ORIGINAL ARTICLE

(wileyonlinelibrary.com) doi: 10.1002/leap.1286

Received: 14 November 2019 | Accepted: 9 January 2020

A global questionnaire survey of the scholarly communication attitudes and behaviours of early career researchers

David Nicholas,[1*] Hamid R. Jamali,[2] Eti Herman,[3] Anthony Watkinson,[3] Abdullah Abrizah,[4] Blanca Rodríguez-Bravo,[5] Cherifa Boukacem-Zeghmouri,[6] Jie Xu,[7] Marzena Świgoń,[8] and Tatiana Polezhaeva[1]

[1]Laboratory for Library and Communication Studies, Tomsk State University, Tomsk, Russia

[2]School of Information Studies, Charles Sturt University, Locked Bag 588, Wagga Wagga, NSW, 2678, Australia

[3]CIBER Research Ltd., Newbury, Berkshire, RG147RU, UK

[4]Department of Library and Information Science, University of Malaya, Kuala Lumpur, 50603, Malaysia

[5]Biblioteconomía y Documentación, Universidad de León, León, Castilla y León, 24071, Spain

[6]Department of Computer Science, Université de Lyon, Université Lyon 1, 69100 Villeurbanne, France

[7]School of Information Management, Wuhan, University, Wuhan, Hubei, 430072, China

[8]Instytut Dziennikarstwa i Komunikacji Społecznej, Wydział Humanistyczny, Uniwersytet Warmińsko-Mazurski, 10-719, Olsztyn, Poland

ORCID:
D. Nicholas: 0000-0001-8046-2835
H. R. Jamali: 0000-0003-1232-6473
E. Herman: 0000-0001-8526-9081
A. Watkinson: 0000-0002-2317-6557
A. Abrizah: 0000-0002-8224-5268
B. Rodríguez-Bravo: 0000-0002-9476-7602
C. Boukacem-Zeghmouri: 0000-0002-0201-6159
J. Xu: 0000-0002-9820-8066
M. Świgoń: 0000-0003-3600-8349
T. Polezhaeva: 0000-0002-5133-5439

***Corresponding author:** David Nicholas
E-mail: dave.nicholas@ciber-research.eu

Abstract

This article describes an international study informed by a 3-year-long qualitative longitudinal project, which sought to discover the scholarly communication attitudes and behaviour of early career researchers (ECRs). Using a combination of small-scale interviews and a larger-scale survey, ECRs were questioned on their searching and reading behaviour, publishing practices, open data, and their use of social media. Questionnaire invitations were sent out via publisher lists, social media networks, university research networks, and specialist ECR membership organizations. One-thousand and six-hundred responses were received, with many coming from China, Russia, and Poland. Results showed that ECRs are adopting millennial-facing tools/platforms, with Google, Google Scholar, social media, and smartphones becoming embedded in their scholarly activities. Open data sharing obtains widespread support but somewhat less practice. There are some differences in attitudes and behaviour according to age and subject specialism.

Keywords: early career researchers, scholarly communication attitudes and behaviours, survey

Key points

- Building on the work of the Harbingers study, new research supports its findings that early career researchers (ECRs) are adopting new communication strategies.
- Google Scholar is the main search mechanism for most disciplines, with Google being used predominantly by humanities ECRs.
- Ease of access is the main reason to choose to read a publication, closely followed by journal reputation.
- ECRs in arts and humanities are more traditional in thinking and behaviour, perhaps, because journals are not the dominant publishing form.
- Although there is strong support for sharing data, it is not commonly undertaken, the main reason being a lack of policies to require this.
- Social media are important for networking and current awareness, with ResearchGate and Twitter being the most frequently used platforms.

BACKGROUND AND AIMS

The survey reported here constitutes the second leg, and final year, of a 4-year-long study, the Harbingers research project (CIBER, 2018). This was a project that sought to determine how the new wave of researchers – early career researchers (ECRs), with their millennial beliefs, social media interests, and ready access to digital disruptors, such as ResearchGate and Sci-Hub, are utilizing the scholarly communications system. The first leg, conducted during 2016–2018, was a longitudinal, in-depth interview study that sought to map in detail the changes in scholarly communication attitudes and behaviour of nearly 120 ECRs (Nicholas *et al.*, 2019, for a summary) and prepared the ground for the survey reported here.

The second leg of the study had the same broad aim as the first leg: establishing the extent to which ECRs are changing scholarly communications. However, as befitting its position as a follow-up study, it also sought to include the following objectives:

- To extend the study to a larger and wider ECR population by making it more international and comprehensive in terms of subject representation. This was necessary because the interviews covered a relatively small number of ECRs from just seven countries (China, France, Malaysia, Poland, Spain, UK, and USA) and the arts and humanities were excluded;
- To revisit the findings of the interview phase of the study in order to obtain further detail and elucidation;
- To seek answers to additional questions that came up in the interviews or raised in the literature since;
- To achieve further clarification of the answers obtained in the interviews by utilizing survey techniques and so triangulating the data.

ECRs were questioned regarding searching (discovery), finding (locating) and reading behaviour, publishing and authorship practices, open access and data, peer review, social media, citation indicators, and altmetrics. However, in order to make this paper manageable, results regarding use of citation indicators and altmetrics, authorship/peer review behaviour, and open access will be published elsewhere (e.g. Jamali *et al*., 2020).

LITERATURE REVIEW

Millennials deserve being put at the centre of investigations of scholarly communication behaviour, since this generational cohort, having been exposed to the unique educational, economic, social, and political contexts of today's connectivity-governed global village, has been found to differ in their generational views, values, attitudes, preferences, expectations, and media habits from those of past generations (Burstein, 2013; Ng, Schweitzer, & Lyons, 2010; Nielsen, 2018). Having been shown to be confident, self-expressive, liberal and open to change, resilient, respectful of diversity, and appreciative of multiculturalism (Burstein, 2013; Pew Research Center, 2010a, 2010b, 2018a; Schewe *et al*., 2013), they have the potential to act as harbingers of change. However, millennial researchers' communication behaviour has largely been explored almost in passing, in either of two ways: first, by means of small, non-generalizable case studies, to which the sole exception was Carpenter, Wetheridge, and Tanner's (2012) study of UK doctoral students, and second, via wider studies of the general research population that examined how similar/different to their senior counterparts they are. This is justifiably so, because ECRs are in too vulnerable a position to set about transforming the communication practices through the approaches and skills they 'grew up with' (Harley, Acord, Earl-Novell, Lawrence, & King, 2010). Thus, no one it seems has queried in depth junior scholars' information behaviour patterns, certainly not with the express aim of establishing the extent to which they are change agents. Indeed, our understandings of ECRs' communication practices and attitudes, which serve as the backdrop for the research reported here, are patchy and based on fragments of empirical evidence.

The published literature broadly tells us the following:

- Attitudes and behaviour comply with extant norms, so that any changes are more in the nature of gradual developments rather than disruptions. This is inevitably so, since because of their status as scholarly apprentices, they are expected to toe the line (Laudel & Gläser, 2008). It is also because in an era where they need to work harder, that is, publish more, at a younger age and in more prestigious journals than their seniors ever did

(Müller, 2014a, 2014b), realizing any revolutionary thoughts and practices poses a risk to budding careers. Unsurprisingly then, ECRs resolutely hold the traditional peer-reviewed journal with a high impact factor (IF) to be the most sought-after outlet for publishing papers (Nicholas *et al*., 2015; Tenopir *et al*., 2016).

- Information-seeking behaviours follow a steady trend, with only subtle changes from the past, particularly in the use of social media and networking sites. A shift towards a greater use of novel ways and means of locating information remains subtle, and while it is the younger researchers who assign the greatest importance to utilizing academic social networks for keeping up with relevant scholarship, the differences among the age cohorts are not marked (Blankstein & Wolff-Eisenberg, 2019; Spezi, 2016).
- There are, though, indications that ECRs are prepared to stray from the beaten scholarly path, especially when in line with their millennial beliefs and/or promising in terms of career advancement. Open Access (OA) publishing, purported to have a host of societal- and individual-level benefits (Allen & Mehler, 2019; McKiernan *et al*., 2016), is certainly a case in point. Junior researchers have been found to hold much more positive views of OA than their senior counterparts (Nicholas *et al*., 2015; Tenopir *et al*., 2016). ECRs also think to a greater degree than other age cohorts that OA increases the visibility and citation rates of articles (Segado-Boj, Martín-Quevedo, & Prieto-Gutiérrez, 2018)

METHODOLOGY

A questionnaire was developed based on the first leg's interview schedule and the replies obtained, which was then pilot-tested. The resulting questionnaire featured 44 questions about scholarly communication practices and attitudes. It also included a few demographic and personal questions to help determine whether attitudes and behaviours vary according to age, discipline, country, gender, research experience, publishing productivity, and job status. The full questionnaire can be found at the project website (CIBER, 2018). Not all the topics explored in the typically 60–120-min interviews featured in the questionnaire, largely in order to keep the questionnaire short; as a result, questions on careers, ethics, and scholarly impact were omitted.

The questionnaire was translated by 'local' interviewers into Chinese, French, Polish, Russian, and Spanish. All versions of the survey, except for the Chinese version, were hosted on SurveyMonkey and went live on 10 May 2019 and closed on 30 July 2019. The Chinese version was instead hosted on WJX.com, because SurveyMonkey does not work well on the mobile devices used in China.

SAMPLING

It was not possible to use a single sampling frame or method of dissemination because no record/register of ECRs exists; indeed, there is not even a common definition of them (see comments in the Limitations section). It was necessary, instead, to cast the net as widely as possible in search of ECRs. Thus

- invitations were sent out by scholarly publishers to their authors and users (Emerald, Cambridge University Press, Clarivate Analytics, PLoS, and Wiley);
- links were sent out via university/institutional/lab email lists by the national lead researchers in the case-study countries and by the UCL library;
- the link was widely shared on social media and academic social networks (e.g. Twitter, Facebook, Messenger, ResearchGate, WeChat);
- Invitations to the survey were distributed by two ECR/PhD networks, namely Eurodoc and Sense about Science, to their members.

CHARACTERISTICS OF RESPONDENTS

The survey started with a binary (yes/no) screening question, asking respondents whether they felt they were an ECR. Those who said no were removed from the survey, and presented here is the data collected from those who self-reported that they were an ECR. After data-cleaning, 1,600 responses remained for analysis. This included 678 (42.4%) from the English survey, 253 (15.8%) from the Chinese one, 236 (14.8%) from French, 172 (10.8%) from Polish, 148 (9.3%) from Russian, and 113 (7.1%) from the Spanish version. Gender-wise, 45.7% were females. Close to a third (32.2%) were 31–35 years old, about half (51.1%) had a doctoral degree, 28.3% were doctoral students, and about a third of respondents (33.9%) were from social sciences. For more details of the demographics of the ECR population, see Table 1. The mean and median of years active as researcher was around 5 years, and, on average, they had published 2.7 articles in 2018 (median = 2).

DATA ANALYSIS

The Likert question options used throughout the survey were 'To a great extent/Somewhat/A little/Very little/Not at all'. Mean values for these questions were calculated based on numeric values of the scale item with not at all being 1 and to a great extent being 5. Diverging stack bars were used to illustrate them, showing the percentages with another green bar that shows mean values.

After exploring both parametric and non-parametric methods and similarity of the results, we used parametric statistics where possible. For Likert questions, independent sample t-test for gender differences and analysis of variance (ANOVA) for subject and age differences with Tukey test for pair-wise comparison were used. The ANOVA tables present only items with statistically significant differences (p > 0.05) along with F-values and mean and standard deviation. In those tables (e.g. Table 2), the darker cells indicate the subject that was different in pair comparisons and the lighter grey cells indicate the subjects that were significantly different from the darker cells. Cells with no shading exhibit no

TABLE 1 Demographics of respondents.

Item	*N*	%
Gender		
Male	680	42.5
Female	731	45.7
Prefer not to say	31	2
No answer	158	9.9
Age		
21–25	133	8.3
26–30	488	30.5
31–35	515	32.2
36–40	206	12.9
40+	99	6.2
No answer	159	9.9
Subject		
Health sciences	155	9.7
Life sciences	261	16.3
Physical sciences and engineering	331	20.7
Social sciences	542	33.9
Arts and humanities	138	8.6
No answer	173	10.8
Highest degree completed		
Bachelor's degree	54	3.4
Master's degree	491	30.7
Doctorate degree (PhD)	817	51.1
Professional degree (MD, JD, etc)	52	3.3
Other/prefer not to say	27	1.7
No answer	159	9.9
Job position		
Doctoral student	453	28.3
Post-doctoral student/researcher	261	16.3
Academic researcher	218	13.6
Non-academic researcher	79	4.9
Non-tenure track faculty	57	3.6
Assistant professor/lecturer	262	16.4
Other	107	6.7
No answer	163	10.2

statistically significant differences. Chi-square test was used for cross-tabulation tables. For questions with multiple responses (e.g. Table 8), both percentages of responses and percentages of cases (total greater than 100%) are presented.

Throughout the paper, reference is made to what was found in the interviews (CIBER, 2018); this is undertaken primarily in order to explain the reasons for asking the questions and why they are framed in the way they are. We view the two datasets as different readings from the target population. This is because making comparisons are problematic because of the difference in make-up of the two samples, especially in regard to subject, nationality, chronology, and how an ECR is defined.

RESULTS

Searching for and finding information

ECRs are heavily involved in information-seeking activities, which are frequently delegated to them by senior members of the research group/collaboration to which many belong. They, therefore, are the very community to ask about these activities, which are so fundamentally associated with research and paper publishing, and to discover what researchers on the frontline are up to. Interview data had shown that Google and Google Scholar were the key services used, as well as PubMed for the life/medical sciences, and that there was little evidence of researchers searching for non-peer-reviewed information (Nicholas *et al*., 2017). While not much appears to have changed in the course of the 3 years of study in this regard, there is, though, an increasing trend to use the smartphone to search for scholarly information (Nicholas *et al*., 2019). We sought to confirm and supplement these findings. The results do, indeed, confirm the popularity of Google Scholar and Google, and especially so the former, with nearly two out of five ECRs using it to a great extent (Fig. 1). Google Scholar has truly established itself in the field. Indeed, the surprise is that their scores are not higher, but, perhaps, the results constitute a reluctant admission of a rather painful truth or, maybe, it is a reflection, of the inability of Google or Google Scholar to always deliver the prized full text.

Non-peer-reviewed content, growing considerably, of course, in an open and social scholarly world, is sought, albeit not extensively, as also found by the interview data. But then again, given the preoccupation in academe with traditional scholarly journals, it might be expected. However, with 29% claiming some (moderate) or extensive use of non-peer-reviewed content, the practice has obviously made a mark. Plainly, this type of content is useful, if not wholly trusted.

Similarly, while smartphones had a relatively small role to play in searching for and retrieving content, more than a quarter of ECRs did claim to use them somewhat or to a great extent; again, confirming the interview study results (Nicholas *et al*., 2019; Nicholas, Boukacem-Zeghmouri, et al., 2017). An interesting group of ECRs has to be that small group who said they search for scholarly material on a smartphone to a great extent (7%; N = 109). These researchers were more likely to come from Russia or China (the latter also found to be the case in the interviews), and, perhaps unsurprisingly, in view of the findings of a recent survey in smartphone ownership (Pew Research

TABLE 2 Subject differences in statements related to looking for information ($df = 4$; $p < 0.05$).

	Health sci. (N = 152)		Life sci. (N = 255)		Physical sci. and engineering (N = 319)		Social sci. (N = 521)		Arts and humanities (N = 130)		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
I rely on Google Scholar to search for and find scholarly publications	3.7	1.3	3.8	1.3	4.0	1.2	4.0	1.1	3.2	1.3	13.8
I rely on Google to search and find scholarly publications	3.3	1.3	3.7	1.2	3.8	1.2	3.4	1.3	3.5	1.3	6.5
I rely on PubMed to search and find scholarly publications	4.5	0.9	3.6	1.4	2.0	1.3	2.1	1.3	1.8	1.1	176.5
I search for scholarly publications on a smartphone	2.8	1.4	2.6	1.3	2.3	1.3	2.4	1.3	2.5	1.3	3.5

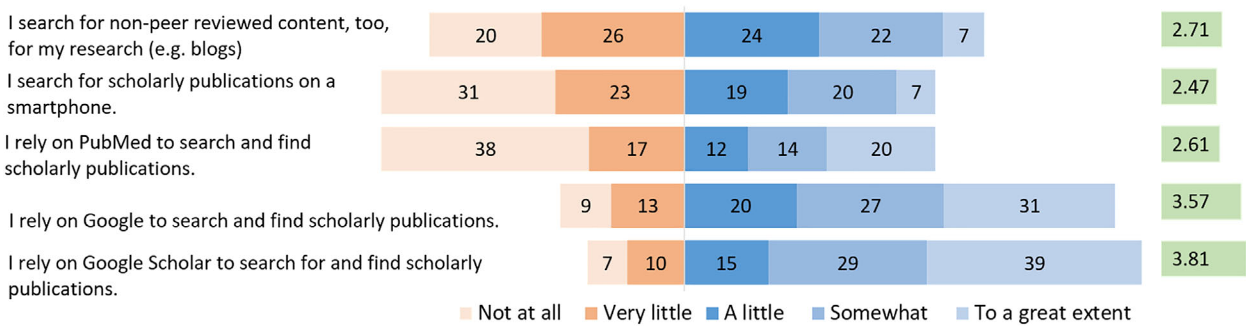

FIGURE 1 Percentages and mean value for 'To what extent are the following statements true about how you look for and find scholarly material?' (*N* = 1,545).

Center, 2019a), age was not found to be a significant factor. Apparently, smartphone use, while still much more characteristic of younger people, is becoming more prevalent in all age groups.

There are some differences between disciplines. Thus, Table 2 shows just those statements that recorded statistically significant differences. Shaded cells indicate pair-wise differences. For instance, for PubMed statements, both health and life sciences ECRs show a much higher reliance than those from the three other disciplines. If we exclude the PubMed result, because it is, after all, a largely a life/health sciences platform, the most noteworthy differences are the lower reliance on Google Scholar by arts and humanities ECRs ($M = 3.2$) and the greater use of Google by physical sciences and engineering ECRs ($M = 3.8$). The former could be explained by the fact that the arts and humanities are less reliant on journal articles, and the latter because sciences and engineering more often need basic/technical information. Finally, smartphone use was highest in the health sciences ($M = 2.8$), and this might be explained by the fact that health scientists work in hospitals and might rely on their mobile devices to look for information on the move or on the job.

Reading behaviour

In today's digital and social scholarly environment, where there are so many more content choices, how do ECRs determine what to read? This was a topic not covered in the interviews other than in connection with smartphones, so the question was designed to plug a gap in our knowledge. The most important of the six influencers listed in Fig. 2 are the traditional ones of ease of access ($M = 3.85$), journal prestige ($M = 3.83$) and rank, and impact factor ($M = 3.55$), although the latter two might have been conflated in the minds of ECRs. The fact that researchers can readily and openly admit to preferring something close to hand is telling, an acknowledgement, perhaps, that with the digital information explosion there are difficulties in keeping up. The importance of ease of access is further emphasized by the percentage (35%) of respondents admitting to the fact that they are influenced by it to a great extent.

The importance of rank and IF of an article's journal when deciding what to read grew significantly with age. Thus, for the youngest group (21–25) the median was 3.27 ± 0.1, while that for the oldest (36–40) band it was 3.67 ± 0.08; ANOVA [$F(4, 1{,}419) = 3.9$, $p = 0.003$)]. We see a similar age distribution for journal prestige. Thus, for those aged 21–25 the median was 3.5 ± 0.1, which is lower than the 3.88 ± 0.08 for those aged 36–40 ($M = 3.88$; ANOVA [$F(4, 1{,}423) = 4.5$, $p = 0.001$)]. It would seem then, that rank and prestige matter to the young, but not as much as it does for older researchers.

As for social media, despite publisher and emerging reputation platforms (e.g. Kudos) widespread promotion of altmetrics, they are only minor influencers in what is actually read ($M = 2.65$). Recommendations, for instance, obtain high prominence on ResearchGate (Copiello, 2019), but they appear to obtain little in the way of traction for our ECRs. Older ECRs are slightly more likely to act on recommendations, and, maybe, this is because their networks are bigger and better informed. Those

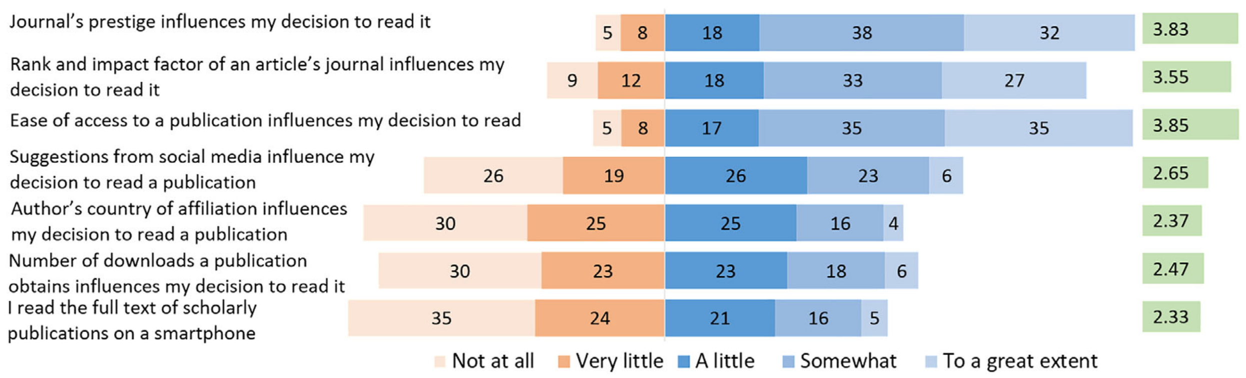

FIGURE 2 Percentages and mean value for 'To what extent are the following statements true about your current practices concerning reading?' (N = 1,582).

in the age group 31–35 ($M = 2.8 \pm 0.05$) rated them higher than those in the 26–30 age group ($M = 2.6 \pm 0.05$) [ANOVA (F (4, 1,418) = 2.6, $p < 0.05$)]. The number of downloads, another widely hyped altmetric, had even less influence on what is read (M = 2.47).

Reading scholarly work was once largely confined to the library, of course; but courtesy of the smartphone, it can be undertaken anywhere. So, do ECRs use them for this purpose? Well, the interview data showed that they largely did not use them for this purpose (Nicholas, Boukacem-Zeghmouri, *et al.*, 2017), and this is borne out to a certain extent by the survey (M = 2.33). Nevertheless, the seeds of growth are there with over one in five ECRs using them moderately or extensively for reading purposes.

There are subject differences in reading practices: Table 3 shows the four practices where the most significant differences occur. We pick out the most interesting differences: (1) while no subject really rates downloads very highly, social scientists rated them the most (M = 2.7); (2) while the influence of the author's country of affiliation is generally not a very strong influence (M = 2.37), life scientists rated it the least influential (M = 2.1); (3) in respect to rank and IF, understandably, arts and humanities – less dependent as they are on journals (Sivertsen, 2014) – rated it the lowest (3.2).

Publishing

In the digital age, there are many ways of publishing or disseminating research, and in view of the purported societal and individual benefits of open science practices, there is increased pressure to publish more content openly (Vicente-Sáez & Martínez-Fuentes, 2018). We wished to determine whether ECRs were taking advantage of the new choices. The interview study showed that attitudes were positive towards open and innovative publishing outlets, but this did not translate into more practice, this largely due to the reputational losses of not publishing in highly ranked journals and lack of time due to preoccupation with the latter (Nicholas *et al.*, 2017). The survey asked about nine practices and the main result was to confirm the dominance of publishing in highly ranked journals for career progression (M = 4.2). The closely related practice of relying on quantifiable metrics to determine where to publish obtained the second highest score (M = 3.84). However, the less traditional practice of embracing open science practices was not that far behind (M = 3.73).

The practices little used are those to do with social media (range M = 2.2–2.8) and institutional repositories (IRs; M = 2.39). There is no surprise here, because we have heard from interviewees that this is largely down to the lack of reputational

TABLE 3 Subject differences in statements related to reading practices (df = 4; $p < 0.05$).

	Health sci. (N = 152)		Life sci. (N = 255)		Physical sci. and engineering (N = 319)		Social sci. (N = 521)		Arts and humanities (N = 130)		
	M	SD	M	SD	M	SD	M	SD	M	SD	F
The number of downloads a publication obtains influences my decision to read it	2.4	1.3	2.1	1.2	2.6	1.2	2.7	1.3	2.3	1.2	10.8
The author's country of affiliation influences my decision to read a publication	2.5	1.2	2.1	1.1	2.5	1.1	2.4	1.2	2.3	1.1	4.7
Rank and impact factor of an article's journal influences my decision to read it	3.7	1.2	3.4	1.2	3.6	1.3	3.6	1.2	3.2	1.4	5.3
The journal's prestige (standing in the community) influences my decision to read it	3.9	1.1	3.6	1.1	3.9	1.1	3.9	1.1	3.7	1.2	4.9

TABLE 4 Subject differences in statements related to publishing practices ($df = 4$; $p < 0.05$).

	Health sci. (*N* = 152)		Life sci. (*N* = 255)		Physical sci. and engineering (*N* = 319)		Social sci. (*N* = 521)		Arts and humanities (*N* = 130)		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F* ($p < 0.05$)
I rely on quantifiable metrics (such as the impact factor) when deciding which journal to publish in	4.2	0.8	4.1	1.0	3.9	1.1	3.7	1.1	3.1	1.3	25.9
I use social media (Twitter, Facebook, blogs, etc) to promote my research	3.0	1.5	2.7	1.5	2.2	1.3	2.8	1.4	2.6	1.4	12.0
I share links to and news about my publications on social media	3.0	1.5	2.9	1.5	2.3	1.3	2.8	1.4	2.7	1.4	12.0
I post the peer-reviewed version of my publications on social media based scholarly platforms (e.g. ResearchGate)	3.4	1.6	3.2	1.5	2.9	1.5	3.1	1.5	2.5	1.5	7.2
I utilize social media to disseminate less formal/interim outputs (e.g. presentations, working papers)	2.4	1.4	2.2	1.3	2.1	1.2	2.4	1.3	2.2	1.3	3.3

rewards and recognition for these activities and lack of time to involve themselves in them (Nicholas, Rodríguez-Bravo, *et al.*, 2017). The repository result will be disappointing news for librarians and funders who have pushed for deposition. It has to be said that though ECRs were asked whether they deposited before publication, perhaps the figures for after publication might be higher. Of course, if they did deposit before publication, it would make IRs more attractive, which no doubt they would welcome. The interviews revealed some concern about sharing data and results before publication, but according to the survey results, this seems to have lessened.

There were some subject differences, and the most statistically significant are shown in Table 4. Arts and humanities and social science ECRs rated reliance on quantifiable metrics lowest ($M = 3.1$), which is largely because journals are not as dominant in these disciplines, nor do they tend to have IFs (Sivertsen, 2014). In respect to the use of the social media to promote research and sharing links and news on social media, physical scientists and engineers rated it the lowest ($M = 2.3$) and health scientists the highest ($M = 3.0$). Arts and humanities ECRs rated posting peer-reviewed versions of their publications on social media lowest ($M = 2.5$) and health scientists the highest (3.4) (Fig. 3).

Open data

ECRs were asked whether they had produced data and, if they had, made it openly available. Over three-quarters (76.4%; 1,135) of the 1,484 ECRs said they had produced data. As might be expected, there were subject differences in terms of producing data, with the arts and humanities the least likely to produce data and life sciences the most (Table 5).

Those ECRs who produced data were directed to a question about making data openly available. From the 1,153 ECRs who responded, 37.2% made their data openly available. There were subject differences in this practice (Table 6), with life scientists the most likely to make their data publicly available and social scientists the least likely to do so. There is also significant gender difference, with males more likely to make data openly available (41.1%) than females (34%) ($X^2 = 5.7$, $df = 1$, $p = 0.01$).

Those ECRs who had made their data openly available were asked how they accomplished it. It transpired that ECRs mostly

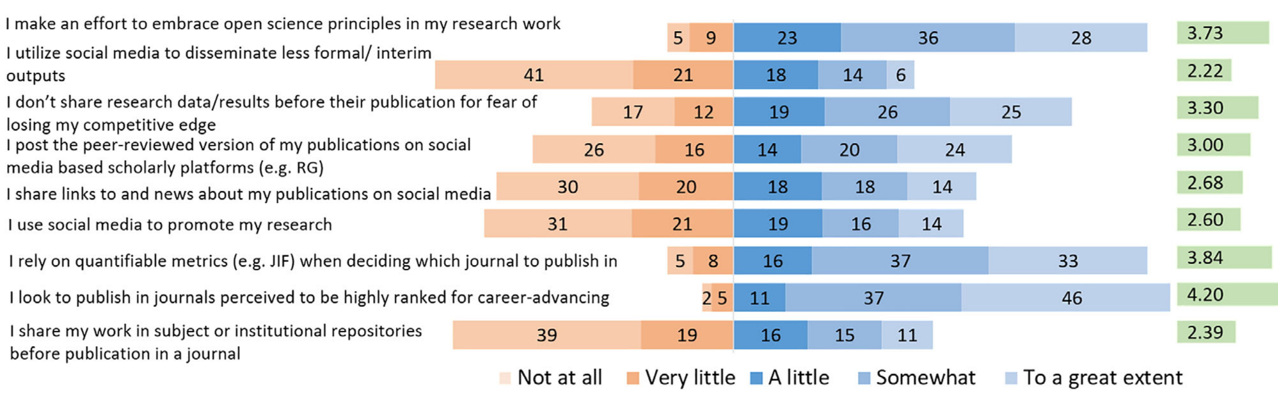

FIGURE 3 Percentages and mean value for 'To what extent are the following statements true about your current practices concerning publishing?' (*N* = 1,533).

TABLE 5 Producing data by subject (X^2 = 85.4, df = 4, p = 0.000).

	Health sciences		Life sciences		Physical sci. Engineering		Social sciences		Arts and humanities	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Yes	131	84.5	241	92.3	243	73.4	402	74.2	74	53.6
No	24	15.5	20	7.7	88	26.6	140	25.8	64	46.4
Total	155	1,000	261	100	331	100	542	100	138	100

TABLE 6 Was data made available openly by subject? (X^2 = 55.2, df = 4, p = 0.000).

	Health sciences		Life sciences		Physical sci. and engineering		Social sciences		Arts and humanities	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Yes	51	38.9	128	52.5	93	37.2	101	24.9	37	48.7
No	80	61.1	116	47.5	157	62.8	305	75.1	39	51.3
Total	131	100	244	100	250	100	406	100	76	100

publish their data as a supplement to a paper (Table 7). They were also asked why they did it (Table 8), and the majority said for reproducibility reasons. Questions in Tables 7–9 were multiple answer questions, and hence the percentages are higher than 100.

Those ECRs who did not make their data openly available were asked why not (Table 9). The most common reason was an absence of policies mandating data-sharing, with 57% saying this. The second reason was that the nature of data did not lend itself to sharing (43%). Seventy-seven per cent of respondents cited further barriers, too, via the 'other' option provided, such as the wish to publish results before releasing data, the need to obtain permission to do so (from their supervisor, principal investigator), a lack of knowledge as to how to go about it, and the lack of time. Two provided a very honest answer, saying that they had spent so much time and money on their data that they were not willing to give it a way for free. Similarly honest, two ECRs said they were not confident about their data and were afraid that any mistakes made might be revealed.

TABLE 7 How was the data made available? (Multiple answers).

Method of publishing data	*N*	%	% of cases[1]
Publishing data as supplementary materials to a paper	305	47.6	72.8
Hosting data on a website. With files available for a download	149	23.2	35.6
Hosting data in a repository such as Dryad, Figshare, and Zenodo)	104	16.2	24.8
Publishing a data paper about the dataset	83	13	19.8
Total	641	100	153

[1] Percentage (%) of responses have been computed by dividing the number of people to have selected any option by the number of people to have selected one or more options, and percentage of cases have been computed by dividing the number of people to have selected any option by the total sample.

TABLE 8 Why make the data openly available? (Multiple answers).

Reason for making data available	*N*	%	% of cases
Enables reproducibility	241	16.5	58.4
Enables reuse	199	13.7	48.2
Signals credibility	188	12.9	45.5
Compliance with journal publication policy	166	11.4	40.2
Ensures preservation and future accessibility	165	11.3	40
Belief in OS policies	164	11.2	39.7
Encouraged/mandated by open science policies	161	11	39
Facilitates collaboration	117	8	28.3
Confers a citation advantage	57	3.9	13.8
Total	1,458	100	353

TABLE 9 Reasons for not making the data openly available? (Multiple answers).

Reasons	*N*	%	% of cases
No policies that mandate data sharing	375	28.2	56.8
The nature of data (i.e. confidential, national security related) prohibited sharing	286	21.5	43.3
Competitive worries	215	16.2	32.6
Too much trouble to clean up	189	14.2	28.6
Risk to career advancement as data sharing not generally rewarded by current reward systems	150	11.3	22.7
Size of datasets prohibited sharing	116	8.7	17.6
Total	1,331	100	201.7

Social media

The use of social media has already been viewed in a number of contexts, but here we place it centre stage with ECRs required to focus entirely on the purpose of scholarly social media use, meaning we could better compare and measure its scholarly communication strengths and weaknesses. Interviews had alerted us to a growing interest and use in social media and the fact that some institutions now encouraged its use and the survey very much confirmed this, with nearly two-thirds of ECRs (63.1%, 932) using it for scholarly communication purposes. It has to be said, though, that the figure is probably inflated by the fact that – as can be seen in Table 11 where named platforms are listed –researchers include platforms that would not generally be viewed as social media (e.g. Google Scholar, Publons, and ORCID). We can look at the result in another way, namely a significant minority did not use social media when many of these ECRs have been using social media personally nearly all their life.

ECRs were asked to what purpose they used social media, and a wide range of purposes were mentioned (Fig. 4), most notably (in order of importance), current awareness (M = 4.05), keeping up to date (M = 3.98), and networking (M = 3.96). No surprises here, because these are the very strengths of social media. The 'other' option provided in the question meant that ECRs could specify other purposes. Seventeen did so, and purposes included recruiting study participants, sharing less formal research findings, public engagement, following practitioners to maintain connection with practice, and obtaining advice from people. Two researchers said they were expected to use social media by their host institutions.

There were age differences for two of the purposes. For 'Building and showcasing your reputation' [ANOVA (F(4, 886) = 3.37, p = 0.009)], the 26–30 group rated it lower (M = 3.44 $\pm$ 0.06) than the 31–35 group (M = 3.7 $\pm$ 0.05). Also, for 'Keeping up to date in your field' [ANOVA (F(4, 886) = 3.7, p = 0.005)], those aged 36–40 rated it lower (M = 3.67 $\pm$ 0.09) than the 21–25 (M = 4.14 $\pm$ 0.10) or 26–30 group (M = 4.0 $\pm$ 0.06). Presumably, the older group has built networks and connections, which lessens the need to use social media.

There are significant subject differences for two of the purposes (Table 10). For sharing research, the Tukey *post hoc* test showed that the difference was between health sciences and the other subjects in that in health sciences it was rated the highest. For conducting original research, the significant difference was that the life sciences rated it the lowest in importance.

ECRs were also asked if there were any social media tools/platforms they thought especially beneficial for their research and were given the opportunity to choose four (Table 11). In total, 547 ECRs listed 67 platforms with a total of 1,015 mentions. The table shows the top 20. ResearchGate is the most popular of them all, and this by some margin. Twitter, a conventional social media platform, of course, came next: the two of them way ahead of the rest. Twitter is ideally organized for recommending scholarly work in a way that Facebook is not, and that probably explains its popularity.

More than a third (36.9% N = 546) of ECRs said they did not use social media for any scholarly purpose, a sizeable minority. The percentage of those that did not was highest in the physical sciences and engineering (47%) and lowest in the social sciences

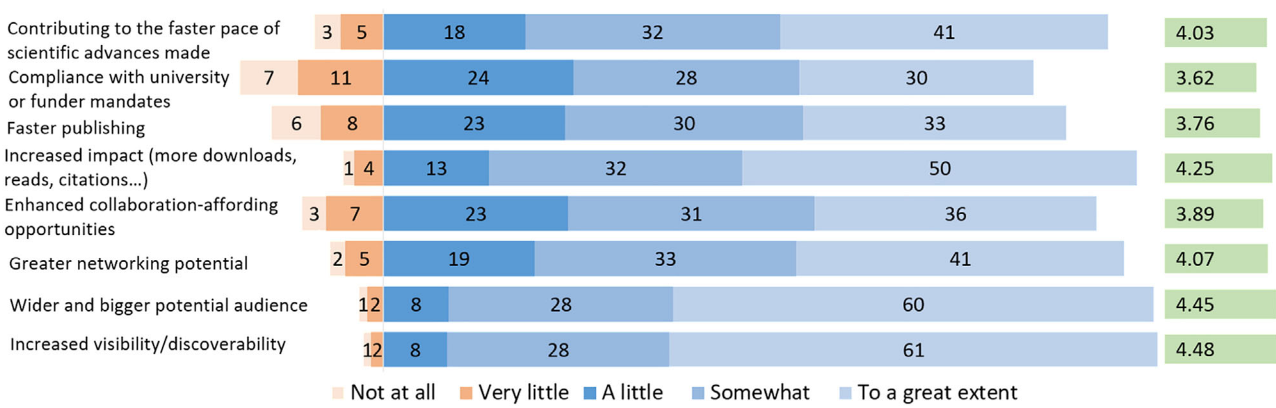

FIGURE 4 Percentages and mean value for 'To what extent do you use social media for each of the following purposes?' (N = 909).

TABLE 10 Subject differences in purposes for using social media (df = 4; p < 0.05).

	Health sci. (N = 98)		Life sci. (N = 168)		Physical sci. and engineering (N = 169)		Social sci. (N = 365)		Arts and humanities (N = 83)		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Sharing research	4.3	0.9	3.9	1.1	3.7	1.1	3.8	1.1	3.6	1.2	5.4
Conducting original research	2.7	1.3	2.6	1.3	2.8	1.2	3.0	1.3	3.0	1.3	3.3

TABLE 11 List of platforms and the frequency they were mentioned.

No	Platform	Frequency	No	Platform	Frequency
1	ResearchGate	272	11	Publons	9
2	Twitter	240	12	blogs	8
3	Facebook	116	13	YouTube	8
4	LinkedIn	107	14	Reddit	6
5	Academia	51	15	ScienceNet.cn	6
6	Wechat	34	16	muchong.com	5
7	Instagram	22	17	ORCID	5
8	Google Scholar	18	18	Telegram	5
9	WhatsApp	17	19	Weibo	5
10	Mendeley	16	20	Instagram	4
21	47 other platforms (37 were mentioned once)				61

(31%); highest among doctoral students (45%) and lowest among non-academic researchers (25%); highest among 21–25-year-olds (51%) and lowest among the 31–35 group (33%), and was higher with females (40%) compared to males(33%).

DISCUSSION AND CONCLUSION

Many, but not all, of the findings of this study confirm that ECRs are adopting new-age methods and tools as a matter of course, although that is not to say that their more senior and secure colleagues are not: for example, the past six cycles of the Ithaka S+R US Faculty Surveys have shown a general increase in preference for and use of electronic materials and tools within scholarly communication (Blankstein & Wolff-Eisenberg, 2019).

Scholarly information discovery is certainly a case in point. Thus, the long-established popularity of Google Scholar and Google and their embeddedness in the scholarly field (Blankstein & Wolff-Eisenberg, 2019; Oh & Colón-Aguirre, 2019) are confirmed, despite the long and continuing criticisms levelled against them (Lynch, 2016; Miller & Record, 2017; Schneier, 2015). Google Scholar, however, is not as relied upon in the arts and humanities, a finding found elsewhere (Blankstein & Wolff-Eisenberg, 2019; Wolff, Rod, & Schonfeld, 2016). As for Google, it is engineers and physical scientists who tend to use it more, as Wellings and Casselden (2019) also found, possibly because they need basic technical information and information about external products from the web (Freund, 2015).

The extent to which smartphones are used for scholarly discovery purposes, while limited to around a quarter of the ECRs and varying markedly by country and discipline, is nevertheless indicative of the prevalence of the practice. Indeed, with mobile 'visits' having been found to be information 'lite' – typically shorter, less interactive, and with less content viewed per visit (Nicholas, Clark, Rowlands, & Jamali, 2013) – smartphone use seems to be well suited to ECR information-seeking. Miller (2019) lists smartphones among the tools that enable ECRs to obtain the knowledge they need for knowledge transfer and creation; indeed, as Chang and Zimmerman (2019) find, mobile technology use is increasing and is clearly affecting learning and teaching scenarios. As the prevalence of smartphone ownership continues to grow globally (Pew Research Center, 2019a), and ever-more user-friendly phones increasingly become people's primary device for going online (Pew Research Center, 2019b), the shift toward mobile technology is likely to further affect the information-seeking practices of scholars, too.

When it comes to social media use, the behaviour reported by the ECRs exemplifies the extent to which social media-based online communities have come of age as platforms for meeting scholarly information needs. Very much in line with previous evidence on the role played by social media in researchers' information discovery practices (Jordan & Weller, 2018a, 2018b; Meishar-Tal & Pieterse, 2017; Sugimoto, Work, Larivière, & Haustein, 2017), ECRs listed current awareness, keeping up to date, and finding scholarly content among the most important purposes of their social media use.

Turning to reading behaviour, in today's digital, information-rich, and disintermediated information environment, how do ECRs determine what to read? Well, it is telling that convenience comes first, with the majority admitting to using what is closest to hand, telling, but perhaps not very surprising, for the centrality of convenience in scholarly information-seeking and its particular prevalence among millennials (Connaway, Dickey, & Radford, 2011) has long been established. Indeed, when researchers weigh the relative importance of various characteristics to select which articles to read, the second most highly ranked characteristic after topic is convenience in terms of online accessibility (Tenopir et al., 2011). It is only to be expected that it would be more so for young researchers, who have been found to expend less effort to obtain information than more senior colleagues and to show greater readiness to compromise on quality (Nicholas, Jamali, et al., 2015). Indeed, this may be the reason why journal rank and prestige matter to the older among the ECRs more than they do to the truly novice ones. Perhaps the youngest, presumably the most inexperienced, but also the most pressured, not having had an opportunity to prove themselves in the publish-or-perish world, are the most likely to assume that convenience-afforded faster pace of work should be the overriding consideration in their research practices. Beyond that, other possible influencers of reading behaviour, such as suggestions from social media or the author's country of affiliation, obtain very little traction. Altmetrics, too, are no more than minor influencers, despite publishers' and social media-based platforms' best efforts to promote them. This is in line with the latest cycle of Ithaka S+R US Faculty Surveys.

Given the increasing prevalence of smartphone ownership and its utilization for going online (Pew Research Center, 2019a, 2019b), another question of interest was whether ECRs' affinity for convenience results in the use of smartphones for reading scholarly work, too. With one in five ECRs already using them moderately or extensively for the purpose, further growth can be anticipated.

When it comes to publishing research, despite a wide and increasing number of outlets available, ECRs remain very traditional, which is no surprise given that the scholarly reputational system prizes publishing in highly ranked journals (Borrego & Anglada, 2016; Mulligan, Hall, & Raphael, 2013; Nicholas *et al*., 2015). As the Ithaka S + R Faculty Surveys repeatedly find, academics generally believe that when their work is assessed for appointment, promotion, or research funding, more recognition should be awarded for traditional research publications as compared to alternative research products (Blankstein & Wolff-Eisenberg, 2019; Wolff *et al*., 2016). In fact, as Gagliardi, Cox, and Li (2015) argue, the scholarly predilection for high-quality peer-reviewed journals as the avenue of publication – coupled with operational barriers to the adoption of Open Science practices – reinforces the narrative that privileges traditional publications as a guarantee of scientific legitimacy.

ECRs, as newcomers, are undoubtedly even more tied down by the journal-centred publishing dictates of the scholarly system (Schoen, Paradeise, Cauchard, & Noël, 2014). Lending further support to the validity of these notions, in this study, too, ECRs expressed a staunch belief in the overriding importance, for career-associated reasons, of publishing in top-tier journals. Still, in accordance with long established patterns of publishing behaviour in the arts and humanities, where publishing in international journals is supplemented by book publishing and the use of journals in the native languages (Sivertsen & Larsen, 2012), for humanities ECRs this was not so much the case.

Confirmed also is the popularity of social media, with two-thirds of ECRs using social media for scholarly communication purposes. Of course, not only is the use of social media par for the course for the community being studied (Pew Research Center, 2018b, 2019c), but, as it emerges from the findings of this study, it is plainly seen to deliver on additional fundamental scholarly activities – current awareness, collaboration, sharing, and networking. This confirms the findings in the latest cycle of Ithaka S+R US Faculty Survey, according to which younger scholars assigned more importance to academic social networks and following other researchers through blogs or social media than older cohorts (Blankstein & Wolff-Eisenberg, 2019). Health sciences ECRs are especially keen on using social media for sharing and collaboration, a point in need of further exploration, as previous evidence does not point to medicine and health sciences researchers as leading the way in this area (Blankstein & Wolff-Eisenberg, 2019).

We have come a long way since social media was frowned upon (Coppock & Davis, 2013; Tenopir, Levine, *et al*., 2016); rather, as Kjellberg, Haider, and Sundin's (2016) show, social media networks and tools are increasingly used by researchers for a variety of different purposes. True, problems and tensions are still associated with its scholarly use (Jordan & Weller, 2018a), so much so, as the case of SSNs exemplifies, that some researchers make a conscious decision to reduce their social media activities (Greifeneder *et al*., 2018). However, the findings in this study leave little room for doubt, as does the literature, that researchers appreciate social media-based scholarly communication tools and platforms (Jordan & Weller, 2018b; Meishar-Tal & Pieterse, 2017).

As to the open sharing of data, which is said to be assuming an ever-more important role in facilitating science and benefitting the scholarly community (McKiernan *et al*., 2016; Piwowar & Vision, 2013), ECRs' adoption of the practice is limited. Thus, although over three-quarters of the ECRs said they had produced data, only around one-third of those who responded to the question on making data publicly available testified to doing so, mostly publishing their data as a supplement to a paper. This is very much in line with Tenopir *et al*.'s (2015) findings, according to which younger respondents feel more favourably towards data sharing and reuse, yet make less of their data available than older researchers. ECRs' willingness to share data may very well vary with discipline: thus, life scientists were the most likely to make their data publicly available, as were the ECR authors in a study that compared their readiness to make their data available with that of senior authors (Campbell, Micheli-Campbell, & Udyawer, 2019).

The majority of those who did share their data cited reproducibility reasons, while the majority of those who refrained from doing so cited an absence of policies mandating data-sharing, with another, often chosen, reason being the unsuitability of their data for sharing. Interestingly, while these findings are generally in agreement with those of Schmidt, Gemeinholzer, and Treloar (2016), in the latter's case policies played a more significant role among the motivators, to the extent that one of their conclusions is that stronger mandates will strengthen the case for data-sharing. However, the jury is plainly out on this. Thus, in line with the findings of the present study, Mauthner and Parry's (2013) and Tenopir *et al*.'s (2015) results also indicate that data-sharing policies have little impact on practice. On the other hand, a report based upon Figshare data found that two-thirds of respondents felt that funding should be withheld if data mandates were not complied with, and about the same number felt that funders should require the sharing of data (Digital *Science et al*., 2019).

Finally, how then do these survey findings compare to those of the interview study (CIBER, 2018; Nicholas *et al*., 2019)? The main findings of the interview study were that ECRs are, in some respects, the harbingers of change with significant change being registered, especially so in regard to a willingness to employ social media-based tools and platforms, to employ open science practices, and to share and collaborate. This is very much borne out in this study. Perhaps the social media impact is a little greater here, but this might be accounted for by the passage of time between the two studies, as the environment is one of rapid change and by the fact that more countries and disciplines were covered.

ACKNOWLEDGEMENTS

This study was funded by the University of Malaya (Project No BKS079-2017). Organizations that helped distribute the questionnaire were El Profesional de la Información, Wiley, Emerald, Cambridge University Press, Public Library of Science, Eurodoc, Sense about Science, and UCL library.

INFORMED CONSENT STATEMENT

The introduction page of the survey had an informed consent statement that said 'By clicking NEXT and completing the survey, you are indicating that you have agreed to take part in this research and give permission for us to gather and analyse the answers you provide'.

REFERENCES

Allen, C., & Mehler, D. M. A. (2019). Open science challenges, benefits and tips in early career and beyond. *PLoS Biology*, *17*(5), e3000246. https://doi.org/10.1371/journal.pbio.3000246

Blankstein, M., & Wolff-Eisenberg, C. (2019). *U.S. faculty survey 2018*. New York, NY: Ithaka S+R Retrieved from https://sr.ithaka.org/wp-content/uploads/2019/03/SR-Report-US-Faculty-Survey-2018-04122019.pdf

Borrego, Á., & Anglada, L. (2016). Faculty information behaviour in the electronic environment: Attitudes towards searching, publishing and libraries. *New Library World*, *117*(3/4), 173–185. https://doi.org/10.1108/NLW-11-2015-0089

Burstein, D. D. (2013). *Fast future: How the millennial generation is shaping our world*. Boston, MA: Beacon Press.

Campbell, H. A., Micheli-Campbell, M. A., & Udyawer, V. (2019). Early career researchers embrace data sharing. *Trends in Ecology & Evolution*, *34*(2), 95–98. https://doi.org/10.1016/j.tree.2018.11.010

Carpenter, J., Wetheridge, L., & Tanner, S. (2012). Researchers of tomorrow: The research behaviour of generation Y doctoral students [Web log post]. Retrieved from www.webarchive.org.uk/wayback/archive/20140614040703/http://www.jisc.ac.uk/publications/reports/2012/researchers-of-tomorrow.aspx#annex1

Chang, H. C., & Zimmerman, T. (2019). Navigating the role of mobile technologies in shaping information behavior: A meta-synthesis. *Curriculum*. *ALISE 2019 Conference Proceedings*. Retrieved from www.ideals.illinois.edu/handle/2142/105320

CIBER. (2018). *Harbingers project website*. Retrieved from http://ciber-research.eu/harbingers.html

Connaway, L. S., Dickey, T. J., & Radford, M. L. (2011). "If it is too inconvenient, I'm not going after it:" Convenience as a critical factor in information-seeking behaviors. *Library & Information Science Research*, *33*(3), 179–190. https://doi.org/10.1016/j.lisr.2010.12.002

Copiello, S. (2019). Research interest: Another undisclosed (and redundant) algorithm by ResearchGate. *Scientometrics*, *120*(1), 351–360. https://doi.org/10.1007/s11192-019-03124-w

Coppock, E. G., & Davis, L. (2013). Status of the adoption of social media in the scientific research community. *Information Services and Use*, *33*(4), 203–217. https://doi.org/10.3233/ISU-130711

Digital Science, Fane, B., Ayris, P., Hahnel, M., Hrynaszkiewicz, I., Baynes, G., & Farrell, E. (2019). The State of Open Data Report 2019. *figshare*. Report. https://doi.org/10.6084/m9.figshare.9980783.v2

Freund, L. (2015). Contextualizing the information-seeking behavior of software engineers. *Journal of the Association for Information Science and Technology*, *66*(8), 1594–1605. https://doi.org/10.1002/asi.23278

Gagliardi, D., Cox, D., & Li, Y. (2015). Institutional inertia and barriers to the adoption of open science. In E. Primeri & E. Reale (Eds.), *The transformation of university institutional and organizational boundaries*. (pp. 107–133). Rotterdam, The Netherlands: Brill Sense.

Greifeneder, E., Pontis, S., Blandford, A., Attalla, H., Neal, D., & Schlebbe, K. (2018). Researchers' attitudes towards the use of social networking sites. *Journal of Documentation*, *74*(1), 119–136. https://doi.org/10.1108/JD-04-2017-0051

Harley, D., Acord, S. K., Earl-Novell, S., Lawrence, S., & King, C. J. (2010). *Assessing the future landscape of scholarly communication: An exploration of faculty values and needs in seven disciplines*. Berkeley, CA: UC Berkeley Center for Studies in Higher Education Retrieved from https://escholarship.org/uc/item/15x7385g

Jamali, H. R., Nicholas, D., Watkinson, A., Abrizah, A., Rodríguez-Bravo, B., Boukacem-Zeghmouri, C., … Świgoń, M. (2020). Early career researchers and their authorship and peer review beliefs and practices: An international study. *Learned Publishing*. https://doi.org/10.1002/leap.1283

Jordan, K., & Weller, M. (2018a). Academics and social networking sites: Benefits, problems and tensions in professional engagement with online networking. *Journal of Interactive Media in Education*, *2018*(1). https://doi.org/10.5334/jime.448

Jordan, K., & Weller, M. (2018b). Communication, collaboration and identity: Factor analysis of academics' perceptions of online networking. *Research in Learning Technology*, 26. https://doi.org/10.25304/rlt.v26.2013

Kjellberg, S., Haider, J., & Sundin, O. (2016). Researchers' use of social network sites: A scoping review. *Library & Information Science Research*, *38*(3), 224–234. https://doi.org/10.1016/j.lisr.2016.08.008

Laudel, G., & Gläser, J. (2008). From apprentice to colleague: The metamorphosis of early career researchers. *Higher Education*, *55*(3), 387–406. https://doi.org/10.1007/s10734-007-9063-7

Lynch, M. (2016). *The internet of us: Knowing more and understanding less in the age of big data*. New York, NY: W.W. Norton and Company.

Mauthner, N. S., & Parry, O. (2013). Open access digital data sharing: Principles, policies and practices. *Social Epistemology*, *27*(1), 47–67. https://doi.org/10.1080/02691728.2012.760663

McKiernan, E. C., Bourne, P. E., Brown, C. T., Buck, S., Kenall, A., Lin, J., … Spies, J. R. (2016). Point of view: How open science helps researchers succeed. *eLife*, *5*, e16800. https://doi.org/10.7554/eLife.16800

Meishar-Tal, H., & Pieterse, E. (2017). Why do academics use academic social networking sites? *The International Review of Research in Open and Distributed Learning*, *18*(1), 1–22. https://doi.org/10.19173/irrodl.v18i1.2643

Miller, B., & Record, I. (2017). Responsible epistemic technologies: A social-epistemological analysis of autocompleted web search. *New Media & Society*, *19*(12), 1945–1963. https://doi.org/10.1177/1461444816644805

Miller, F. Q. (2019). Encountering relatable information in experiential learning spaces: A partnership framework for research information specialists and early career researchers. *Journal of Documentation*, *75*(3), 517–529. https://doi.org/10.1108/JD-05-2018-0069

Müller, R. (2014a). Racing for what? Anticipation and acceleration in the work and career practices of academic life science postdocs. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, *15*(3), 329–349. https://doi.org/10.17169/fqs-15.3.2245

Müller, R. (2014b). Postdoctoral life scientists and supervision work in the contemporary university: A case study of changes in the cultural norms of science. *Minerva*, *52*(3), 329–349. https://doi.org/10.1007/s11024-014-9257-y

Mulligan, A., Hall, L., & Raphael, E. (2013). Peer review in a changing world: An international study measuring the attitudes of researchers. *Journal of the American Society for Information Science and Technology*, *64*(1), 132–161. https://doi.org/10.1002/asi.22798

Ng, E. S., Schweitzer, L., & Lyons, S. T. (2010). New generation, great expectations: A field study of the millennial generation. *Journal of Business and Psychology*, *25*(2), 281–292. https://doi.org/10.1007/s10869-010-9159-4

Nicholas, D., Boukacem-Zeghmouri, C., Rodríguez-Bravo, B., Xu, J., Watkinson, A., Abrizah, A., … Świgoń, M. (2017). Where and how early career researchers find scholarly information. *Learned Publishing*, *30*(1), 19–29. https://doi.org/10.1002/leap.1087

Nicholas, D., Clark, D., Rowlands, I., & Jamali, H. R. (2013). Information on the go: A case study of Europeana mobile users. *Journal of the American Society for Information Science and Technology*, *64*(7), 1311–1322. https://doi.org/10.1002/asi.22838

Nicholas, D., Herman, E., Jamali, H., Rodríguez-Bravo, B., Boukacem-Zeghmouri, C., Dobrowolski, T., & Pouchot, S. (2015). New ways of building, showcasing, and measuring scholarly reputation. *Learned Publishing*, *28*(3), 169–183. https://doi.org/10.1087/20150303

Nicholas, D., Jamali, H. R., Watkinson, A., Herman, E., Tenopir, C., Volentine, R., … Levine, K. (2015). Do younger researchers assess trustworthiness differently when deciding what to read and cite and where to publish. *International Journal of Knowledge Content Development and Technology*, *5*(2), 46–53. https://doi.org/10.5865/IJKCT.2015.5.2.045

Nicholas, D., Rodríguez-Bravo, B., Watkinson, A., Boukacem-Zeghmouri, C., Herman, E., Xu, J., … Świgoń, M. (2017). Early career researchers and their publishing and authorship practices. *Learned Publishing*, *30*(3), 205–217. https://doi.org/10.1002/leap.1102

Nicholas, D., Watkinson, A., Boukacem-Zeghmouri, C., Rodríguez-Bravo, B., Xu, J., Abrizah, A., … Herman, E. (2019). So, are early career researchers the harbingers of change? *Learned Publishing*, *32*(3), 237–247. https://doi.org/10.1002/leap.1232

Nielsen. (2018). *Millennials on Millennials: TV and digital news consumption* [Web log post]. Retrieved from www.nielsen.com/us/en/insights/reports/2018/millennials-on-millennials-tv-digital-news-consumption.html

Oh, K. E., & Colón-Aguirre, M. (2019). A comparative study of perceptions and use of Google scholar and academic library discovery systems. *College & Research Libraries*, *80*(6), 876.

Pew Research Center. (2010a). *Millennials: A portrait of generation next* [Web log post]. Retrieved from www.pewsocialtrends.org/2010/02/24/millennials-confident-connected-open-to-change/

Pew Research Center. (2010b). *Millennials will make online sharing in networks a lifelong habit* [Web log post]. Retrieved from www.pewinternet.org/2010/07/09/millennials-will-make-online-sharing-in-networks-a-lifelong-habit/

Pew Research Center. (2018a). *Social media use continues to rise in developing countries, but plateaus across developed ones* [Web log post]. Retrieved from www.pewresearch.org/global/2018/06/19/social-media-use-continues-to-rise-in-developing-countries-but-plateaus-across-developed-ones/

Pew Research Center. (2018b). *Social media use in 2018* [Web log post]. Retrieved from www.pewinternet.org/2018/03/01/social-media-use-in-2018/

Pew Research Center. (2019a). *Smartphone ownership is growing rapidly around the world, but not always equally* [Web log post]. Retrieved from www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/

Pew Research Center. (2019b). *Mobile technology and home broadband 2019* [Web log post]. Retrieved from www.pewinternet.org/2019/06/13/mobile-technology-and-home-broadband-2019/

Pew Research Center. (2019c). *Share of U.S. adults using social media, including Facebook, is mostly unchanged since 2018* [Web log post]. Retrieved from www.pewresearch.org/fact-tank/2019/04/10/share-of-u-s-adults-using-social-media-including-facebook-is-mostly-unchanged-since-2018/

Piwowar, H. A., & Vision, T. J. (2013). Data reuse and the open data citation advantage. *PeerJ*, *1*, e175. https://doi.org/10.7717/peerj.175

Schewe, C. D., Debevec, K., Madden, T. J., Diamond, W. D., Parment, A., & Murphy, A. (2013). "If you've seen one, you've seen them all!" are young Millennials the same worldwide? *Journal of International Consumer Marketing*, *25*(1), 3–15. https://doi.org/10.1080/08961530.2013.751791

Schmidt, B., Gemeinholzer, B., & Treloar, A. (2016). Open data in global environmental research: The Belmont Forum's open data survey. *PLoS One*, *11*(1), e0146695. https://doi.org/10.1371/journal.pone.0146695

Schneier, B. (2015). *Data and goliath: The hidden battles to collect your data and control your world*. New York, NY: WW Norton & Company.

Schoen, A., Paradeise, C., Cauchard, L., & Noël, M. (2014). A double shift in researchers' activity profiles: An actor-based analysis of the making of quality in high standing academic departments. In E. Noyons (Ed.), *Context counts: Pathways to master big and little data. Proceedings of the Science and Technology Indicators Conference, 3–5 September 2014*. (pp. 558–563). Leiden, the Netherlands: Universiteit Leiden.

Segado-Boj, F., Martín-Quevedo, J., & Prieto-Gutiérrez, J. J. (2018). Attitudes toward open access, open peer review, and altmetrics among contributors to Spanish scholarly journals. *Journal of Scholarly Publishing*, *50*(1), 48–70. https://doi.org/10.3138/jsp.50.1.08

Sivertsen, G. (2014). Scholarly publication patterns in the social sciences and humanities and their coverage in Scopus and Web of Science. In E. Noyons (Ed.), *Context counts: Pathways to master big and little data. Proceedings of the Science and Technology Indicators Conference, 3–5 September 2014*. (pp. 598–604). Leiden, the Netherlands: Universiteit Leiden.

Sivertsen, G., & Larsen, B. (2012). Comprehensive bibliographic coverage of the social sciences and humanities in a citation index: An empirical analysis of the potential. *Scientometrics*, *91*(2), 567–575. https://doi.org/10.1007/s11192-011-0615-3

Spezi, V. (2016). Is information-seeking behavior of doctoral students changing? A review of the literature (2010–2015). *New Review of Academic Librarianship*, *22*(1), 78–106. https://doi.org/10.1080/13614533.2015.1127831

Sugimoto, C. R., Work, S., Larivière, V., & Haustein, S. (2017). Scholarly use of social media and altmetrics: A review of the literature. *Journal of the Association for Information Science and Technology*, *68*(9), 2037–2062. https://doi.org/10.1002/asi.23833

Tenopir, C., Allard, S., Bates, B. J., Levine, K. J., King, D. W., Birch, B., … Caldwell, C. (2011). Perceived value of scholarly articles. *Learned Publishing*, *24*(2), 123–132. https://doi.org/10.1087/20110207

Tenopir, C., Dalton, E., Fish, A., Christian, L., Jones, M., & Smith, M. (2016). What motivates authors of scholarly articles? The importance of journal attributes and potential audience on publication choice. *Publications*, *4*(3), 22. https://doi.org/10.3390/publications4030022

Tenopir, C., Dalton, E. D., Allard, S., Frame, M., Pjesivac, I., Birch, B., … Dorsett, K. (2015). Changes in data sharing and data reuse practices and perceptions among scientists worldwide. *PLoS One*, *10*(8), e0134826. https://doi.org/10.1371/journal.pone.0134826

Tenopir, C., Levine, K., Allard, S., Christian, L., Volentine, R., Boehm, R., … Watkinson, A. (2016). Trustworthiness and authority of scholarly information in a digital age: Results of an international questionnaire. *Journal of the Association for Information Science and Technology*, *67*(10), 2344–2361. https://doi.org/10.1002/asi

Vicente-Sáez, R., & Martínez-Fuentes, C. (2018). Open Science now: A systematic literature review for an integrated definition. *Journal of Business Research*, *88*, 428–436. https://doi.org/10.1016/j.jbusres.2017.12.043

Wellings, S., & Casselden, B. (2019). An exploration into the information-seeking behaviours of engineers and scientists. *Journal of Librarianship and Information Science*, *51*(3), 789–800. https://doi.org/10.1177/0961000617742466

Wolff, C., Rod, A. B., & Schonfeld, R. C. (2016). *UK Survey of Academics 2015: Ithaka S+R | Jisc* | RLUK [Web log post]. Retrieved from www.sr.ithaka.org/publications/uk-survey-of-academics-2015/