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

Many scholars are introduced to e-journals primarily 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 few are either 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.**

Many scholars 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.**

It is unlikely that e-journals will replace paper completely. Rather, 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 p. ) 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.