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Special Issue—Future of Publication

The value of scholarly reading in the life sciences

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Abstract

Surveys of academic staff in six universities in the U.K. provide insights for publishers and universities into scholarly article, book, and other publication reading patterns of academics and differences based on academic discipline of readers. These surveys were part of the 2011 *UK Scholarly Reading and the Value of the Library Study* funded by JISC Collections and based on Tenopir and King Studies conducted since 1977. Reading patterns of life and environmental scientists differ from other disciplines, in particular social sciences. Scholarly articles, especially those obtained from the library's e-journal collections, are vital to the work of all academic disciplines. Life and environmental scientists come into contact with multiple sources of information every day, including social media, and the biggest limitation scientists describe when it comes to finding and obtaining articles is cost and time. Knowing more about academic reading patterns help publishers and librarians design more effective journal systems and services now and into the future.

Key Words: user studies, scientists, outcomes measurement, libraries, reading, qualitative techniques

This article is based on part of a larger study funded by JISC Collections. The complete report is available at <http://lib-value.org> or <http://www.jisc-collections.ac.uk/Reports/ukscholarlyreadingreport/> from JISC Collections.

The environmental and life sciences depend on up-to-date information to inspire new research as well as older material to ground current research. This study seeks to gain a deeper understanding of scholarly reading patterns of environmental and life scientists by answering questions such as: How many scholarly articles, books, and other materials do scientists read? Why do they read? How do they obtain the material they read? How do the readings influence their work? What is the value of access to scholarly materials? Understanding the purposes, outcomes, and values of scholarly reading allows publishers, editors, and librarians to better meet the needs of the scientists they work with and anticipate their needs now and into the future.

This study of academic staff in the United Kingdom is based on the Tenopir and King academic reading surveys that have been conducted periodically since 1977. These studies have shown the continued importance and value of scholarly reading to science and non-science faculty members in the United States and in Japan, Australia, Finland, and the United Kingdom (Tenopir et al. 2010; Tenopir and Volentine 2012).

In the Spring of 2011 surveys of academic staff (faculty) were conducted at six research universities in the United Kingdom—Cranfield University, Durham University, Imperial College, University of East Anglia, University of Dundee, and University of Manchester. The surveys measured reading and value of scholarly articles, books, and other publications to the academic staff and the importance of the library collections and other sources of scholarly materials. In this article we focus on the reading patterns of academics in the life

sciences, ecology, and biology fields and how they differ from academics in other disciplines.

Previous Studies

The study builds on reading surveys conducted by Carol Tenopir and Donald W. King in the U.S. since 1977 (Tenopir and King 2000) and in Australia and Finland in 2005 and 2006 (Tenopir et. al. 2010). Together, these studies track scholarly reading patterns and the continued contribution of academic library collections to scholarly work.

Tenopir and King (2000) and King and Tenopir (2001) summarize reading patterns of academics through the 1990s. These two sources provide extensive literature reviews and serve as background for the data presented in this report. Other multi-university studies focus on how academic staff uses electronic journals, online resources, and libraries (Healy et al. 2002). A 2011 study by the Research Information Network (RIN) found a link between the library and the institution's research performance (RIN 2011). A study by Talja and Maula (2003) explored the impact of the subject discipline of the reader on reading patterns. Additional studies show that staff members in the sciences prefer and read more electronic journal articles than in humanities or social science disciplines (Brown 2003), and the importance of journals to scholarship compared to other types of information can vary between different disciplines (Fry & Talja 2004). Access and convenience, especially electronic access, are important across all subject disciplines (Maughan 1999).

Methodology

Earlier surveys examined just the reading of scholarly articles. This survey includes those questions, but expands the scope to look at the readings of books and book chapters and other scholarly materials (e.g. conference proceedings, government documents, and other web sites) used for work-related reading. The questions include both reader-related (demographics) and reading-related questions. Reader-related questions include age, gender, percentage of work time spent on various activities, number of personal subscriptions, and two measures of recent academic success—publication record and record of recent awards.

The reading-related questions focus on the last scholarly reading as the “critical” incident of reading (Griffiths and King 1991). The “critical incident technique” was first developed by Flanagan (1954), and has since been used in many contexts, including libraries and reading (Radford 2006; Andrews 1991). By focusing the questions on the last scholarly reading, we are able to ask questions about a specific most recent reading, of which the respondent will have a better

memory of, rather than having to reflect back on multiple readings over a longer period of time. The questions cover many details of that reading, including time spent on the reading, source of reading, purpose of reading, value of the reading to the purpose, and outcomes of the reading

Starting in March 2011, the head librarian or library representative at the six U.K. universities sent an e-mail message with an embedded link to the survey instrument housed on the University of Tennessee's server. We received 2,117 responses by the official closing date of June 9, 2011. Approximately 12,600 invitations were distributed in total, providing an overall estimated response rate of 16.8%. Of the 1100 respondents who chose to give their academic discipline, 18% are in the life sciences, 30% are in the other sciences (e.g. medical sciences, physical sciences, agricultural science), 36% are in the liberal arts (e.g. social sciences, humanities, arts, law, business), and 16% are in the engineering, technology, and other fields (e.g. engineering, mathematics, computer science, interdisciplinary). For our analysis in this article, we compare the life scientists to other sciences and liberal arts, and we omitted responses from the technology, engineering, and “other” fields. We defined the life sciences as fields that involve the study of living organisms, and we included the disciplines of: life sciences, environmental sciences, earth sciences, biology, plant sciences, and natural sciences.

The respondents in the life sciences are 39% female/61% male. They represent all ages with an average (mean) age of forty years. The respondents in the life sciences are 33% research associates assistant/officer/tutors, 13% professors, 12% lecturer, 10% senior lecturer, and 6% associate professor. Less than a quarter (19%) has received an award or recognition for their work in the past two years.

As with all methods, there are some limitations to our study. Since the survey is self-reported, we have to assume that respondents are replying accurately and the exact numbers should be viewed as approximations. The response rates are relatively low since the instrument is sent out through e-mail to the entire university population, and we cannot guarantee that every e-mail was sent to an active account. Respondents were allowed to skip any question or exit the questionnaire at any time, so response rates to any one question may be lower than the total response rate. The academics surveyed here, and in earlier surveys, are all affiliated with universities that have robust libraries with electronic and print collections available to all of their affiliated academic staff. Results will differ in surveys of academics without access to collections that a university affiliation provides. We believe, however, the advantages outweigh the disadvantages. Since it is self-reported we get a personal view, including quantitative

and qualitative information. By maintaining similar core questions since 1977, we are able to compare over time and across populations.

Findings and Discussion

How many scholarly articles, books, and other materials do scientists read?

It is no surprise that scholarly articles are an important source for sharing and spreading new ideas. Academics refer to scholarly articles as, “Essential. Scholarly articles are the most trustworthy source of information that is new,” and “Central. I judge myself and others judge me on the basis of those I publish.” Value can be demonstrated by the amount of time academics spend dedicated to reading articles, books, and other publications for their work (Machlup 1979). For our analysis we defined reading as going beyond the table of contents, abstract, and title of the article, book, or other publication. On average, life scientists read 25 articles, two books or book chapters, and seven other publications per month.¹ “Other publication” readings by life scientists include magazine/trade journals (42%), government documents (25%), and conference proceedings (15%). Life scientists read fewer total publications compared to the other disciplines (Figure 1).

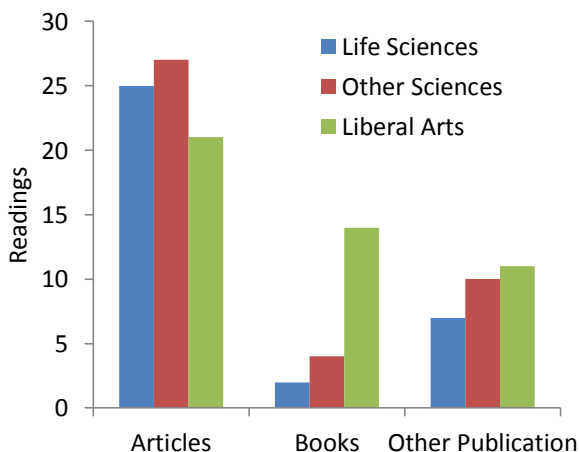


Figure 1. Average number of readings per month by discipline.

In addition to the total number of readings per month, we asked how much time they spent on the last reading. Life scientists spend on average 45 minutes per article reading, an hour and thirty-one minutes per book reading, and 34 minutes per other publication reading.

¹All means exclude outliers 3 standard deviations away from the mean in order to achieve a more accurate representation.

They spend more time per article and book reading than other scientists; however, academics in the liberal arts spend the most time, on average, per reading (Figure 2). While life scientists are not the heaviest users of scholarly material, they still dedicate large portions of their work time to scholarly reading.

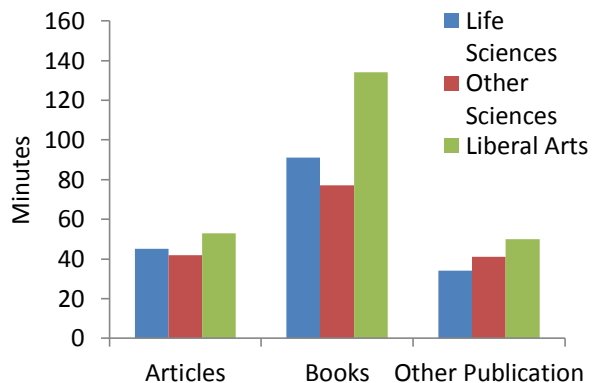


Figure 2. Average time spent per reading (in minutes) by discipline.

By taking the average (mean) time per reading multiplied by the number of readings per month we can estimate the total time dedicated to scholarly reading (Table 1). Life scientists spend 225 hours, or 28 eight-hour work days, each year dedicated to scholarly article reading. They spend 36 hours reading scholarly books and 48 hours reading other publications. The amount of time dedicated to scholarly reading is a measure of exchange value.

Table 1. Exchange value of scholarly reading to life scientists

	Time per reading (min)	Number read per month	Time spent reading per year (h)
Article	45	25	225
Book	91	2	36
Other Publication	34	7	48
<i>Total</i>		<i>34</i>	<i>309</i>

What is the age of the last article reading?

While recent articles are important to keep abreast in the field, older articles allow readers to see trends or how ideas develop over time, and to provide foundational theories and ideas. Over half (59%) of the article readings by life scientists are in the first eighteen months of publication (2010-first six months of 2011 due to the timing of the survey), but about a quarter (24%) of the readings are two to five years old and another 17% are older than five years (Table 2).

Table 2. Year of article publication (Grouping) by discipline.

Age of article reading (y)	Life Sciences	Other Sciences	Liberal Arts	Row Total
15+	13 6.6%	23 6.9%	52 13.7%	88 9.7%
11–14	4 2.0%	14 4.2%	32 8.4%	50 5.5%
6–10	17 8.6%	42 12.7%	64 16.9%	123 13.6%
2–5	47 23.9%	79 23.9%	104 27.4%	230 25.4%
0–1.5	116 58.9%	173 52.3%	127 33.5%	416 45.9%
Column	197	331	379	907
Total	100.0%	100.0%	100.0%	100.0%

Life scientists read, on average, slightly more articles in their first eighteen months of publication than academics in the other sciences (52%) and in the liberal arts (34%). One life scientist praises the importance of up-to-date information, “It’s crucial to access the latest information on my research field in order to better understand and improve my research.” For all disciplines the concentration of reading is still within the first five years of publication. While only 17% of the article readings in the life sciences are older than five years, they are still important for academic work. One respondent comments, “Good access to past and newer journal articles is critical for my work.” Having access to older articles, in addition to the current issues, is vital to grounding new theories and ideas. Providing backfiles and archived journal issues is a worthwhile investment.

Does they use social media for work-related purposes?

Social media also plays a role in the spread of information and ideas, and as it grows in non-work activities, we assume its use and creation is also growing in academia. Recent studies, including a 2010 study by Nicholas and Rowlands, found that social media tools (blogs, wikis, file-sharing services) are being used as supplements to the traditional forms of information (monographs, journal articles, etc.). They found that only 13% of the respondents used social media tools frequently, and 39% did not use them at all (Research Information Network 2010).

One of the problems in studying social media use for work-related purposes and comparing studies of social media is the different ways social media tools can be categorized. Nicholas and Rowlands, for example, placed tools in eight categories: social networking, blogging, microblogging, collaborative authoring, social

tagging and bookmarking, scheduling and meeting tools, conferencing, and image or video sharing (Nicholas and Rowlands 2011). Gu and Widen-Wulff categorized social media tools for scholarly communication into eight slightly different categories: blogs, mini blogs, RSS, wikis, tagging, social networks, multimedia sharing, and online documents (Gu and Widen-Wulff 2010). In this study we looked at social media that emphasize the information gathering and dissemination functions of social media. We categorized the tools into six groupings: blogging (e.g. Blogster, WordPress), video sharing (e.g. YouTube), RSS feeds, microblogging (e.g. Twitter), user comments in online articles, and audio sharing (e.g. Podcasts).

We found that while some life scientists are participating and creating social media, it is occasional (defined as less than monthly) rather than regular. Nearly half the respondents participate daily, weekly, monthly, or occasionally in user comments in online articles and video sharing (Figure 3). Their participation in social media does not significantly differ from the use of social media by the other disciplines, though overall, academics in the liberal arts participate slightly more than the sciences.

On average, life scientists rarely create any social media tools, and less than 20% create any of the social media tools we listed (Figure 4). We found a significant association between subject discipline and the creation of blogging ($\chi^2=34.649$, $p<.0001$), microblogging ($\chi^2=11.234$, $p=.004$), and audio sharing ($\chi^2=13.997$, $p=.001$). Faculty members in the liberal arts create those social media more frequently than the life and other sciences.

Social media are not replacing traditional scholarly material, but we found many life scientists are participating in social media to augment their traditional work activities. One respondent comments, “In addition to writing scientific publications...contribute to collaboration-wide discussions by email and video conferences,” and another respondent uses, “Blackboard web pages that link to my taught courses and Wikis that relate to taught courses.” Using social media to advertise, market, and share information will potentially enhance the use of traditional scholarly material.

Overall, life scientists focus their reading on journal articles, but they also observe information from books, government documents, conference proceedings, websites, and even social media. Academics spend much of their work time dedicated to reading these materials because they understand that the sharing and spreading of information is essential to their disciplines.

Why do they read?

We established that life scientists are reading many different types of scholarly material, but to further determine the value of scholarly reading we need to establish

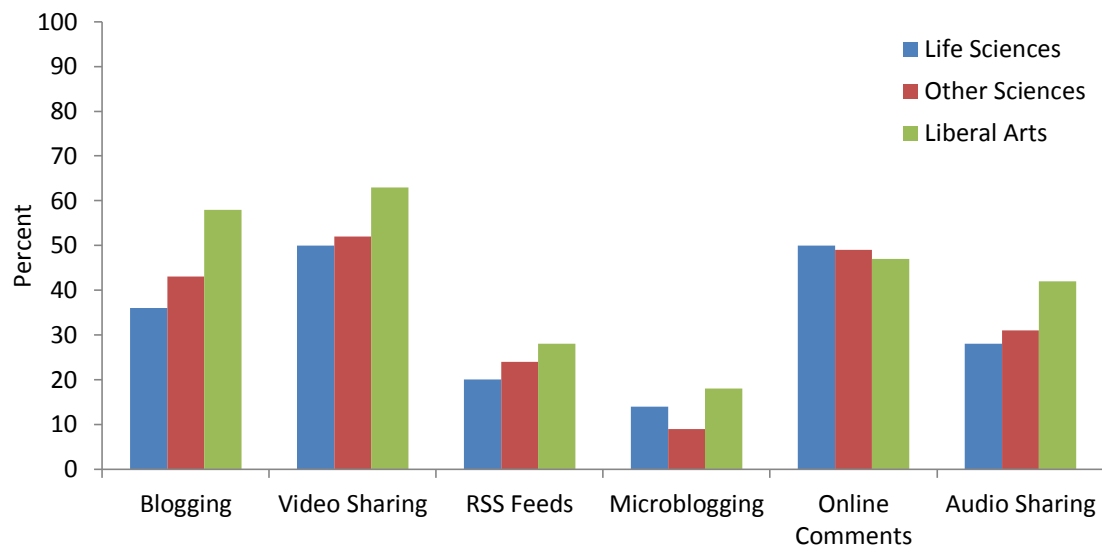


Figure 3. Frequent to occasional participation in social media by discipline.

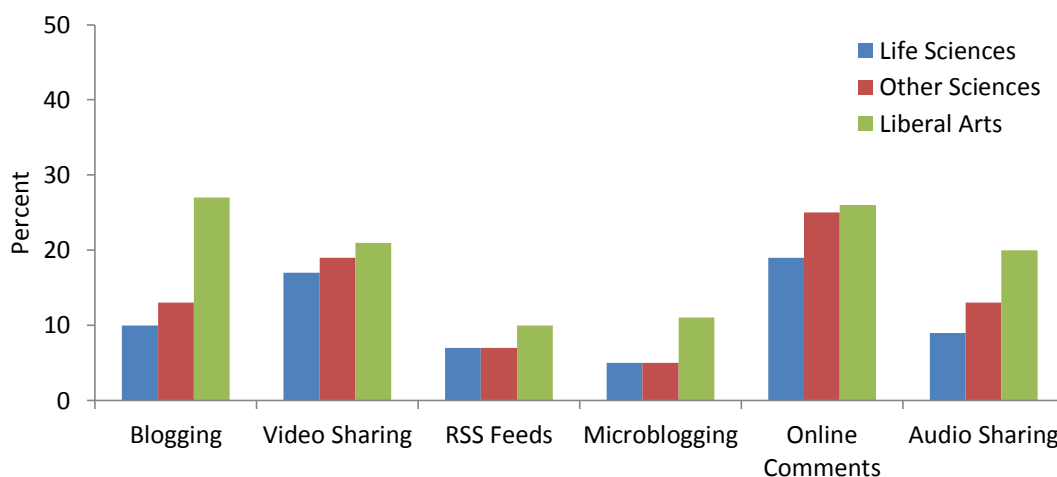


Figure 4. Frequent to occasional creation of social media by discipline.

how the readings benefit their work. Another method to determine value is by examining the purposes, values, and outcomes the readings have on academic work and research (Tenopir and King 2000). We asked, “What is the principal purpose of reading? What outcomes or affects do the readings have on their work?”

When we asked life scientists how they spend their work time, they said they spend the majority their time on research and writing (Mean=68%), followed by teaching (12%). The majority of readings by life scientists support research and writing (Table 3). One respondent says, “[Scholarly articles] are of fundamental importance to my research,” and another respondent confirms that scholarly articles are the “core of my research activity.” Life scientists are more likely

to use book readings to support their teaching (27%) than articles (7%) or other publications (7%).

The other disciplines also primarily read for research and writing, and the principal purpose of book and other publication readings are consistent across the different disciplines (See Table 2). Academics in the life sciences report slightly more article readings for research and writing (77%) than in the other sciences (74%) and liberal arts (69%). Fewer article readings are for done for the purpose of teaching in the life sciences (7%) or other sciences (8%) than in liberal arts (21%).

In addition to supporting work activities in the life sciences, article readings are considered important to their work. One respondent describes them as, “The lifeblood of my work,” and another respondent continues,

Table 3. Principle purpose of reading by discipline.

		Research & Writing	Teaching	Current Awareness	Others	Row Total
Life Sciences	Article Reading	77%	7%	11%	6%	100%
	Book Reading	55%	27%	4%	14%	100%
	Other Publication Reading	50%	7%	29%	14%	100%
Other Sciences	Article Reading	74%	8%	7%	11%	100%
	Book Reading	55%	27%	4%	14%	100%
	Other Publication Reading	37%	10%	38%	15%	100%
Liberal Arts	Article Reading	69%	21%	3%	7%	100%
	Book Reading	61%	27%	2%	10%	100%
	Other Publication Reading	48%	16%	21%	15%	100%

“[they are] centrally important. Without them it would be impossible.” We provided the respondents a five-point scale to rank the importance of the reading. The majority of article readings by life scientists are considered absolutely essential, very important, or important (68%), while only 30% are considered ‘somewhat important’ and 2% considered ‘not at all important’ (Table 4). Fewer article readings in the life sciences are considered ‘absolutely essential’ (6%) than in the other sciences (16%) or liberal arts (15%). It is unclear why life scientists rank the importance of the article reading slightly lower than the other disciplines

Although they read a greater number of articles, academics in life sciences, other sciences, and liberal arts rate book readings, on average, as more important than article readings (See Table 4). In the life sciences, 19% of book readings are considered absolutely essential and over a quarter are considered very important, while less than 1% is considered not at all important. Book readings in the liberal arts are considered more important to the principal purpose than the other disciplines, with over half of the readings (54%) are considered absolutely essential or very important.

In contrast, other publication readings are considered the least important by each discipline (See Table 4). Only 6% of other publication readings by life scientists, 10% by other scientists, and 12% by liberal arts academics are considered absolutely important. Since other publications are often read for current awareness they tend to support ‘non-core’ work activities, which may explain why they have less importance than article or books which support the main work activities of research and teaching.

How do they obtain the material they read?

While there are many alternatives to the library, including free web journals, websites, and personal subscriptions, life scientists continue to depend on the library’s collections and services to find and obtain articles. We first asked, “How did you or someone on your behalf become aware of this last article reading?” Respondents in each discipline use a variety of methods to become aware of articles, including searching, a citation, another person, and browsing (Figure 5).

When articles are found by searching, academics mainly use electronic sources, many of which are provided through the library’s online journal collections or electronic indexing/abstracting services (Figure 6). One life scientist comments, “Having robust search facilities—and access to contemporary and archived literature is vital.” Life scientists search preprint/e-print services (26%) more often than do academics in the other disciplines, illustrating the importance of up-to-date information in life sciences. No respondents in the liberal arts, and only 14% of respondents in the other sciences search a preprint/e-print service.

Regardless of how an academic becomes aware of an article, they obtain articles most frequently from their library’s subscriptions (Figure 7). Nearly two-thirds (64%) of the article readings by life scientists are obtained from the library. Only 4% of article readings by life scientists are obtained from a personal subscription. One scientist praises, “Library (free to user) resources have been essential to my work for the past 20 years.” Academics in the life sciences obtain articles from a free web journal (16%) more often than

Table 4. Importance of Readings by Discipline

		Life Sciences	Other Sciences	Liberal Arts
Article Reading	Absolutely Essential	6%	16%	15%
	Very Important	27%	21%	29%
	Important	35%	31%	25%
	Somewhat Important	30%	31%	31%
	Not At All Important	2%	1%	.3%
	<i>Column Total</i>	<i>100.0%</i>	<i>100.0%</i>	<i>100.0%</i>
Book Reading	Absolutely Essential	19%	15%	22%
	Very Important	26%	31%	32%
	Important	32%	35%	27%
	Somewhat Important	23%	18%	18%
	Not At All Important	.8%	.4%	1%
	<i>Column Total</i>	<i>100.0%</i>	<i>100.0%</i>	<i>100.0%</i>
Other Reading	Absolutely Essential	6%	10%	12%
	Very Important	18%	19%	20%
	Important	20%	24%	30%
	Somewhat Important	44%	43%	35%
	Not At All Important	12%	5%	3%
	<i>Column Total</i>	<i>100.0%</i>	<i>100.0%</i>	<i>100.0%</i>

academics in the other sciences (9%) or liberal arts (6%).

All disciplines depend on electronic sources, and the majority of article readings by life sciences (91%), other sciences (90%), and liberal arts (79%) are obtained from electronic sources. The library's electronic subscriptions seem to be the key to the library's success because each discipline obtains the majority of its readings from the library's e-collections. One respondent simply says, "Access to electronic journals is key to research in life sciences." Nearly all of the library-provided article readings by life sciences (96%), other sciences (96%), and liberal arts (88%) are obtained from an electronic library subscription.

Our findings show the library is still valuable source for scholarly reading. A good library enhances the university, such as one respondent who said, "[My university] is very fortunate to have such a great library resource," while poorly stocked libraries create discontent, including one respondent who says, "The small nature of [my university library] dictates that I am often frustrated by being unable to obtain journal articles which are essential for our work." The library continues to be a cornerstone of a good university. The one cannot exist without the other, and a good relationship between publishers and libraries is essential to maintain a high quality of academic work, especially focusing on its electronic services.

While the library's e-collections are a popular source for article readings, academics more often purchase the books from which they read (Figure 8). Academics in the liberal arts are the most likely to obtain a book reading from the library collection (31%), while life

scientists also depend on colleagues (18%) and publishers (15%) for book readings. Many respondents say they already owned the book or it is a seminal or classic text in their field. Life scientists and academics in the other disciplines read books multiple times and refer to them over the years, and the convenience of pulling a print volume off of their personal shelf seems to influence reading behavior.

We found vastly different sources of other publication readings in the life sciences and other disciplines. Respondents in the life sciences, other sciences, and liberal arts obtain other publications from a variety of sources, including websites, publishers, and colleagues (Figure 9). The library is not the primary source of other publications for liberal arts (16%), other sciences (11%), or life sciences (9%). Life scientists obtain more other publications from publishers (29%) than other sciences (19%) or liberal arts (12%). Websites, such as government agencies and conference websites, provide easy to access, free-to-user documents.

The library is an important resource for life scientists, especially for journal articles, but life scientists also depend on their colleagues, publishers, websites, and personal copies to obtain information. They use a variety of convenient sources and services to get access to the information resources important to their work. Life scientists are not working alone, but instead, depend on their community to keep informed of important works and often share resources to promote further development and ideas. Understanding how they obtain materials allows publishers, universities, and libraries to allocate resources and maintain a highly productive community.

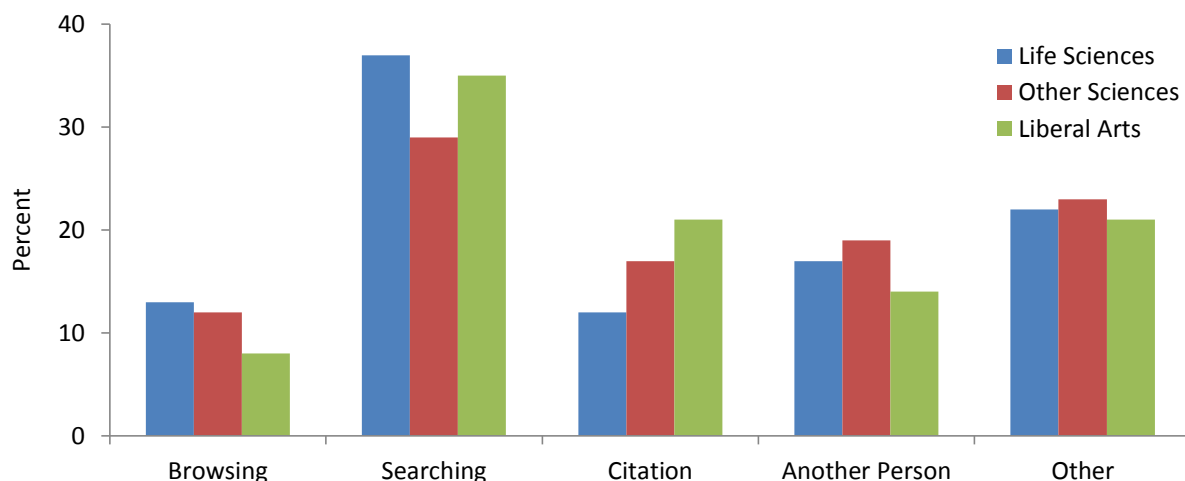


Figure 5. How respondent (by discipline) became aware of article.

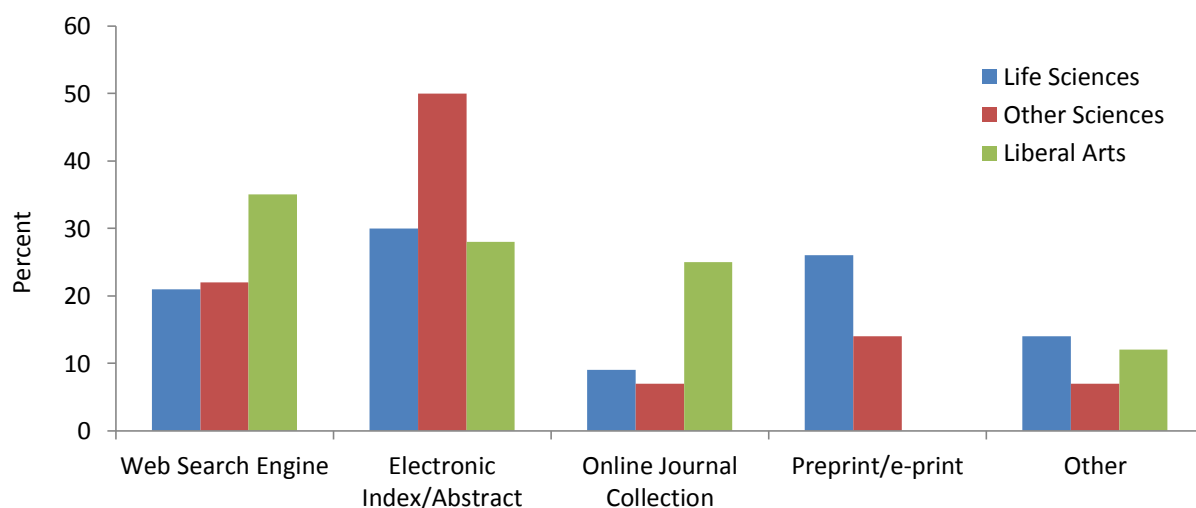


Figure 6. Method of searching by respondent's discipline.

How do the readings influence their work? What is the value of access to scholarly materials?

Scholarly reading influences many aspects of research, teaching, and other work activities of the life sciences. One respondent says, "They are critical to research and grant making. They are the central nervous system of academic life. Without them, it seems impossible to do science and teaching," and another respondent says, "[scholarly articles have] extreme importance, and we could not do without it because [they] make me aware of what has been done by colleagues across the world, teach me new methods and techniques, and make me think about the research with a different prospective, improving the possibility of discovering something new." In other words, the influence of scholarly reading

cannot be summed up in a single word or statement; its impact reaches into all aspects of the academic community.

We found many different positive outcomes of article, book, or other publication reading, and rarely does the reading have little or no importance. Less than 1% of book readings, 2% of article readings, and less than 4% of other publication readings are considered 'a waste of time'. Often even when a reading is not considered important, the reading is still not considered a waste of time. The most common outcomes of readings are: 'inspired new thinking' (36% of book readings, 60% of article readings, 43% of other publication readings), 'improved the result' (52% of book readings, 24% of article readings, 23% of other publication readings), and 'narrowed/broadened/changed the focus'

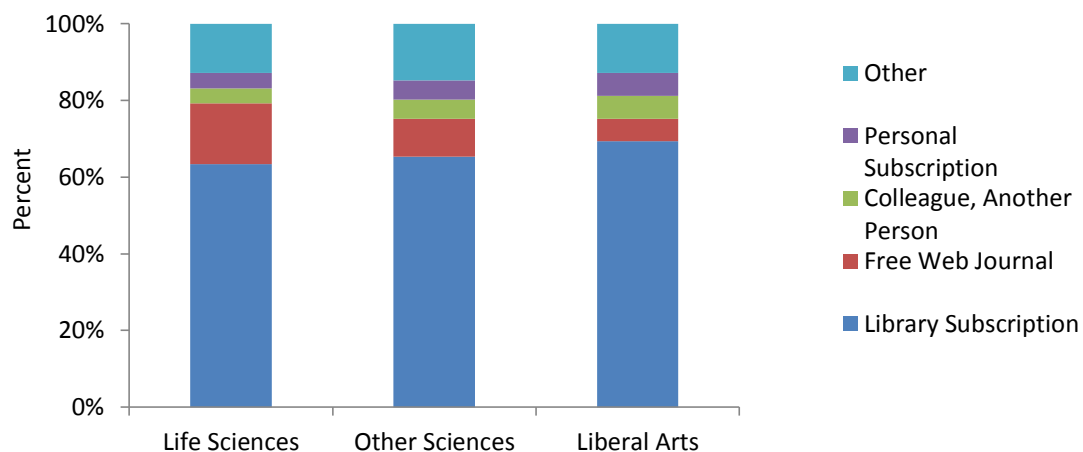


Figure 7. Source of article reading, by respondent's discipline.

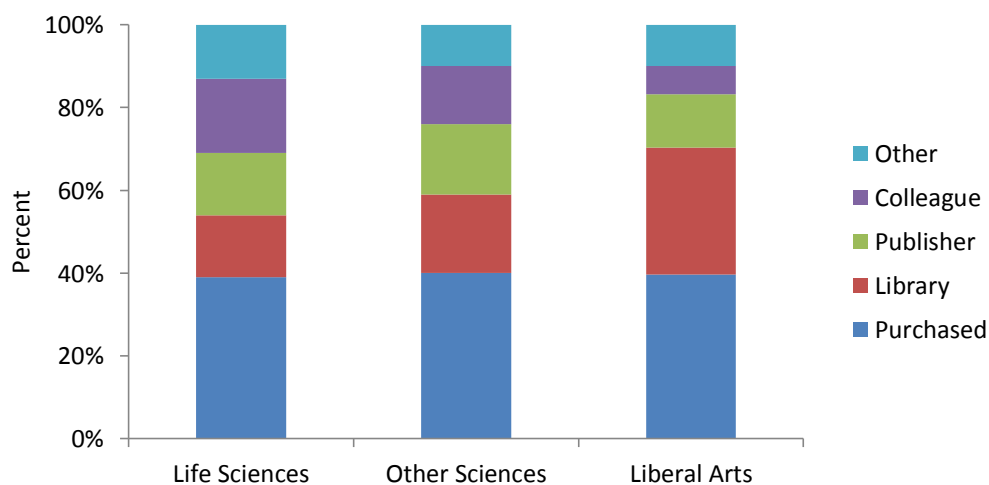


Figure 8. Source of book reading by respondent's discipline.

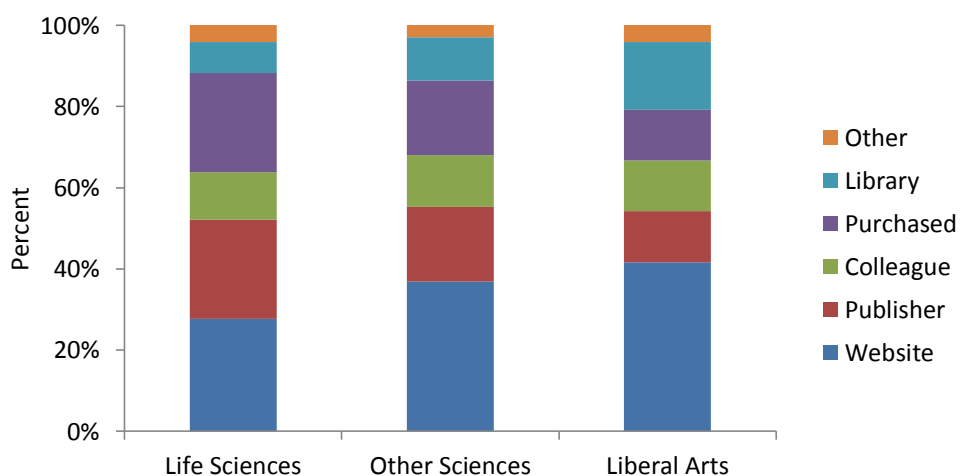


Figure 9. Source of other publication reading by respondent's discipline.

(23% of book readings, 25% of article readings, 17% of other publication readings). Book readings also help resolve technical problems (27%).

Beyond the immediate impact, scholarly reading has a lasting impact on the success of life scientists. We asked how many refereed journal articles they published in the past two years and if they received an award or recognition for their work in the past two years. Over the years we have found a relationship between both publishing productivity and reading and between receiving awards and reading (Tenopir and King 2000). The life scientists who received an award read more articles ($F=4.656$, $p=.032$), books ($F=10.695$, $p=.001$), and other publications ($F=1.278$, $p=.260$). Award winners ($n=36$) read, on average, 34 articles, seven books, and 10 other publications per month, while non-award winners ($n=155$) read 24 articles, two books, and seven other publications per month. In addition, life scientists who publish more read more articles ($F=5.343$, $p=.006$) and books ($F=1.110$, $p=.332$). Those who publish less than three items read, on average, 19 articles and two books per month, while those who publish over ten items read 36 articles and three books per month.

Conclusion

Scholarly reading has immediate and long-term benefits for the life and environmental sciences. Reading supports current research, teaching, and keeps them up-to-date in the field, and it also supports the continued success of the scientists and its use in teaching supports the future scientists in the field.

Many respondents to our survey echo the sentiment of this thirty-six year old male biologist, "Rapid and straightforward access to *all* relevant papers is essential to writing my paper effectively. Knowing what is relevant is frequently impossible in advance, so a wide range of subscriptions is vital." The biggest limitations scientists describe when it comes to finding and obtaining articles are cost and time. The library and open access e-journals provide cost-friendly resources. One respondent says, "Open access journals are absolutely key, hitting pay walls frustrates my own research and research communication in general." Other publications are also typically obtained from free-to-user resources, but books are often purchased and passed between colleagues. Library-provided e-books may be one cost-effective alternative for scientists; in addition, the publisher's copies are a common source of book readings. It is important to continue to support and provide scholarly reading resources for life and environmental scientists. The value of scholarly reading to the academic enterprise is shown through the amount of time invested in reading, the purpose and importance of the reading, and the outcomes of the reading.

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