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Scholarly article seeking, reading, and use: a continuing evolution from print to electronic in the sciences and social sciences

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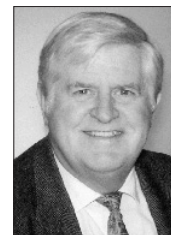
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ABSTRACT. *Electronic journals are now the norm for accessing and reading scholarly articles. This article examines scholarly article reading patterns by faculty in five US universities in 2012. Selected findings are also compared to some general trends from studies conducted periodically since 1977. In the 2012 survey, over three-quarters (76%) of the scholarly readings were obtained through electronic means and just over half (51%) of readings were read on a screen rather than from a print source or being printed out. Readings from library sources are overwhelmingly from e-sources. The average number of articles read per month was 20.66, with most articles read by the medical and other sciences, and on average each article was read for 32 minutes.*

Introduction

The transformation of scholarly journal articles from print to electronic may seem to be nearly complete as many academic libraries endorse e-preferred or even e-only policies for their journal collections[1–3] and the number of open access e-journals reached 9,925 in October 2013.[4] In fact, previous studies by Tenopir and King[5,6] from 1977 to 2005 have showed steady changes in the way academic scientists and social scientists in the United States seek and read articles.

Since 1977, King[7] and then Tenopir and King[5,8] have conducted surveys to examine information-seeking behaviour and scholarly reading patterns of faculty and other researchers in the United States. Beginning in 2000, it became clear that the shift to electronic resources had changed patterns of reading and usage, particularly in regards to scholarly articles and journals. The large, if inevitable, shift towards electronic journals was accompanied by a drop in reading from personal subscriptions, an increase in reading from library-provided e-journals, an overall increase in the average number of articles read per scientist or social scientist per month, with a concomitant decrease in the average time spent per article.[5,9] Yet, the trend of reading more articles in less time surely is unsustainable in the long run, unless reading is redefined to include text mining and machine-aided reading. Since the early 2000s, the increasing percentage of journal articles being accessed and obtained through electronic means has reduced the time that readers spend finding and locating articles and provided easier access to more articles, including a higher percentage of older articles.[6,10] But once articles are located electronically, scholarly article reading remains mostly a process of a scholar interacting with the content of one article at a time.

Widespread e-access has undoubtedly changed a whole range of article seeking, reading, and use patterns, yet other behav-

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iours may be more resistant to change or are agnostic regarding form and format. In light of increasing access, this article reports on results from a 2012 update of previous surveys. It provides a closer look at article seeking, reading, and use patterns among US academics in 2012. It also examines which trends over the last four decades have accelerated and which have slowed down in the last six years.

Background and research questions

Starting in the early 1990s, several studies focused on reading patterns of faculty and students at many universities.[11–15] Increasing availability of electronic articles, including backfiles, through libraries has been responsible for the largest percentage of the increase of e-article readings in the United States and elsewhere.[8,9] Therefore, libraries and publishers are both reacting to user preferences and driving changes in behaviour by changing to e-formats. Other studies also show the impact of electronic access and e-journals on changes to reading patterns. Maughan[16] and Healy[17] contend that the convenience and ease of use of electronic resources are an increasingly important factor for faculty. Other studies have found that differences in usage of electronic resources and journals vary significantly by subject discipline of the reader.[18,19] Brown's study[20] of electronic preprints in chemistry found that scientists were more likely to read and use electronic journal articles than their counterparts in the social sciences or humanities, although Vakkari[21] found that when availability of the percentage of e-journals in a subject discipline was normalized, many of the differences disappeared.

Previous studies also found that the increasing availability of electronic journals encouraged faculty to read more articles, though the time spent reading each article decreased from previous years.[8,9] This convenience of e-access anywhere and anytime led to the situation where, by the mid-2000s, the majority of journal article readings were accessed by faculty electronically, mostly from having access through their library, and over half were read from an electronic version away from a physical library.[22] By 2011 in the United Kingdom, 94% of library article readings by faculty members in research

the availability of electronic articles encouraged faculty to read more articles

universities were obtained through e-journal collections.[9] Increases in downloads in libraries over the last decade confirm this growing use of library-provided e-resources.[23–25]

The research questions for this study focus on reading patterns among US faculty members. What are the article reading patterns of faculty members, including the number of articles read, how readings are discovered, the proportion of articles read in the library, the reading format, and the reason for reading? Are the patterns that have been observed for 30 years continuing? Are new or different patterns emerging? What value do faculty members receive from reading scholarly articles, including results and exchange (time spent) value? Are faculty continuing to read more, with less time spent per reading?

Methodology

The 2012 survey used a set of core questions consistent with surveys since 1977 to allow comparisons of results over time.[26] The surveys included two main types of questions: (i) reader-related and (ii) reading-related questions. Reader-related questions focus on respondents' demographics, including age, gender, allocation of work time, amount of personal journal subscriptions, and scholarly achievements including recent publications and awards. We defined personal subscriptions only as those subscriptions addressed personally to a respondent at his/her home, office, lab, etc. We did not distinguish between purchased personal subscriptions and gifted personal subscriptions (i.e. through membership of a professional society). Reading-related questions focused on details of article readings from all sources (library-provided, other sources, and social media), providing an in-depth look at the value and purpose of reading in addition to how articles are discovered, located, and obtained, including the form and format of reading (reading onscreen v. reading in print journals or printed-out articles). Together these questions help define reading patterns for the purposes of this study – that is, reading patterns are the behaviours of respondents in how they choose and obtain reading material, purpose of reading, time spent reading, and the format of the reading.

Reading-related questions rely on Flanagan's *critical incident technique*.[27] Since the introduction of the critical incident technique, it has been used in a variety of contexts, including library use studies.[28,29] The survey uses the last scholarly reading as a stand in for a 'critical' incident of reading.[30] By asking about a specific most recent reading, respondents should be able to recall that reading more clearly than a number of older readings. While the last reading is not necessarily characteristic of a respondent's normal reading practices, it reveals general reading and use patterns across the study group. The questions examine many different aspects of the reading, including the article's source, the amount of time dedicated to reading the article, the reason for reading, and the significance of the reading with regard to the larger purpose.

Reading-related questions also examine two types of value in the information context, which economist Fritz Machlup[31] describes as purchase or exchange value and use value. An assumption can be made that faculty members will dedicate a large percentage of their work time to reading if they deem it to be a valuable activity; therefore, the exchange value can be measured by time spent reading. To assess the exchange value of reading, respondents were asked to recall the amount of time invested and their attention to detail while reading their most recent scholarly article.

From February 2012 through October 2012, an e-mail message was sent by librarians to faculty members at five US universities. The message included an external link to a survey hosted by the server at the University of Tennessee. The universities included both public and private universities, ranging in size from approximately 400 total faculty members to over 2,000. Although it is difficult to tell exactly how many faculty members were reached by the message, there are approximately 11,000 total faculty members at these universities. By the closing date of 9 January 2013, we had received 877 responses. If all faculty members received an invitation, this represents a response rate of just under 8%. Many of the universities surveyed reported simultaneous surveys deployed at their institutions; therefore, although we cannot definitely identify the reason for the relatively low number of responses, we suspect that survey fatigue may have played a role at certain institutions.

Method of analysis

Surveys were built and maintained using IBM's MR Interview survey software and exported into SPSS for data analysis. For all correlations, significance is at the 0.05 level unless otherwise noted. In addition, outliers for means are excluded based on three standard deviations from the mean in order to remain consistent with the past studies and to exclude responses outside the realm of reasonable expectation.[32] For instance, it is unreasonable to assume that a respondent could read 500 articles in a single month (30 days). Questions and order of questions remained the same throughout surveys and universities. Survey tools and overall reports for 2012 are available at http://libvalue.cci.utk.edu/. Survey tools and individual university reports for previous surveys are available at http://scholar.cci.utk.edu/carol-tenopir/survey-instruments-and-reports.

Limitations

The response rates in 2012 may make it hard to generalize across the population, although responses came from the range of disciplines and demographics represented at US universities. Surveys over time have different respondents and are from a range of US universities, and therefore exact comparison must be done with caution. The number of responses varies for each question because respondents were permitted to exit the survey at any point, to leave questions unanswered, and were logged off automatically if the questionnaire was started but never finished. In analysis, the number of responses for any given question is considered to be 100%. For example, if only 700 of the 877 respondents answered a question, then the analysis for that single question is calculated with 700 as the total number of responses. All of the responses are self-reported estimates of behaviours and we assume that respondents are truthful.

All respondents are associated with institutions that have strong libraries with subscriptions to journal resources. Conclusions should therefore be limited to academics who work at institutions where there are resources for them to access.

reading-related questions examine the two types of information value: purchase value and use value

Table 1. Overall population of participating universities in 2012

Institution	University A	University B	University C	University D	University E
Description					
Size	Small	Large	Large	Large	Large
Public/private	Private	Private	Public	Public	Public
Location	Northeast	Northeast	Southwest	Midwest	Southeast
Total population					
Faculty	446	1513	3514	2975	2884
Graduate	3300	6170	5127	10,673	6267
Undergraduate	5000	21,267	24,757	32,281	21,607
Faculty responses	84	201	91	393	68
Faculty response rate (%)[a]	18.8	13.3	2.6	13.2	2.4

[a]Response rate is calculated assuming that all faculty received an invitation.

Demographics

Table 1 shows the overall population of each university as well as the number of respondents. The response rate is the worse-case scenario based on total faculty population at each institution, but we cannot be certain that the survey reached every single faculty member.

Responses came from a variety of disciplines, as can be seen in Table 2. It should be noted that previous studies by Tenopir and King often reported respondents of all disciplines with the exception of humanities, but humanities are included in the 2012 results.

For easier analysis and comparison, ages of respondents were grouped into age categories by decades and under 30 or over 60 as shown in Table 3.

all respondents are in institutions with strong libraries

Results and discussion

Last source used

In order to contextualize the information-seeking behaviour and reading patterns of respondents, the following question was asked: what source did you use for the last substantive piece of information in your work? Articles still remain the most frequently used source of information to assist with the work of academics (see Table 4).

It should be noted that respondents may not always distinguish between websites and

Table 2. Disciplines of respondents in 2012

	A	B	C	D	E	Row total
Sciences	10	11	17	60	7	105
	15.6%	7.7%	29.3%	23.2%	10.0%	17.7%
Medical sciences	14	4	1	5	10	34
	21.9%	2.8%	1.7%	1.9%	14.5%	5.7%
E/T/M[a]	2	4	10	49	7	72
	3.1%	2.8%	17.2%	18.9%	10.1%	12.2%
Social sciences	20	75	13	81	27	216
	31.3%	52.8%	22.4%	31.3%	39.1%	36.5%
Humanities	14	42	13	50	12	131
	21.9%	29.6%	22.4%	19.3%	17.4%	22.1%
Other	4	6	4	14	6	34
	6.3%	4.2%	6.9%	5.4%	8.7%	5.7%
Column total	64	142	58	259	69	592
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Engineering/technology/mathematics.

Table 3. Respondent age in 2012

	A	B	C	D	E	Row total
Under 30	2	4	10	17	5	38
	3.2%	2.9%	17.5%	6.8%	7.5%	6.6%
31–40	12	37	15	69	16	149
	19.4%	27.0%	26.3%	27.6%	23.9%	26.0%
41–50	12	35	11	69	11	138
	19.4%	25.5%	19.3%	27.6%	16.4%	24.1%
51–60	23	38	10	58	17	146
	37.1%	27.7%	17.5%	23.2%	25.4%	25.5%
Over 60	13	23	11	37	18	102
	21.0%	16.8%	19.3%	14.8%	26.9%	17.8%
Column total	62	137	57	250	67	573
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

journals, particularly e-journals. Therefore, we must consider that some respondents may have chosen 'website' when 'journal' may have been more accurate. Nonetheless, journal articles, books or book chapters, and websites are the dominant types of information source used.

As King *et al.*[22] pointed out, an important factor in examining the information-seeking and reading patterns of readers is determining whether or how much of the information found in a recent reading was previously known by the reader. In 2012, three-quarters (74.3%) of respondents knew the information before reading it in their most recent article reading. Information was first discovered through a variety of sources, including other articles or previous readings of this same article (Table 5). It should be noted that respondents who became aware of information through a journal article are most likely referring to a citation. Furthermore, over a quarter (27.8%) of faculty respondents are using routes not listed in the survey. These sources included archive files, citations, books, author speaking engagements, a television show, Facebook, Twitter, Google Scholar, other news reports, and databases such as PubMed, EBSCO, and ScienceDirect. Scholars are increasingly using diversified means of discovering information and this tendency has only increased with the advent of various social media networks and sites.

how much information in the recent reading was already known?

Source and format of reading

The past three decades have shown a dra-

Table 4. Sources used by US faculty for their last substantive piece of information or work in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
Journal article	83	30	43	140	45	15	356
	79.8%	88.2%	62.3%	66.4%	34.6%	48.4%	61.5%
Book or book chapter	7	1	5	36	66	4	119
	6.7%	2.9%	7.2%	17.1%	50.8%	12.9%	20.6%
Website	10	1	12	23	8	4	58
	9.6%	2.9%	17.4%	10.9%	6.2%	12.9%	10.0%
Other	0	0	0	2	7	5	14
	0%	0%	0%	0.9%	5.4%	16.1%	2.4%
Personal contact	2	2	3	3	0	3	13
	1.9%	5.9%	4.3%	1.4%	0%	9.7%	2.2%
Conference proceeding	1	0	5	3	1	0	10
	1.0%	0%	7.2%	1.4%	0.8%	0%	1.7%
Magazine article	1	0	1	4	3	0	9
	1.0%	0%	1.4%	1.9%	2.3%	0%	1.6%
Column total	104	34	69	211	130	31	579
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 5. How US faculty who knew about the information prior to the last article reading initially became aware of the information in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
Journal article	28	13	12	43	31	5	132
	37.8%	54.2%	26.7%	29.5%	33.7%	26.3%	33.0%
Other	11	8	7	44	35	6	111
	14.9%	33.3%	15.6%	30.1%	38.0%	31.6%	27.8%
Informal discussion with colleagues	7	0	12	24	7	2	52
	9.5%	0%	26.7%	16.4%	7.6%	10.5%	13.0%
Email from colleague	8	0	3	11	4	3	29
	10.8%	0%	6.7%	7.5%	4.3%	15.8%	7.2%
Conference or workshop	7	1	4	8	5	1	26
	9.5%	4.2%	8.9%	5.5%	5.4%	5.3%	6.5%
Listserv or blog	3	2	0	10	4	1	20
	4.1%	8.3%	0%	6.8%	4.3%	5.3%	5.0%
Institutional Repository	1	0	3	5	2	0	11
	1.4%	0%	6.7%	3.4%	2.2%	0%	2.8%
Website of author	3	0	1	1	4	1	10
	4.1%	0%	2.2%	0.7%	4.3%	5.3%	2.5%
Preprint or e-print service	6	0	3	0	0	0	9
	8.1%	0%	6.7%	0%	0%	0%	2.3%
Column total	74	24	45	146	92	19	400
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

over three-quarters of article readings were from electronic resources

matic change in reading habits, particularly in regards to the sources where scholars obtain articles and format of reading. In 2000 and 2003, well under half of all readings (41%) were from an electronic source,[33] and scholars continue to obtain more reading material from electronic resources. In 2012, over three-quarters (76.4%) of scholarly article readings were obtained from an electronic resource. Even more dramatically, almost all (94.5%) of the readings obtained through a library subscription in 2012 were from electronic collections (Table 6). Much of this increase is no doubt due to improvements in desktop screen technology and a growing dependence on mobile devices.

The percentage of article readings obtained through personal subscriptions has been decreasing since 1977.[5] Articles obtained from personal subscriptions decreased from 60% in 1977 to 53% in 1984, down to 35.5% by the early 1990s.[6] This decline has continued – only 18% of article readings in 2012 are from personal subscriptions.

Table 6. Where US faculty obtain article readings in 2012

Where the article is obtained	Print		Electronic		Row total	
	n	%	n	%	n	%
Library subscription	15	5.5	260	94.5	275	100.0
Personal subscription	73	82	16	18	89	100.0
School/department subscription	6	11.8	45	88.2	51	100.0
Copy for a colleague or other person	11	25.6	32	74.4	43	100.0
Other	14	34.1	27	65.9	41	100.0
Institutional Repository	3	17.6	14	82.4	17	100.0
Interlibrary loan	3	42.9	4	57.1	7	100.0
Preprints	0	0	6	100	6	100.0
Column total	125	23.6	404	76.4	529	100.0

Table 7. Final format of reading by US faculty in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
Print article in a print journal	3 2.9%	7 21.2%	8 12.3%	41 20.4%	29 23.4%	7 23.3%	95 17.1%
Photocopy/facsimile copy	1 1.0%	1 3.0%	0 0%	6 3.0%	3 2.4%	2 6.7%	13 2.3%
Downloaded and printed on paper	30 29.1%	7 21.2%	20 30.8%	53 26.4%	35 28.2%	10 33.3%	155 27.9%
Online computer screen	47 45.6%	11 33.3%	24 36.9%	70 34.8%	39 31.5%	4 13.3%	195 35.1%
Previously downloaded and read on a computer screen	21 20.4%	6 18.2%	11 16.9%	24 11.9%	14 1..3%	4 13.3%	80 14.4%
Mobile, tablet, e-reader	0 0%	0 0%	2 3.1%	5 2.5%	1 0.8%	1 3.3%	9 1.6%
Other	1 1.0%	1 3.0%	0 0%	2 1.0%	3 2.4%	2 6.7%	9 1.6%
Column total	103 100.0%	33 100.0%	65 100.0%	201 100.0%	124 100.0%	30 100.0%	556 100.0%

Faculty may be looking for alternative (and perhaps more convenient or economical) means for obtaining readings. Or, perhaps, the increased numbers of free web journals available to academics in recent years are attracting more faculty notice. For example, article readings obtained through free web journals increased from 4.7% in 2005[22] to 7.6% in 2012, an increase of 62%. Likewise, readings from other websites increased from 0.5% to 3.8% between 2005 and 2012.[22] Furthermore, in 2012 nearly 7% of faculty members' readings (6.7%) were obtained through means not listed in the survey. These included Google, JSTOR, and Westlaw (demonstrating, perhaps, that faculty may not always be aware which resources constitute library sources or subscriptions and which are freely available on the open web).

Just because articles are obtained from an electronic source does not mean they are read on screen, however. Just over half of article readings were read on a computer or mobile screen (51.1%) (Table 7) and only a few article readings were read on a mobile/tablet/e-reader device. However, this will surely increase in the future, as publishers create more mobile device-friendly articles and academics con-

faculty may be looking for alternative means of obtaining readings

Table 8. Location of article reading by US faculty in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
Office or lab	86 83.5%	17 51.5%	54 83.1%	123 61.2%	48 38.7%	16 53.3%	344 61.9%
Home	14 13.6%	14 42.4%	6 9.2%	69 34.3%	71 57.3%	9 30.0%	183 32.9%
Elsewhere	1 1.0%	1 3.0%	2 3.1%	3 1.5%	2 1.6%	2 6.7%	11 2.0%
Travelling	1 1.0%	1 3.0%	3 4.6%	4 2.0%	1 0.8%	0 0%	10 1.8%
Library	1 1.0%	0 0%	0 0%	2 1.0%	2 1.6%	3 10.0%	8 1.4%
Column total	103 100.0%	33 100.0%	65 100.0%	201 100.0%	124 100.0%	30 100.0%	556 100.0%

tinue to alter their e-reading habits. When added together, 47.3% of article readings were read in a print format and 51.1% were read on a computer or mobile screen.

Physical location of reading

In addition, just because faculty members are reading e-articles obtained from the library collection, does not mean they are reading them in the physical library. Past surveys have indicated that faculty members perform a majority of readings in the office or lab.[6] Academics use library resources; however, they tend to access them remotely and rarely read e-resources in the library (Table 8). In 2012, very few article readings were read in the library. Faculty read in a variety of places in addition to the office, lab, or library, including while travelling, in the classroom, at a coffee shop, gym, or in multiple places. Location no longer dictates academic resource accessibility since faculty members can access and read scholarly material from almost anywhere.

Purpose of reading

Purpose of article readings by faculty is virtually unchanged since 2005.[6] Research and writing remains the most common purpose of reading, followed by teaching, current awareness/education, and others (Table 9). However, only 43% of article readings by faculty were cited or planned to be cited.

Outcomes

Consistent with previous surveys, in 2012 the top outcomes of article readings were 'added to my general knowledge', 'inspired new thinking', 'improved the result', and 'narrowed/broadened/changed the focus'. Fewer than 1% of article readings were considered a 'waste of time' (Table 10). Respondents were allowed to choose more than one outcome of reading.

Age of articles read

Previous studies found that when older articles are easily accessible, they will be used extensively; however, in an effort to stay well informed in their fields, scholars have a tendency to cite more current articles.[34–36] The usage of articles older than 6 years changed little between 1993 and 2005, holding steady at around 4.5%;[6] however, by 2012 there appears to be an increase in the readings of older articles. This may be because a greater number of older articles are available electronically and because ranking algorithms that display the most highly cited articles first (e.g. Google Scholar) display older items first that have had a chance to be cited more. In 2012, 54.9% of article readings were less than 2 years old, while only 9.3% were older than 15 years (Table 11). But, there were significant differences based on discipline ($\chi^2 = 43.655$, $df = 20$, $P = 0.002$).

There is a significant association between year of publication and where the respondent obtained the scholarly article. In 2012, articles obtained through personal subscriptions (88%), preprints (100%), and school/department subscription (53%) were more likely to be within their first 2 years of publication ($\chi^2 = 55.558$, $df = 40$, $P = 0.052$). This finding supports previous studies which found that

Table 9. Article readings by purpose by US faculty in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
Research and writing	73 71.6%	18 54.5%	45 69.2%	116 57.7%	71 57.3%	5 16.7%	328 59.1%
Teaching	10 9.8%	9 27.3%	8 12.3%	42 20.9%	35 28.2%	6 20.0%	110 19.8%
Current awareness/education	13 12.7%	4 12.1%	8 12.3%	28 13.9%	9 7.3%	12 40.0%	74 13.3%
Others	6 5.9%	2 6.1%	4 6.2%	15 7.5%	9 7.3%	7 23.3%	43 7.7%
Column total	102 100.0%	33 100.0%	65 100.0%	201 100.0%	124 100.0%	30 100.0%	555 100.0%

Table 10. Outcomes of article readings for US faculty in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
It added to my general knowledge	53 51.5%	17 51.5%	48 72.7%	127 63.2%	74 59.7%	24 80.0%	343 61.6%
Inspired new thinking	58 56.3%	15 45.5%	34 51.5%	116 57.7%	69 55.6%	14 46.7%	306 54.9%
Improved the result	29 28.2%	15 45.5%	20 30.3%	72 35.8%	64 51.6%	6 20.0%	206 37.0%
Narrowed/broadened/changed the focus	21 20.4%	8 24.2%	20 30.3%	44 21.9%	31 25.0%	8 26.7%	132 23.7%
Saved time or resources	12 11.7%	2 6.1%	14 21.2%	23 11.4%	17 13.7%	2 6.7%	70 12.6%
Resolved technical problems	12 11.7%	1 3.0%	14 21.2%	10 5.0%	3 2.4%	2 6.7%	42 7.5%
Made me question my work	6 5.8%	0 0%	2 3.0%	12 6.0%	13 10.5%	1 3.3%	34 6.1%
Resulted in faster completion	3 2.9%	1 3.0%	6 9.1%	11 5.5%	10 8.1%	1 3.3%	32 5.7%
Others	5 4.9%	2 6.1%	1 1.5%	11 5.5%	4 3.2%	2 6.7%	25 4.5%
Resulted in collaboration/joint research	4 3.9%	0 0%	3 4.5%	9 4.5%	2 1.6%	3 10.0%	21 3.8%
Wasted time	0 0%	0 0%	1 1.5%	1 0.5%	0 0%	2 6.7%	4 0.7%
Column total	103	33	66	201	124	30	557

[a]Participants could select more than one outcome, so percentages will not add up to 100%.

the library becomes an increasingly important source of obtaining material as the material ages.[6]

Amount of reading

From 1977 to 2012, all surveys distributed by Tenopir and King asked respondents to estimate how many articles they had read in the previous month. The results provide an approximation of how many articles are read on average in a month or can be projected to a year, which is often done to compare

Table 11. Year of publication of readings by US faculty in 2012

	Sciences	Medical sciences	E/T/M	Social sciences	Humanities	Others	Row total
Over 15 Years	6 5.9%	1 3.0%	7 10.9%	13 6.6%	22 17.9%	2 6.7%	51 9.3%
11–15 Years	3 2.9%	0 0%	3 4.7%	6 3.0%	8 6.5%	2 6.7%	22 4.0%
6–10 Years	11 10.9%	1 3.0%	8 12.5%	18 9.1%	20 16.3%	3 10.0%	61 11.1%
2–5 Years	18 17.6%	6 18.2%	8 12.5%	53 26.8%	26 21.1%	3 10.0%	114 20.7%
Less than 2 Years	64 62.7%	25 75.8%	38 59.4%	108 54.5%	47 38.2%	20 66.7%	302 54.9%
Column total	102 100.0%	33 100.0%	64 100.0%	198 100.0%	123 100.0%	30 100.0%	550 100.0%

results over time and across populations. Both articles and reading are defined in the survey question:

> In the past month (30 days), approximately how many scholarly articles have you read? Articles can include those found in journal issues, Web sites, or separate copies such a preprints, reprints, and other electronic or paper copies. Reading is defined as going beyond the table of contents, title, and abstract to the body of the article.

In 2012, the mean of monthly article readings was 20.66 (median = 15.00).[37] Figure 1 shows the amount of reading differences among disciplines ($F = 3.774$, $df = 5$, $P = 0.002$). Assuming the last month was typical, calculations projected over 1 year (12 months) show that faculty read approximately 252 articles per year in 2012.

there is an increase in the numbers of older articles being read

If these numbers are examined against previous Tenopir and King surveys (which did not include humanities faculty), beginning in 1977 when 150 readings per year were reported, we may be seeing the start of a plateau in the number of article readings per year.[6] After a period of rapid growth in the late 1990s and early 2000s (from 188 readings in 1993 to 281 in 2005 surveys), the number of readings by faculty may be slowing.[6] Excluding humanities respondents, science and social science faculty read approximately 264 articles per year.

We recognize that the high standard devia-tions and large range values do not allow the means to be a very reliable standard for comparison, and neither were the medians since the data was not normally distributed. However, since previous studies examined the means, we continued with this examination in order to identify the trend over time. Our focus here remains on the trend, rather than on particular means or numbers.

Quality v. quantity: time spent reading and thoroughness of reading

In order to get an indication of exchange value, academics were asked how much time they spent reading an article and how thoroughly they read the article. In 2012, faculty spent approximately 32 minutes per article reading (mean = 32.04, median = 25.00).[38] Figure 2 looks at the differences between discipline and time spent reading, with no significant differences based on discipline.

Since 1977, science and social science academics, on average, have spent less time per reading. In 1977, science and social science faculty spent an average of 48 minutes per reading.[6] By 2005 mean article reading time had decreased to just under 31 minutes per article,[6] an average that did not significantly change for 2012 when excluding humanities to comply with earlier studies (mean = 30.79, median = 25.00).[39] As with the total amount of article readings per year, the findings suggest a plateau has been reached. Having reported
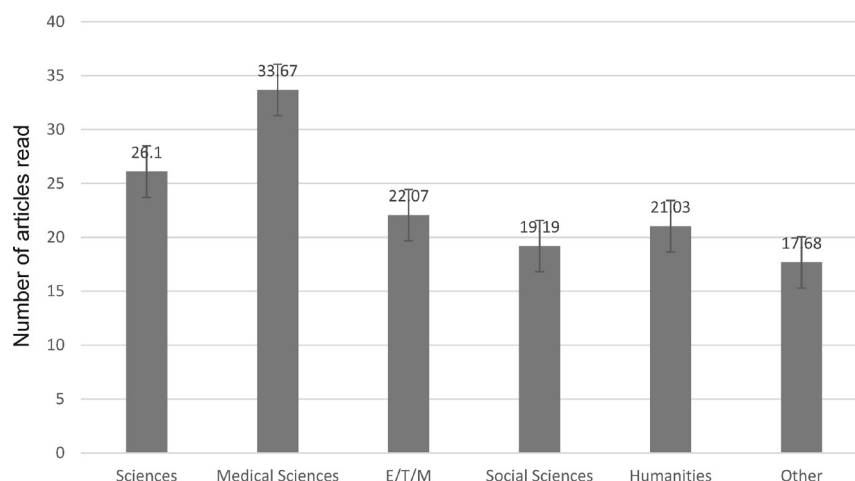

Figure 1. Differences in monthly amount of reading between disciplines by US faculty in 2012.
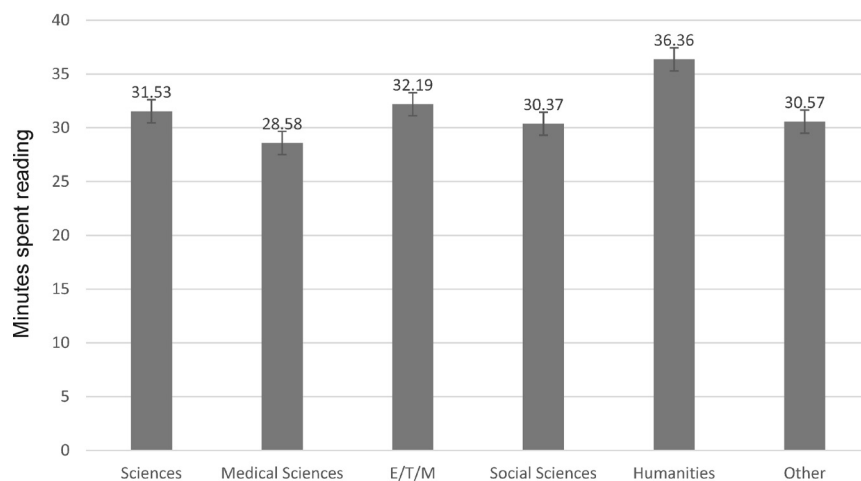
Figure 2. Differences in time spent reading (in minutes) between disciplines by US faculty in 2012.

decreased time spent per reading in every survey since 1977, this decrease has slowed.[6] Perhaps about a half hour per reading on average is reaching the shortest time possible for a productive reading of a scholarly article.

Thoroughness of reading is also an important indicator of exchange value; therefore, we asked of the critical incident of last reading, 'How thoroughly did you read this article?' In 2012 64% of respondents reported reading scholarly articles with 'great care'.

Conclusions and implications

Since Tenopir and King's first surveys examining scholarly reading in 1977, several patterns of information-seeking and reading behaviour have emerged. Some behaviours have undoubtedly changed with the advent and increasing popularity of electronic resources, both through electronic journal and database subscriptions from libraries and open access through the Internet.

From 1977 until 2005, studies showed a substantial increase in the average number of article readings by science and social science academics, while the time spent reading each article on average decreased significantly. These 30 years also saw an increased reliance upon library materials as readings from personal subscriptions declined.[6]

The latest results show the first signs that the increase in the number of article readings may have reached a plateau among US academics, while time spent per article reading has levelled off. Academics in 2012 still spend much of their time reading scholarly articles, and articles remain the most frequently used source of information to support the work of academics.

The answers to why a 30-year trend may be changing can only be speculated, and there may be differences in the survey population. It may be that academics are reaching a limit in the amount of information sources they can reasonably consume. Moreover, changes may also be due to the growing variety of types of sources that contain scholarly information and are readily available. Academics continue to discover articles through a growing variety of sources and they read for many different purposes. Today they may access scholarly content through an ever-widening range of sources other than articles, including not just books, conference proceedings, government documents, and magazine articles, but also blogs, listservs, and social networking sites.[9,40]

Scholarly articles, now most often accessed electronically, are increasingly also read on screen. This is no doubt due to improvements in screen technology and also the growing tendency to expect access to information wherever a scholar may be and on multiple types of devices. Although most scholarly article reading is done for the purposes of research or teaching, publishers will need to provide formats and access that meets the scholars' expanding view.

the increase in the number of readings may be slowing

Articles still remain important to academics' work life for research, writing, teaching, and current awareness. Changes in behaviour are evident, however, in access, final form of reading, and amount of reading. As scholarly journal systems progress and as scholars use new ways to access and read scholarly material, additional changes are likely.

maybe academics are reaching a limit in the number of information products they can consume

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38. SD = 27.581, median = 25.00, SEM = 1.101, excluding three outliers over 180; including the outliers, mean = 34.22, median = 25.00, SD = 48.687, SEM = 1.938.

39. SD = 27.205, median = 20.00, SEM = 1.313, excluding three outliers over 180; including the outliers, mean = 34.22, median = 25.00, SD = 48.687, SEM=1.938.

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