people are part of this community? Colleagues? Librarians? Grants administrators? Graduate students?
PROBE. What role do they play in your work life?
PROBE. Where are these people located? Same/different discipline?

- 7a. How do you generally communicate or interact with these various people?
PROBE. How often do you interact with these people? Regularly, special events?
PROBE. Do you meet in person? How do you connect? Stay in touch?

III. Technology background and access (10-15 minutes)

8. The following is a list of information and communications technologies and services that you may access in your office, other work location, or at home.

Can you please cross out those that you don't have access to and circle the items that you have access to at home, work or some other location. For each item, please tell me where you have access and how often you use this tool/service.

NOTE: Hand list to respondent and go down the list with them **out loud**.

Communication Tool List

Personal computer

Laptop computer

Personal digital assistant (Palm Pilot, electronic organizer, PDA, so on)

Printer (color or black and white)

Web access

Electronic mail

On-line forums for discussion, printing, and/or posting (such as bulletin board, chat rooms, list serves)

On-line journal subscriptions, personal

On-line journal subscriptions, institutional

Paper journal subscriptions, personal

Paper journal subscriptions, institutional

Cellular phone

Pager/beeper

Voice mail (voice messaging service)

DSL connection

Cable modem

Fax machine

Scanner

PROBE: Is there any item that is not on this list that you use regularly and consider important for your work?

9. Look over all the tools on the list and think about how you use them in your work. If you had to give up all of these items except for four of them, which four would

you not give up?

ASK THE RESPONDENT TO NAME THE FOUR ITEMS

10. Why would you keep these items? How do they support you doing your work?
PROBE: How do they support your research, teaching, writing/publishing, so on?

IV. Journals: electronic and paper

General Practices—

11. You did/did not mention journals in your list of the four most important items for your work. Why is that so? I'd like to know what role journals, both paper and electronic, play in your work activities.
PROBE: How many journals do you read regularly? Which ones? Are these journals just in your field or broader?
PROBE: Do paper and electronic journals serve the same purpose for you? Why do you use one, the other, or both?
PROBE: Have you started reading new journals in the past 1-2 years? Why? Which ones? How did you start?

12. How do you get access to the journals that you use regularly?
PROBE: Personal subscriptions, lab, department, colleagues, library?
PROBE: Which of these are these in paper or electronic form?
PROBE: Are you aware of the costs of these kinds of subscriptions?
PROBE: Where do you read them?

Specific Practices—

In the next section we want to talk about how you do your research, reading, writing and publishing.

13. Let's say you have a question you need to research: how do you go about that?
PROBE: What are the different tools and sources that you use? Can you give me a specific example of when you did this?
PROBE: Where and how did you begin your search?
PROBE: Did you search for a known item? Subject-based search? Citation and abstract search? Full text search? Why? When would you do it differently?
PROBE: Did you go directly to the journal Web site, through HighWire Press,

- through PubMed or MedLine? Through another database? Why? When would you do it differently?
- PROBE: Are you looking for new articles and material only or are you also looking for archived information? Why? When do you want new or archived material?
- 13a. When you are searching, what are you looking for that guides you through your search? Why? Can you give me an example? What constitutes a successful search for you?
14. At what point do e-journals come into play in your research process? Why? How do they help you in your research?
15. Can you tell me specifically how you use e-journals in this way?
16. What features of e-journals are important for you when you're researching? Can you give me a concrete example of how you use these features?
- 16a. Do you read articles you find online when you are researching or do you print and read them later? Why? What would make you either read or print out an article?
- PROBE: When do you read, skim, browse?
- PROBE: Some journals post more than one version of an article. Does this impact how you would use it?
- PROBE: If you find an unedited version, are you likely to go back and read it when they post the edited one?
- PROBE: If you cannot click onto an article, are you less likely to read it?
- 16b. To the extent that you read journal contents online, what helps you do it?
- PROBE: Links to data, to authors, citations, full text?
- PROBE: Can you give me a concrete example of how you use these features?
17. Are there other things besides articles that you might read or do in an e-journal or at a journal Web site?
- PROBE: Other forms of data retrieval (such as graphics, data sets)?
- PROBE: Link to citations?
- PROBE: E-mail the author?
- PROBE: Send a letter to the editor?

- PROBE: Submit an article?
PROBE: Respond to an alert?
18. Does the way you research and read change when you are using paper journals? How do they change? When do you prefer to use paper journals to research and read?
PROBE: Are there sources you can't find that you want access to? Which ones? Why?
19. Was there a time when your research and reading practices were very different from what you just described? When was this? How was it different?
20. Now let's talk about publishing in journals.
PROBE: How do you decide when you're going to publish?
PROBE: Which journals do you publish in? Why?
PROBE: How often do you publish in journals?
- 20a. Tell me about a recent occasion when you published in a journal. How did you go about it?
PROBE: What was the journal? Was it published electronically and/or on paper?
PROBE: Did you specifically choose which format it came out in? What difference does it make to you?
- 20b. Has the existence of e-journals affected your own publishing practices? If so, how? Examples? (such as where you submit for publication; how polished your submissions are)?
PROBE: What specific features have contributed to this change?
PROBE: Has this had an impact on your scholarly work?
PROBE: Do you have a different sense of the timing and release of information in electronic publications versus the paper version?
- PROBE: Do your articles appear fully peer-reviewed, or do they appear in other formats before this?
PROBE: Have your publishing practices changed in the last five years? If so, how?

- 20c. Have e-journals changed the significance of publishing in any way in your field?
How? What impact has this had on you?
PROBE: Has it changed how you share knowledge with peers? Timing, content of data, so on.
PROBE: Has it changed the nature of prestige accorded to publishing?
PROBE: Has it changed the nature of peer review? Have tenure review or other evaluative processes changed?
PROBE: How would you feel about never publishing in a paper journal again?
21. Are there any other ways that you use journals that we haven't discussed?
22. What other work activities do you do on line?
PROBE: Do you participate in academic discussion forums such as bulletin boards?
PROBE: How about chat rooms?
PROBE: List serves?
PROBE: Are there other formats for discussion, such as lab Web sites, corporate Web sites, institutional Web sites?

V. Quality of Science

24. Imagine that you and your colleagues are discussing your work and you start talking about e-journals. What are some of the key issues that would come up?
PROBE: Increased the pace of scientific discovery, rate of innovation?
PROBE: Increased the speed of publishing process and its purpose?
PROBE: Decreased/increased the quality of good material available, more time and effort to research?
PROBE: Impact on scholarly work?
- 24a. What would this discussion be like five years from now?
PROBE: In an electronic age, would journals of any kind be anachronistic?
PROBE: Do e-journals contribute to increasingly narrow niches in science?
25. Does having a journal with all the extra functionality of e-journals help you do better science? If not, how would e-journals have to change to become helpful to you? If so, how could they change to be even more helpful to you?

