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Desired Affordances of Scholarly E-Articles: Views from Scholars Based on Open-Ended Answers

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Abstract: E-journals are constantly evolving and adding new features, however, scholars' views of desired features of scholarly e-articles have not received much attention. Scholars' opinions were studied as part of two scholarly reading surveys conducted in Finland in 2016 and internationally in 2018. Respondents were asked "What features would you like to see in e-scholarly articles in the future" and "How have your reading practices changed in the last few years and how do you expect them to change". A qualitative thematic analysis of 588 open-ended comments to these questions was performed. Themes discussed in open ended comments concern availability and accessibility; readability, searchability, findability, and discoverability; sharing and collaboration affordances; and seamlessness between reading and writing. Respondents also discussed affordances such as more visual materials, more interactivity, easier export of references, links to original research data, open commenting, open peer review, possibility to update articles, links to authors' social media sites, and templates for secondary and meta-analysis. Users' discussion of affordances for finding, discovering, sharing, and handling information provide insights to publishers, libraries, and web designers.

Keywords: affordance theory, e-journals, reading research, scholarly communication

1 Introduction

Scholarly e-journals are part of the knowledge infrastructure of science and technology. According to Edwards et al. (2007),

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knowledge infrastructures are not systems in the sense that they would be fully coherent, deliberately engineered processes. Infrastructures for scholarly knowledge production are ecologies consisting of numerous actants, including communities of scholars, scientific organizations, commercial enterprises, information technologies, content, shared norms, genres, and practices (Edwards et al. 2007). These numerous actants have diverse origins and goals, interoperating in the technological material ensembles that are scholarly e-journals. E-journals have both a material technological basis and associated social practices. They are complex adaptive systems, continually changing, as new features are introduced reflecting the changes in the overall web services and environments which scholarly journals are now part of. From the viewpoint of scholars' work practices, some changes in e-infrastructures enhance ways of working, while some may have a less than optimal fit with ways of working.

Users' views on the affordances of e-journals have not received much attention. We gathered data on scholars' views from answers to open-ended questions as part of two surveys focused on scholars' reading of different types of materials for their work. The surveys were conducted in Finland in 2016 and internationally in 2018. Answers to two open-ended questions, "What features/characteristics would you like to see in e-scholarly articles in the future" and "How have your reading and sharing practices changed in the last few years and how do you expect them to change in a year or two", are analyzed thematically. The answers to these questions offer a rich body of testimonies regarding desired affordances and preferred ways of working with e-journal articles.

The closed-questions in the surveys concerned the use, reading, and obtaining of different types of materials in scholarly work (Late et al. 2018, 2019; Tenopir, Christian, and Kaufman 2019; Tenopir et al. 2019a, 2019b).

The affordance theory and its background is presented in the following section. The affordance theory provides a useful lens for analyzing the open ended answers, because it helps in bridging scholars' views and statements with suggestions concerning concrete design of e-journals and the e-journal infrastructure. Earlier studies concerning scholars' use and desired affordances of print and e-journals are reviewed in Section 3. The data and methods are

presented in Section 4, and results in Section 5, followed by discussion and conclusions.

2 Affordance Theory

The affordance concept was coined by Gibson (1979) together with his wife Eleanor, as part of a body of work called an ecological theory of perception and learning. In Gibson's (1979) thinking, what people are able to notice and perceive in their environments inform the possibilities for action. The term affordance refers to possibilities: what a technology enables us to do, and what kinds of constraints it sets to our possibilities to do things with a given technology.

Affordances are not the same for every actor because the actors' earlier experiences greatly influence their perception. Both the material actual existence of affordances and the socially developed skills to notice them are needed for the perception of affordances (Hutchby 2001). For forming an analytic framework for studying affordances, Gaver (1991) made distinctions between perceived affordances and latent (not perceived) affordances, and between desired affordances and undesired affordances.

Table 1 describes users' possible relationships to existing affordances: users may be able to notice existing affordances or not notice them (identified or not identified affordances). They may assume that affordances that do not exist would be available (assumed affordances). Or they may notice that some desired affordances are not available (missing affordances).

Table 2 describes users' possible relationships to identified affordances. These can be experienced as desired or undesired, and necessary or unnecessary.

Affordance theory thus does not approach the material features of technologies as "given", but as relational to their use in a specific practice or activity (Bloomfield, Latham, and Vurdubakis 2010). Affordances become visible and are

experienced as useful or not useful in the sociocultural context in which they are used and in relation to specific kinds of work tasks (Bloomfield, Latham, and Vurdubakis 2010). Different readers observe the affordances of e-journals differently, and have different expectations (Table 2). Understanding users' views of e-journals' affordances may help in developing the features of e-journals to better support scholarly work practices.

3 Earlier Studies

3.1 Reading Research

In their classic study of the functions and uses of paper and digital documents at work, Harper and Sellen (2002, 82–83) identified 10 categories of work-related reading, each type related to different work tasks and purposes of reading. They found that reading for work is sometimes sequential – carefully reading a whole document from start to finish to properly understand its contents. Often, reading involves skimming through documents to get a feel of their contents and to decide whether they are useful, flicking through pages to search for answers to questions, reading and comparing several documents simultaneously for getting an overview of an issue. Reading is often done in collaboration or in group situations where contents are jointly reviewed or discussed (Harper and Sellen 2002).

Some types of reading identified by Harper and Sellen (2002) are particularly typical for scholarly work, for instance, reading to edit or critically review a text, and reading in conjunction with writing. Reading involves multiple documents as often as it involves one document at a time. Reading for writing encompasses a range of activities such as making comments, notetaking, annotation, creating and modifying new documents. The problems of writing across multiple sources have been studied by, for instance, O'Hara et al. (2002), Hillesund (2010), Pearson et al. (2012), and Bold and Wagstaff (2017). Extracting and integrating information from diverse sources and marking up documents in a paperlike way have been identified as major challenges when using electronic books and journal articles.

3.2 Digital Reading

Longitudinal studies on changes in scholars' reading patterns show that scholars now read more but spend less time per article (Tenopir et al. 2009; Tenopir, Volentine, and King 2012). Summarizing digital footprint studies of

Table 1: Users' relationships to existing affordances (modified from Arminen and Raudaskoski 2003).

| Existing affordance | Identified Assumed | Latent (not identified) Missing |
|---------------------|-----------------------|------------------------------------|
|---------------------|-----------------------|------------------------------------|

Table 2: Users' possible views of identified affordances (modified from Arminen and Raudaskoski 2003).

| Identified affordance | Necessary Desired | Unnecessary Undesired |
|-----------------------|----------------------|--------------------------|
|-----------------------|----------------------|--------------------------|

scholars' actions in the digital space, Nicholas and Clark (2012) concluded that the digital reading environment tends to foster surface reading. Less time spent per site, lessening amounts of downloads, signify an increase in "lite reading" and a decrease in word-by-word, sentence-by-sentence deep reading. These findings are similar to Hillesund's (2010) interview study with scholars concluding that highly interactive digital environments afford little space for sustained reading of longer texts. Hillesund (2010) and Mangen (2008) point out that reading is conditioned by text technologies. The digital environment is, through its systems of links and facilities, extremely accessible but "essentially borderless" (Hillesund 2010, 8).

Mangen (2008) stresses that print text is tangible in ways that digital texts are not (unless they are printed out). According to Mangen (2008), the constancy, temporal, and spatial permanence of print text have different sensory-motor affordances to intangible digital texts. Digital reading entails physical actions such as clicking and scrolling and jumping between pages, providing cues that draw attention away from content at hand, that easily induce a constant state of distraction, making us read in a less focused way (Mangen 2008).

On the other hand, digital reading encourages skills of its own (Hayles 2010), if we believe that each technology offers its own kinds of extensions to our minds and how we work (Clark and Chalmers 1998). Hayles notes that scholars have been slow to admit any salutary effects from digital reading. However, scholars have always had to scan through a great amount of material to identify the most relevant articles and results, and to get an overview before deeper analysis and interpretation. As the amount of information available only continues to increase, the digital reading environment supports the task of quickly constructing "landscapes of associated fields and subfields" and filtering the range of already existing research (Hayles 2010, 66). She also stresses that "as electronic literature matures, it develops rhetorics, grammars, and syntaxes unique to digital environments" (Hayles 2003, n.p.). This study wishes to learn from scholars' own experience about the affordances, readability and usability of information, in paper and electronic formats.

3.3 Reader Typologies

Shrimplin and colleagues (Revelle et al. 2012; Shrimplin et al. 2011) studied university faculty and student preferences for digital or printed media via a survey. They identified four clusters of readers: 1) book lovers (34%), who prefer the tangible nature of print books and dislike

reading off a computer monitor; 2) technophiles (23%), who were interested in the possibilities of new technologies, experienced no difficulty in reading from screen, and who value the accessibility and searching functionality of e-books; 3) pragmatists (17%), who preferred printed books for leisure reading but used e-books for academic reading; 4) printers (26%), who preferred to print out e-books due to difficulties of reading on screen. Opinion types were strongly associated with academic discipline, with humanities, fine arts, and education scholars preferring print books, and technophiles more strongly represented in engineering and business (Revelle et al. 2012).

Kurata et al. (2017) used the same reader typology as a basis in their study of reading preferences amongst the general public in Japan. Digital reading was studied in its entirety including not only e-books or e-articles but all digital content. According to their results, paper lovers always prefer paper. The digital reader cluster preferred mostly digital materials whereas other reader types' (named as utilitarian and eclecticist) preferences varied according to the purpose of reading (for pleasure or for work), style of reading (skimming, selective, intense, for deep understanding), task performed (e.g., marking or finding a specific part), situation (e.g., travel) and mood (e.g., relaxed, or seeking accomplishment). According to this study, time spent on reading had shifted in favor of digital media (70% of total reading time) (Kurata et al. 2017).

3.4 Scholars' Perceptions of Changes in Scholarly Publications

Studies of scholars' reading show that a vast majority of readings (90%) are now obtained through electronic means, however, printing discovered readings on paper is still not an obsolete practice. While the majority of readings (54.9%) were read on a computer or mobile/tablet screen, 44.5% were read on paper (Tenopir, Christian, and Kaufman 2019, 13).

In a study focusing on what influences scholars' choices of e-articles, Tenopir et al. (2011) found that after topical relevance, the most important characteristic was the online accessibility of the article (availability online without direct personal cost to the reader). The other important factors were the readers' knowledge about the authors and their reputation, followed by journal type and reputation (presence of peer review). In open-ended comments, respondents introduced other characteristics such as readability, editing quality, good graphic design, impact factor, easy downloading, and full abstracts (Tenopir et al. 2011).

The University of Tennessee and The CIBER research group (Nicholas et al. 2014; Watkinson et al. 2016) conducted a multi-phase study of scholars' perceptions of scholarly publications in the digital transition. The study looked at scholars' views concerning quality of articles and journals, peer review, open access publications, discovery platforms, and journal functionalities such as access to research data. Many scholars were unsatisfied with the quality and quantity of (too many) journals, and the pace and quality of editorial processes. The quality of abstracts had become more important for choosing what to select for reading. Recommendations coming from personal networks were also rated as important. Due to improved search systems which provided access to a wealth of articles, information management emerged as a greater challenge than finding relevant publications. Modes of searching had become more similar to everyday Google searching practices. Most supported the idea of open access and increased access to data (Nicholas et al. 2014). However, ideas concerning transforming scholarly communication or for changing the standard model of the scholarly article did not emerge from these studies.

4 Research Method and Data Collection

Our data were collected via two electronic surveys in 2016 and 2018. The same questionnaire was used in both surveys. The specific research questions of the current study are:

RQ1. What features of e-articles do scholars perceive as important?

RQ2. What new affordances do scholars desire for e-articles?

RQ1 is answered by analyzing the surveys' quantitative question about the perceived importance of eight different e-publication features. Respondents were asked to evaluate the importance of these eight features with a Likert scale (1–5). In order to answer RQ2 we performed a thematic qualitative analysis of open-ended comments concerning desired e-journal affordances.

The first set of data was collected via electronic survey from scholars working in Finnish universities and research institutes in autumn 2016. The Finnish National Library's FinELib consortia asked its member libraries to distribute the questionnaire to their respective faculty members, doctoral students, and other researchers

during October through to mid-December 2016. A total of 528 Finnish scholars replied to the first survey out of a possible total population of 25,428 (Vipunen Education Statistics 2016). The number of responses varies from question to question because respondents were able to skip any of the questions or exit the survey at any time. For the purposes of this article, respondents who did not answer the questions analyzed in this article were removed from the data, leaving 424 responses.

The same survey questionnaire was distributed internationally in February–May 2018. The IEEE (Institute of Electrical and Electronics Engineers) and Sage Publishing sent emails, inviting members or authors to participate in the survey by providing a link to the instrument held in the University of Tennessee server. In addition, the ProQuest Pivot service added a message in their "In Product" announcement feature in February 2018. Six hundred and six scholars from different countries responded to the international survey. Respondents who did not answer the questions analyzed in this article were removed from the data, leaving 274 responses. In the international survey, respondents came from many countries, with representation across the world (Table 3).

In terms of disciplinary background (Table 4), scholars working in the fields of technical sciences and social sciences were the most active respondents in the international survey, which is natural given the main subject areas of the distributors (IEEE and Sage). In the Finnish survey, scholars from natural sciences form a bigger proportion of the respondents (24.5%) than in the international survey (3.9%). The lower response rate of medical scientists in both surveys is probably due to the methods of circulating the invitation. In the international survey, 44.5% of the respondents were from technical sciences. In both surveys, about a third of the respondents were social scientists, and about 8% were humanities scholars (Table 4).

In terms of the position of the respondents (Table 5), senior scholars, professors and lecturers, were more

Table 3: Geographic background of respondents to the international survey (2018).

| Region | Freq. | % |
|-----------------------|-------|------|
| US/Canada | 90 | 32.8 |
| Central/South America | 22 | 8.0 |
| Europe/Russia | 62 | 22.6 |
| Australia/New Zealand | 8 | 2.9 |
| Asia/Southeast Asia | 66 | 24.1 |
| Africa/Middle East | 21 | 7.7 |
| Missing | 5 | 1.8 |
| Total | 274 | 100 |

Table 4: The discipline of survey respondents (2016 and 2018).

| Disciplinary group | INT. survey 2018 (%) | Finnish survey 2016 (%) | Total (%) |
|--------------------|----------------------|-------------------------|------------|
| Natural sciences | 10 (3.9) | 104 (24.5) | 114 (16.3) |
| Technical sciences | 168 (44.5) | 94 (22.3) | 262 (37.5) |
| Medical sciences | 17 (8.1) | 72 (17.0) | 89 (12.8) |
| Social sciences | 62 (33.7) | 116 (27.4) | 178 (25.5) |
| Humanities | 14 (8.1) | 32 (7.5) | 46 (6.6) |
| Other | 3 (1.7) | 6 (1.4) | 9 (1.3) |
| Total | 274 | 424 | 698 |

Table 5: The position of the survey respondents (2016 and 2018).

| Status | INT. survey 2018 (%) | Finnish survey 2016 (%) | Total (%) |
|------------------|----------------------|-------------------------|------------|
| Professor | 98 (35.8) | 102 (24.1) | 200 (28.7) |
| Lecturer | 6 (2.2) | 89 (21.0) | 95 (13.6) |
| Post doc | 10 (3.6) | 67 (15.8) | 77 (11.0) |
| Doctoral student | 37 (13.5) | 94 (22.2) | 131 (18.8) |
| Other researcher | 22 (8.0) | 71 (16.7) | 93 (13.3) |
| Missing | 101 (36.9) | 1 (0.2) | 102 (14.6) |
| Total | 274 | 424 | 698 |

active in responding to the questions analyzed in this article. Professors make up about 36% of the respondents in the international set, and professors and lecturers together make up 45.1% of the respondents in the Finnish survey (in Finland, lecturers are typically senior scholars with a doctoral degree and/or postdoctoral research experience). Doctoral students make up about 14% of the respondents in the international surveys, and 22% in the Finnish survey. Project researchers form 15.8% of the respondents in the Finnish survey. In the international survey, about 37% of the respondents worked outside of academia, in industry, profit and non-profit organizations and government.

The surveys included two open-ended questions, “What features/characteristics would you like to see in e-scholarly articles in the future” (226 comments), and “How have your reading and sharing practices changed in the last few years and how do you expect them to change in a year or two” (362 comments). In all, there were 588 open-ended comments. Importantly, scholars working in the fields of technical sciences and social sciences were the most active in writing comments to our questions (Table 6). However, scholars in all disciplines participated in commenting.

Table 6: Number of comments by discipline on two open-ended questions in the surveys.

| Disciplinary group | INT. survey 2018 | Finnish survey 2016 | Total | % |
|--------------------|------------------|---------------------|-------|------|
| Natural sciences | 8 | 90 | 98 | 16.7 |
| Technical sciences | 121 | 96 | 217 | 36.9 |
| Medical sciences | 17 | 39 | 56 | 10.0 |
| Social sciences | 72 | 92 | 164 | 27.9 |
| Humanities | 16 | 26 | 42 | 7.1 |
| Other | 5 | 6 | 11 | 1.9 |
| Total | 239 | 349 | 588 | 100 |

Comments were categorized to themes according to the content. The answers have been edited and shortened for better readability. A typical open-ended comment was 1–2 sentences long. The longest responses were about half a page long (about 200 words). Different aspects discussed in the same comment have mostly been extracted from each other in the quotes presented. All comments in the international survey were in English. Comments written in Finnish were translated from Finnish to English.

5 Results

5.1 The Importance of Different E-Publication Features: Quantitative Results

Scholars were asked in the final section of the survey to evaluate the importance of different e-publication features in a simple Likert scale where 5 equals absolutely essential and 1 not at all important. Mean values of the responses are presented in Figure 1.

Ability to share publications or contents with colleagues was evaluated as the most important e-article feature in both surveys. About one fifth of the scholars saw the ability to share the publication as essential, and over 70% as important.

Enhanced navigation possibilities such as the ability to jump to footnotes, tables, and graphics and back to the body of the text were also perceived as important by the majority of respondents. One fifth of the respondents to the international survey and 13% of the Finnish respondents perceived this feature as essential. The importance of note taking and making highlights was clearly represented in both closed and open questions.

A majority of the respondents also perceived tablet and mobile phone compatibility at least as important. Tablet compatibility was perceived as more important compared

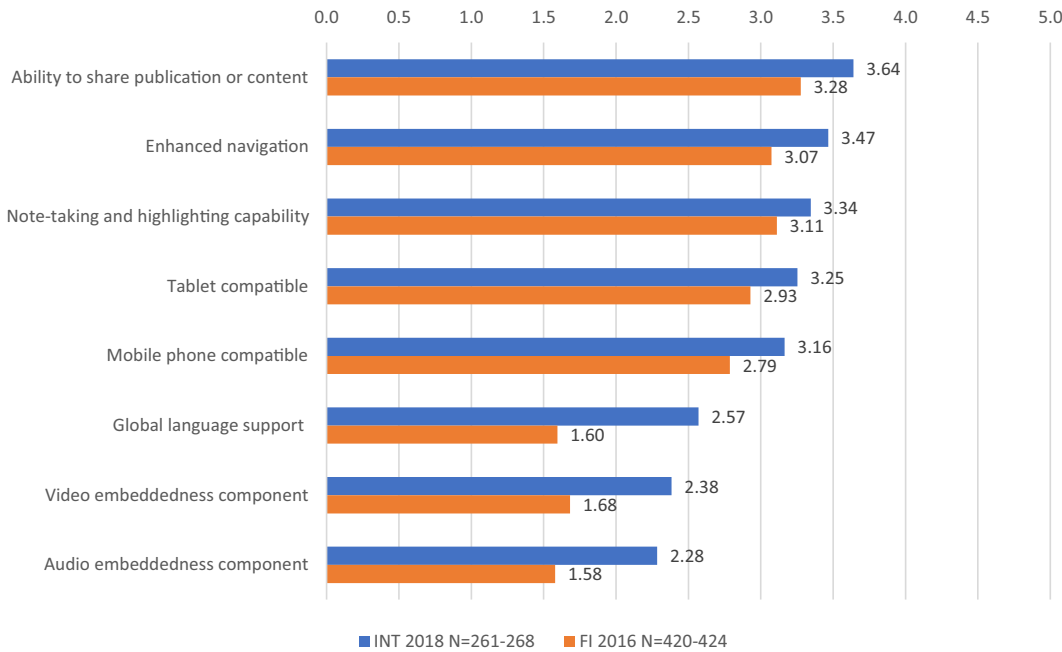


Figure 1: Mean values of the importance of different e-article features for scholars' work (scale 1–5).

to mobile phone compatibility. In the surveys scholars were also asked in what format they read their last scholarly article. Only about three percent of the Finnish scholars and about five percent of the international survey respondents had read their last article from a handheld device. Yet, a majority of the respondents (INT: 55%, FI: 54%) had read their latest article from the screen. Most of the readings were done in scholars' offices or labs (INT: 56.6%, FI: 66.2%), but the share of readings taking place in other settings such as home, or during travelling, has increased during the last 10 years (Tenopir et al. 2019a). Working from a distance may further increase the popularity of handheld devices.

Other value added features were not seen as important by the majority of survey respondents. Over half of the respondents did not perceive global language support or video and audio embeddedness components as important. In the international survey these features were perceived as more important compared to the Finnish survey, which is likely to be due to the time difference between the two surveys. During the two years between the two surveys scholars have become more aware of the potential novel features of e-journals and e-books, because respondents of the international survey perceived all e-publication features as more important compared to Finnish respondents.

All of the features presented in closed questions were brought up also in the open-ended questions, but

open-ended comments offer insights into desired features that we did not specifically ask in the closed questions.

5.2 Thematic Analysis of Open-Ended Comments

The open-ended comments were analyzed into themes according to the aspects lifted up by respondents in their answers. The two open questions were analyzed in tandem, because respondents commented on e-journal affordances in relation to their reading and working practices in answers to both questions. Presenting the full range of views is more important in qualitative analysis than how many expressed a particular view. The themes discussed in the open-ended comments were classified into the following groups:

- availability and accessibility;
- readability;
- searchability, findability, and discoverability;
- sharing and collaboration affordances;
- seamlessness between reading and writing;
- value added features.

5.2.1 Availability and Accessibility

In line with earlier results (Tenopir et al. 2011), availability and accessibility were most often mentioned in the

open-ended answers as the desired features. Many respondents defined availability and accessibility as the most important functionality of e-articles:

Good availability is most important.

Securing availability is the most important thing.

Just traditional readability and good availability.

Some of those who prioritized availability and accessibility as the most essential also expressed that they were happy with the current functionalities and wished for no new features or changes:

Current functionalities are sufficient.

It's too tiresome to read several articles from the computer screen, everything must be printed. So it doesn't matter what gimmicks there are in the article.

The functionalities, readable text and figures, are already sufficient.

Some scholars also expressed a view that e-articles should be as close to paper article format as possible. Links, for instance, represent “noise” for some, drawing attention away from the content. Content and quality of content were stressed by many respondents to be more important than “fancy features”:

Well-written and well-structured texts. The content is more important to me than the layout or other fancy features. It's research, not entertainment.

Commentators who expressed basic availability to be their only and central requirement also hoped to get access to older journals in e-format, stating that the availability of classic texts and articles in digital form should be improved.

Regarding accessibility, open access was often brought up in the comments. Respondents hoped that open access publishing would become more common, and some stressed that “all science ... should be open, also for citizens.”

More open access to content. Closed systems like ResearchGate and closed systems requiring institutional subscription are a significant deterrent to my work and provide substantial friction to innovation and collaboration. Access to research is an archaic mess.

Research should be publicly available, digitally, at any time. I hope in the future everything will be open source and easy to get (as simple as Googling!), and academic publishers go out of business because of their outdated and predatory business models.

Academy shall be free access and free publishing. Now with the e-media journals do not have excuses for rapping money from researchers and institutions.

5.2.2 Readability

Reading surveys show a steady increase in reading from screen (Tenopir, Christian, and Kaufman 2019; Tenopir et al. 2019a). Many open-ended comments stressed that readability, the ease of reading, is a central requirement for e-articles. Reading directly from screen was experienced as un-ergonomic by many. Some scholars saw that reading from screen does not allow deep immersion in the text, and stated that they still preferred to print out e-articles for concentrated reading.

While we short list by glancing at the material on the digital version, I still print out for a proper read and understanding of the paper.

Electronic reading is not in general the most useful way of researching in my discipline when close reading is essential.

When I first started my masters I was mostly printing electronic documents and reading them that way. I do still prefer to do that but since I am reading so many articles I have found myself reading off the screen more and more. I expect my habits to stay about the same as they are now: most articles which I just want a quick feel for I will read on screen and those I feel will be more important or useful I will print out.

On the other hand, many respondents also said that they had grown accustomed to reading entirely or almost entirely directly from screen. Some said that they had observed printing to be futile, as printouts tend to gather into unorganized piles, or because printouts get easily lost or are difficult to find again later.

I read directly from the web, I rarely print out articles anymore.

Only read on the computer. More reading in browsers and on tablets/phones while on the go.

I read articles more and more from the screen only, although I experience it as more laborious than reading from paper. It's likely that I'll give up printing on paper almost entirely, because the printouts tend to get lost anyway after the first glimpse.

The surveys indicated that reading e-articles with mobile devices was not yet common (Late et al. 2019). Some respondents commented they had grown accustomed to reading on mobile devices, for instance during traveling. These respondents estimated reading on mobile devices to increase in the future. Many also commented that because reading on mobile devices is as yet un-ergonomic, ensuring readability on mobile devices is a central target for design.

I would love for articles to be published in e-reader form, i.e. Kindle-compatible. I hate reading demanding texts from backlit

tablets (however, entertainment texts are fine). I would love if I could just download all articles in, for example, .epub format to my reader.

Some comments on readability expressed a hope for more standardization across e-journal or e-book interfaces.

As long as the [functionalities] work in the same way in all environments and with all browsers. No publishers or designers own gimmicks, having to read each journal or book via different tricks.

The advantages of searching and reading documents digitally include the ability for quick navigation through texts, strategically shifting through large amounts of readings to get a picture and choosing the most relevant ones for more detailed inspection. Skimming through abstracts, conclusions, and tables within a short time was viewed as a major improvement in many comments. Several also commented that, for this reason, their amount of reading has increased, and will likely continue to increase.

I read scholarly literature, especially articles, in greater numbers and more efficiently, because I have learned methods that enable a better a reading practice.

I read continuously more. I also comment more (not in social media). The demands and criteria for interesting content and scholarly quality also grow.

I guess the amount of revisited articles is increasing, relative to the amount of new articles read.

5.2.3 Searchability, Findability and Discoverability

Searchability refers to the ease with which users can conduct a search, scan the results of the search, and pick relevant results. The kind of advanced searching conducted by information specialists using selected databases and carefully pre-planned search strings was sometimes seen as unnecessary or no longer needed. Comments on searching almost invariably stressed that “searching has become faster and easier” and that searching “keeps getting easier” (see also Nicholas et al. 2014), because Google or Google Scholar yield results with a couple of keywords and it is quick to decide whether the results are relevant and satisfactory.

The search engine Google already functions so well that with ... searching by keywords you can find the information you need and the published articles. I never use the search fields in publication archives I just google.

Searching has become more seamless, availability grown.

The publications can be found more easily and faster via Google Scholar. Google gets better and better in recommending interesting articles to me.

Some respondents also mentioned that the ease of searching is something that could be developed further – that the user-friendliness and usability of all e-journal platforms is often not yet optimal, and that improved user experience is a direction where much could be done.

It should become all the time easier and faster and cheaper. Interfaces and services should provide the highest possible usability and user experience.

Whereas searchability refers to the possibility of finding relevant content easily, findability refers to the support and affordances for filtering and narrowing down search results.

Improved options for narrowing down the search results.

Information is available in abundance and easily, yet many times, finding a specific distinct piece of information is difficult and time-consuming. Today we have access to huge amounts of fresh information published by all working in the field, like enterprises, communities, and individual persons. The amount of scientific publications has grown so much that there is no time to search and distill information from there.

Some scholars experienced the ease of use of Google Scholar as a relief compared to e-journal databases, even though it currently offers the possibility to filter results only by year and type of publication (book, article, patent). Although people may be accustomed to easy and step-by-step guided and faceted searches in e-commerce websites, which tend to have the inbuilt possibility to narrow searches easily, scholars did not necessary possess a language or terminology for describing what makes a good search interface.

In line with results from earlier studies (Nicholas et al. 2014), comments on findability also concerned the problem of re-finding already found articles from the web or one’s own collections. Here again, answers were divided. Some scholars stressed that saving articles on one’s own computer allows better findability from computer folders and takes less (physical) working space; others commented that printouts are easier to re-find.

Nowadays I do not make paper versions for myself so much but check on the computer and from the saved files. More into the Web. I’m kind of slow in adopting new practices but gradually [advancing].

Keeping articles on paper and paper piles was often regarded as somewhat old-fashioned – even by those who did not experience difficulties with their information management and organization practices.

Discoverability refers to the ease with which a person can unexpectedly discover something relevant while searching for something else. Delivering discoverability in the form of recommendations and related content (“related articles,” “people who viewed this content also viewed this”) are now common features in e-journals. The ease and convenience of finding relevant related articles was mentioned in the comments.

Sometimes you find services that allow, if you find one relevant article, it lets you download 20 other articles on that topic as pdf files. This kind of functionality is handy in web publications. Also, it is convenient if you can directly click into a cited article from the list of references. The bibliographic information should be easy to cut and paste into reference management programs. Direct export is an extremely important functionality.

Several web pages suggest similar articles when you are downloading an article. These suggestions are often relevant and interesting. In some journals these suggestions are placed after the list of references.

Again, there were differences between scholars in the extent to which they had observed and used the recommendations functionalities, since there were several comments that expressed a wish for “links to similar articles” and “links to articles dealing with the same topic.” The latency of recommendations functionalities is likely to be related to scholars’ fields, working language, and the age of journals searched.

A wish for the re-design and elaboration of recommendations functionalities was also mentioned in the open comments:

I foresee that artificial intelligence will become a tool for researchers adding recommendations based on research behaviour.

Some respondents expressed a wish that the platforms used would make it clearer what criteria and features the recommendations (“more like this”) are based on, that there would be more diversity in recommendations criteria, and that the user could choose between different recommendations criteria options.

Several scholars also stressed that they find the recommendations coming from colleagues as more useful and important than other types of recommendations. Colleagues are trusted members of the same “tribe.” Some mentioned that social media affords scholars of the same tribe to become more visible to each other; the former invisible colleges (Crane 1972) are becoming “visible colleges.”

I discover and read ... more articles through ResearchGate, by following researchers of interest. This is easier than having Google Alerts, or browsing journal contents.

Academia.edu has become an important place for finding and sharing texts.

Information about interesting articles are shared more and more on Twitter.

Twitter has revolutionized the communication and community formation between scholars and the ways of finding interesting studies. Email will lose its meaning and open science moves forward. Less articles will be behind payment walls, because they will not be read or discussed or cited.

Quantitative results of our surveys (Tenopir, Christian, and Kaufman 2019; Tenopir et al. 2019a) also showed that sharing increasingly takes place in social media; Twitter and academic social media platforms such as ResearchGate and Academia.edu are increasingly important outlets for sharing articles and information about articles.

5.2.4 Sharing and Collaboration Affordances

Most comments on sharing stressed that sharing via social media has increased and will probably increase further.

I share more often my thoughts about things I’ve read on the social media. I’ve also started to share draft versions of my writings via different portals so that everyone would have a possibility to get to know my texts. In terms of reading, I use Mendeley more and more because there I can easily link what I’ve read to what I write.

I read more now for my research ... I also find and share more via Twitter.

There were also scholars who expressed a preference to share and discuss with only close colleagues, and to avoid the “social media hype.”

Sharing (legal or illegal) has probably increased. I remain highly skeptical about social media.

Some scholars expressed a wish for new and improved functionalities for sharing and collaborative work:

Sharing folders of articles in pdf format with colleagues might be getting more common as we write applications together etc. Distributing the work on searches and sharing analysed results with colleagues would be an effective work practice.

I believe there will be new forms and standards for the sharing of what has been read. Now I share literature with colleagues via

cloud services (when we write articles collaboratively), but hopefully shared libraries will get more common in reference management applications.

The ability of e-articles to follow you on your main social network profiles rather than you save them to bookmarks so all the articles keep following you around on the internet until you collaborate with the authors or send them a message. Academic research needs more collaborative tools across different disciplines.

Sharing search results and analyses of search results within a collaborative project or group currently requires moving between different services and platforms. Some respondents suggested that e-journal interfaces could allow for a more seamless platform for collaborative projects, for instance, shared libraries for sharing searches and readings.

5.2.5 Seamlessness Between Reading and Writing

In the open-ended comments, the ability to make annotations on the digital articles was one of the most often mentioned desired affordances:

I will continue to read so that I save the articles from the database to the computer, and print out a paper version in order to be able make markings with a pen while reading the article.

I am printing less on paper and reading more on-screen. The main problem is that there are inadequate means for highlighting and scribbling my own notes, comments and sketches on the electronic publications. I hope we will see improvements in this field.

Reading from screen has increased but many scholars stressed that integrative reading combining information from different sources for the purposes of writing remains a challenge. The need for a seamless transition from reading an article to writing a memo or to making comments on the articles and adding reasons why a specific reference or section of a text had been important were often mentioned:

I would like to be able to catalogue and archive electronic references for later use in the same way as with paper. Making notes and underlining would help in remembering what it was in the article that originally awoke my interest.

Flexible notes making, putting them on with shortcut commands. Making references lists automatically based on the pdf file without needing manual intermediary phases.

Making notes, highlighting text, and other markings could be much easier than currently, e.g., in PDF. Is pretty clumsy.

I would like to mark the interesting sources while reading an article, where they are cited in the text, and eventually get a report of the references I chose and the context where they were

cited (e.g., a couple of sentences before or after the citation). At the moment I work so that when I encounter an interesting place in a text that cites a source previously unknown to me, a) I look up the source at once from the list of references, which requires jumping to the end of the article and refinding the part that I was reading, or b) copy the sentence (or several sentences) with their references into Notepad or Word for later scrutiny.

The difficulty and need for notetaking and note making was described in detail in many answers, while some also described the practices they had developed as a solution to this problem. Some transported articles to Mendeley to be able to add notes.

I read articles mainly via Mendeley, because I can add notes directly there, even though it's clumsy.

All kinds of easy ways to make notes would be important.

In reading I use programmes through which I make annotations and notes, and through which I have access to these from different places (now Mendeley, whose library resides in a separate cloud service, Dropbox).

Integrating automatic citation option from the source linking into various document types (Latex, Word, Google Docs etc.). Mobile compatible digital reader for research articles supporting highlighting, adding notes and saving a personalized version for future reference.

Despite the increase in reading from the screen, scholars continue to rely heavily on printouts to make notes and annotations. The reasons mentioned are the same as shown by earlier studies: the need for seamless interweaving of reading and writing, need to make annotations to support remembering important points, marking the location of important information in the text, highlighting main points, writing down ideas and further questions. Writers need to anchor their arguments in specific places in the specific texts, and paper makes it easier to draw from multiple sources while composing a paragraph.

5.2.6 Value Added Features

The respondents who named new desired features did not expect e-journals to be similar to paper journals but to more fully take advantage of the possibilities of the electronic environment. The traditional established scientific journal article model has persisted to a large extent, yet not all respondents viewed this persistence as necessary for maintaining the prestige of scientific journal articles. Some of the suggestions for valued added features concerned increased interactivity and visual materials in e-articles:

Videos in document.

Embedded videos. Interactive visual elements as in Mathematica apps.

Interactive graphics (e.g. presentation of variables and curves so that they can be adjusted and modified according to different parameters).

Good visuals and video materials as parts of the article.

In general I would want scholarly publications to include more use of pictures (visuals).

Easy access to additional materials, e.g. video, audio, replication packages, datasets.

Links to the components of the article (power point presentations, videos, etc.).

VR, interactive graphics.

Zoomable maps.

Links to research data were often mentioned as suggestions for value added features.

I would like to get the numerical data involved in the figures to myself directly by clicking the mouse.

Links to supporting data.

Availability of data also in other forms than pictures.

Easy access to raw data of graphs and figures in publications.

Access to software, data, examples for reproducible research.

It would be valuable if mathematical models and data would be included in the articles so that the reader could try changing some background variables and test what this would provide in the terms of the article's results and conclusions. This might remain a utopia for some time to come.

Many open-ended comments also suggested that exporting references from articles could be made easier.

Links to bibliographic sources.

That the bibliographic information would be easy to cut and paste into reference management programs. Direct export is extremely important.

Easier downloadability into a reference management program.

Exporting references to literature management software or Word files was in many comments experienced as extra work. Some suggested that literature management software could be developed further to allow for more

extended meta-analyses of the selected references. These respondents suggested that literature management software could offer better in-built affordances for organizing and sorting the found references such as making mind-maps and other analytic techniques.

Easy visualization of references.

Maps and figures of citation relationships.

E-links to comparative information.

In addition to visualizations some suggested that e-journal interfaces could offer more developed affordances for secondary and meta-analysis. The electronic environment could support a reader's possibilities to understand the controversies and debates that exist around particular topics. Currently, for instance, structured abstracts are used by some publishers, requiring authors to more clearly lay out their hypotheses and results. Some respondents suggested that e-articles could offer an inbuilt structure allowing the author to clearly pin down whether an article supports a given scientific knowledge claim or argues against it. They believed this would provide readers with an easier option to compare different viewpoints.

Possibility for simultaneous reading of two articles, when you click on a reference, the cited article opens up on the side of the main article being read. Would enable direct comparison instead of having to jump between windows.

Distilling information from publications so that it would be possible to compare divergent views presented by different authors simultaneously.

It would be nice to be able to pin down the context of the article in more detail outside of natural sciences. Currently, in my own area, understanding the context and meaning is largely based on one's own subjective analysis, which makes it difficult to absorb a new research topic.

The hope for more informative and/or extended abstracts was also presented in many comments.

Would love to see some kind of extended abstract so I would not have to plow through all of the text in order to get the meat of the article.

Would expect more question specific article portion available for sharing.

Some respondents suggested that research articles could have separate sections added that are specifically directed at practitioners and which would enable a quicker and a less academic takeaway of the key contents and results of the study reported.

Better inclusion of “executive summary” or “lay language” companion articles.

Interviews with the main authors.

Some scholars noted that e-journal articles could develop more built-in ties with scholars’ social media habitats to allow seamless moving from “official” articles to social media sites such as LinkedIn, Academia.edu or Twitter. Possibilities to export content and share links elsewhere on the web is a common standard in the Web 2.0 information ecology. Links to social media sites could help in seeing an author’s research group’s production as an entity, or allow the reader to quickly check the progress of a research project, or to simply get updated about authors’ current locations.

I think e-scholarly articles do not link properly with social networking sites for scientists and researchers.

From author name/bio a link to the author’s academic social media site, personal web page or LinkedIn in order to be able to locate and reach the author despite if the email and affiliation has changed.

Links to authors’ web pages (the department/research group homepages, LinkedIn, ResearchGate). Easy access to the supplementary materials sections.

Links to author websites.

E-articles conventionally exist as relatively isolated, stable and permanent entities: traces of readings exist mainly in the form of citations. Some of the open-ended comments suggested that journal articles could be opened up for comments and discussion in the manner of journalistic digital publishing outlets and platforms:

Publishers should agree that publications can be updated and errors corrected.

Possibility to comment.

It would be interesting to have comments on papers, especially clarifications on the most obscure parts.

The possibility that the authors update the paper based on readers’ comments and provide reference to the comments and publicly keep track of the changes in a single “document”.

A more moderate suggestion in a similar vein of advancing open science is to make peer-review comments available, as already experimented in some journals. Scholars supporting this idea saw that this would enhance the quality of peer reviews and also make it possible for scholars to gain reputation via writing good and thoughtful peer reviews.

Open peer reviews would, in this view, also increase the relevance of peer reviews to the scientific enterprise. Publishing peer reviews in connection to the article would allow readers to gain additional insights into the points made in the article and help in reflecting on the essential findings presented.

Fully open peer review with public commenting functionality.

The ability to read peer reviews and the answers to them written by the authors would be nice and add value. Some journals already publish these. On the basis of this, it is possible to see many things from the background of the article, understand its final content better, and even whether the article has been seriously peer reviewed or not.

Web 2.0 is conventionally defined to differ from Web 1.0 in the increased possibilities for participation and discussion (O’Reilly 2005). Community-building affordances are a key success factor in the web 2.0 environment. Some scholars saw that increased communality and collaboration might be one aspect in which e-journals could do better.

Allowing correction, comments, and discussion in e-journal article platforms is a major change to the traditional article format. For some disciplines such as sociology, history, and literature where theory choices, interpretation, and argumentation play a major role, this might signify an increased interest from both the academic and non-academic audiences to read new articles. Electronic journal articles are conventionally read individually, not as parts of journal issues. Comments, corrections or discussion published in later issues of the same journal do not necessarily reach those who had an interest in the original article. These also have to undergo formal reviewing, which impedes immediate smaller corrections or additions which could enable a faster self-corrective process in the scientific enterprise. On the other hand, even moderated and reviewed comments published in the same issues could introduce noise and bias into the process, with negative comments tending to gain more attention.

6 Discussion and Conclusions

6.1 Overview of Results

Our quantitative results showed that scholars perceive ability to share publications, enhanced navigation and note-taking, and highlighting capabilities as the most important features of scholarly e-articles. Features such as video and audio embeddedness were not seen quite as

important by the respondents. However, respondents to the 2018 survey perceived these features as more important than respondents of the 2016 survey.

Naturally, an affordance such as access to original research data that might be irrelevant in the social and cultural context where a literary scholar works might be highly important and enable new kinds of research and teaching practices for a statistician. The basic categories of observed and unobserved affordances, desired and undesired affordances can be best understood and explained by scholars' sociocultural environment and disciplinary culture involving specific types of working with scholarly literature. Sociocultural environment also involves the scholars' range of experiences within the whole of the web's constantly evolving ecosystem. Scholars who use web 2.0 environments and applications less may expect a more limited range of affordances in the current e-journal environment than scholars who are actively engaged with the pockets of the social web where people come together to learn, discuss, and produce knowledge.

The open-ended answers confirm the existence of distinct reader preferences: book lovers, printers, digital readers, and those who mainly read from screen but print out the article when the task at hand requires making markings (Revelle et al. 2012). Sometimes reading means sampling large amounts of text in a short time in order to navigate through existing literature on a topic; sometimes it means the concentrated in-depth reading of an article from the beginning to the end.

Many scholars commented that they have gradually grown accustomed to screen reading and to switching between different modes of reading. This could be interpreted as counterevidence to notions that the digital environment discourages deep reading. As scholars inevitably have to engage in deep reading, the increase in screen reading (Tenopir et al. 2019a) may mean that scholars are transferring their print reading abilities to digital reading and vice versa as suggested by Hayles (2010). However, the results also confirm that design solutions that better accommodate the need of readers to write are seen as important.

Ease of use and simplicity were named as central qualities of a good publication platform. Scholars hoped for more standardization across e-journal interfaces. More commonalities could support scholars' perception of affordances not present in the paper environment such as recommendations of related articles. Scholars wish interfaces to support their work and not impose additional learning requirements. Scholars expect e-journals to support task performance well but also hoped for support for developing

better work practices, for instance, in collaborative work. Aspects in which more support for work could be offered involved accurate documenting of where important information was located in the text, what in particular made the article important and/or interesting, and support for organizing already found information according to the task. More support was also hoped for sharing the literature searched and found within a work group, reference management, getting a grasp of the full contextual background of a single item found, and help in discerning the various schools of thought in a research field.

6.2 Desired Affordances: Design Implications

The open ended comments are interesting especially in pointing out possibilities that could exist but are not yet used or widely used. Some of these suggestions were:

- more visual materials such as videos;
- more interactivity;
- easier export of references;
- links to original research data;
- open commenting;
- open peer review;
- possibility to update articles;
- links to authors' social media sites;
- affordances for secondary and meta-analysis.

Some of these suggested functionalities also suggest new ways of doing and presenting science. As science in its essence is a collaborative process (Cronin 2005), the view of the scholar reading an article alone and forming opinions individually without a surrounding visible or invisible community is a somewhat limited understanding of science. The Internet as a whole can be likened to an ecosystem, where diverse environments are inextricably interlinked and interdependent (Hinton 2015). E-journals are not separate from other services but keep becoming more closely aligned with other habitats where scholars move in their everyday life. Generic developments and evolving standards in the networked environment create expectations and new ideas of what scholarly communication could be like.

The limitation of the analysis is that it is likely that the scholars who answered the questionnaire have a wide-ranging experience of the current web services, and had more well-defined and structured expectations than scholars who only mainly use email and e-journals and Google. Some respondents were newcomers to e-journals,

and were happy simply with their increased availability, and expressed no desires for additional functionalities. They may not be aware of the existence of many of these functions in some e-journal systems.

The range of views expressed in the open-ended comment shows how affordances are not only material and technological, but also political, interactional, and cultural. For understanding users' preferences, the information ecology metaphor is useful: people move in the web environment using well-trodden paths to visit familiar sites, which are also their everyday life habitats. Consequently, they expect e-journal articles to be findable and residing along the same paths, and possess affordances that are similar to other frequently visited sites on the web. Some new affordances for finding, discovering, sharing, and handling information were suggested that give insights to publishers, libraries, and web designers.

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