










# Outside the library: Early career researchers and use of alternative information sources in pandemic times

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**Abstract:** Presents findings from a study into the attitudes and practices of pandemic-era early career researchers (ECRs) in regard to obtaining access to the formally published scholarly literature, which focused on alternative providers, notably ResearchGate and Sci-Hub. The study is a part of the *Harbingers* project that has been exploring the work lives and scholarly communication practices of ECRs in pre-pandemic times and during the pandemic, and utilizes data from two rounds of interviews with around 170 ECRs from the sciences and social sciences in eight countries. Findings show that alternative providers, as represented by ResearchGate and Sci-Hub, have become established and appear to be gaining ground. However, there are considerable country- and discipline-associated differences. ECRs' country-specific level of usage of the alternative providers is partly traceable to the adequacy of library provisions, although there are other factors at play in shaping ECRs' attitudes and practices, most notably convenience and time saving, as well as the fact that these platforms have become embedded in the scholarly dashboard. There is a dearth of evidence of the impact of the pandemic on ECRs' ways of obtaining scholarly papers.

**Keywords:** early career researchers, pandemic times, shadow libraries

## INTRODUCTION

Research is underpinned by prior work that provides critical context, so obtaining pertinent scholarly literature is the *sine qua non* of any endeavour to add to existing knowledge. Obtaining previously achieved knowledge has always been a vital component of the research process—to use Newton's famous aphorism, each researcher stands on the shoulders of the giants who preceded them, though Simon (2001) was right when he said that the shoulders need not belong to giants, a half dozen small people will serve just as well.

However, if in the past access to formally published scholarly publications was almost wholly dependent on the library, complemented by inter-library loan services and/or sharing of articles among peers, but on the whole curtailed by the reach of its print-based collections, things are now very different. A sea-change in accessibility to the scholarly literature has been taking place. The ideals of the open access (OA) movement, centring as they do on unhampered access to knowledge for all (Suber, 2012), have arguably been paving the way to the emergence of complementary facilities, if not real alternatives to the academic library's information provision services. The scholarly information universe is thus rich with online databases that afford wide access—whether strictly legal or not—to the formally published research literature.

These platforms, which fall into two main categories, scholarly social networks (SSNs), as exemplified by ResearchGate, and shadow or pirate libraries, such as Sci-Hub, are technology-enabled means of directly accessing scientific works. Their great advantage is that they make it possible for researchers to sidestep the paywalls that prevent them from readily meeting their information needs, a capability that may very well become even more important now that the adverse effects of the pandemic on university funds has left academic libraries with budgets under pressure, if not in decline (Frederick & Wolff-Eisenberg, 2021; Maron et al., 2021; Radecki & Schonfeld, 2020, 2021).

There is reason to believe then that researchers might opt for alternative providers of scholarly output. In general, and especially in the case of Sci-Hub, the decision to do so means that researchers need to be unaccepting of or at least willing to turn a blind eye to considerations of legality. In the case of the novices among them, some of whom are unaware of the legal status of alternative sources, this might pose a dilemma. After all, ECRs, as newcomers to academe, who can hardly afford to stray from the straight and narrow in their various undertakings, have been found to be wary of infringing on publishers' copyright (Creaser et al., 2010). The ability to access scientific knowledge freely, swiftly and easily must be a temptation where they are concerned, because: (1) as hopeful entrants to academe, yet to prove themselves by publishing, they are notoriously pressured for time, so that easily accessing the literature must be a tempting option; (2) the ideology behind the alternative information provision options fits with their characteristic mindset as millennial/Google generation ECRs.

### Key points

- Alternative providers, such as ResearchGate and Sci-Hub, are established as sources of papers and are embedded in the scholarly dashboards of some early career researchers (ECRs) because of their convenience and comprehensiveness.
- While the pandemic has had little impact on ECRs' practices of obtaining formally-published scholarly papers it did alert them to the benefits of open access.
- There are country differences with Russia and Spain being big users of ResearchGate, and France and Malaysia using it much less.
- Similarly, Poland and Malaysia are big users of Sci-Hub, while the United Kingdom and United States are low-volume users.
- Country differences can be partly attributed to the quality of library provision in these countries, but not exclusively so.
- Environmental Sciences and Physical Sciences ECRs are most likely to use ResearchGate, whereas their counterparts from Chemistry, Life Sciences and especially the Medical Sciences were the most likely to use Sci-Hub.

We have learnt how ECRs gain access to scholarly literature in the *Harbingers* research project, now in its sixth year, which investigates the working lives and scholarly communication behaviour of junior science and social science researchers. Thus, we are well-placed to report on their practices when it comes to choosing the information provision services that best fit their needs. With the findings of *Harbingers-1*,<sup>1</sup> the first, 4-year (2016–2019) leg of the undertaking, already pointing to the directions that this area might take (Nicholas, Boukacem-Zeghmouri, et al., 2017, Nicholas, Herman, et al., 2017, Nicholas et al., 2018, Nicholas, Jamali, et al., 2020), in *Harbingers-2*,<sup>2</sup> the ongoing, two-year (2020–2022), Alfred P. Sloan Foundation-funded extension to the project, the opportunity was taken to explore how things have been unfolding during pandemic times.

### Aims and objectives

The overarching aim of the research is to establish how pandemic-era ECRs gain access to the formally published scholarly literature, seeking in particular to determine whether they have been supplementing established library provision with alternative sources, such as SSNs (e.g., ResearchGate) and shadow/pirate libraries (e.g., Sci-Hub) and, if so, to what extent and whether the pandemic is the reason why. Within this broad

<sup>1</sup><http://ciber-research.com/harbingers.html>

<sup>2</sup><http://ciber-research.com/harbingers-2/>

aim the paper shall examine similarities and differences in behaviour in respect to nationality, discipline and gender.

## Scope and definitions

For lack of a universally accepted definition of an ECR, with different and conflicting definitions of ECRs circulating (Poli, 2016), which vary from country to country, a pragmatic conceptualisation of an ECR was decided on. Thus, the definition formulated focusses on the common denominators of their standing in the scholarly world, that is, their being employed in a research position but, being youngish and in an early phase of their career, not yet established as researchers: Researchers who are generally not older than 45, who either have received their doctorate and are currently in a research position or have been in research positions, but are currently doing a doctorate. In neither case are they researchers in established or tenured positions. In the case of academics, some are non-tenure line faculty research employees.

The reference to subject/disciplinary representativeness in this paper builds on the findings of Fanelli and Glänzel (2013), which support the 'gradualist' view of scientific knowledge suggested by the *Hypothesis of the Hierarchy of Sciences*—the placing of each field of research, moving from the physical to the social sciences, along a continuum of complexity and softness.

## LITERATURE REVIEW

The ground-breaking development that heralded the rise of initiatives, which had as their express purpose the achieving of better access to scholarly papers, can arguably be seen as the OA movement, with its agenda of striving for barrier-free access to the scholarly literature (BOAI20 6, 2022; Suber, 2012). Much effort went into achieving OA to the scholarly literature through various measures, among which the most prominent are (1) free licensing; (2) the establishment and operation of a publication infrastructure, inclusive of repositories that house literature prior to peer review and/or publication; and (3) the development of alternative funding models (Buehling et al., 2022). However, although the movement has been making considerable progress, especially since funding organizations have started mandating OA—in 2017, for the first time, the majority of new papers across all scholarly disciplines were published OA—it is yet to realize its promise in full (Brainard, 2022). This has certainly left room for more immediate solutions to researchers' very real need for better accessibility to scholarly publications (Buehling et al., 2022).

The first to rise to the challenge were SSNs, among which ResearchGate and Academia.edu are the most popular, which function as document sharing services as part and parcel of their wider aim of serving as scientific communities. Their databases contain, as of May 2022, 135 and 37 million academic papers, respectively. These publications are uploaded by their authors, sometimes in infringement of copyright or in non-compliance with publishers' policy, not so much deliberately as for lack of understanding of the rather complex policies pertaining to the practice (Jamali, 2017).

SSNs have been found in study after study to function for researchers as warehouses of scientific papers, even more so than as platforms for interacting with others (Lee et al., 2019). True, SSNs may not be researchers' first port of call when they set out to obtain a scholarly article, as Meier and Tunger (2018) found in their survey of scientists' opinions and usage patterns for ResearchGate. Still, both ResearchGate and Academia.edu, having started out in 2008 as disruptors of the customary order of things in academia, are by now well-known mainstay services, reporting 20 and 184 million registered users, respectively.

Next to join the ranks of alternative scholarly paper providers were the so-called pirate or shadow libraries—dedicated websites that facilitate the immediate, cost-free, but more often than not copyright-infringing delivery to an end user of paywalled journal articles, monographs and textbooks. Whilst pirate/shadow libraries, trying to avoid exposure and prosecution, on the whole prefer to operate under the radar, Sci-Hub takes the opposite stance (Bodó, 2016). Founded in 2011 by Alexandra Elbakyan, Sci-Hub openly proclaims that its services, intended to enable universal OA to knowledge, only put right the untenable, unethical and harmful situation of publishers' hiding articles behind paywalls (Bodó, 2016; Karaganis et al., 2018).

The past few years saw sustained growth of the accessibility to scholarly literature, much of it courtesy of Sci-Hub. In fact, their database, which contained 68.9% of the 81.6 million scholarly articles registered with Crossref and 85.1% of articles published in toll access journals by 2017 (Himmelstein et al., 2018), has grown by now to over 85 million files, the equivalent to 95% of all scholarly publications with issued DOI numbers (Wikipedia, 2022). Plainly then, nearly all of the scholarly literature is available gratis to anyone with an Internet connection, as long as they are prepared to ignore the possibility that doing so constitutes copyright infringement. The findings of a study that compared Sci-Hub with the subscription-based publisher sites of ScienceDirect and Emerald Insight certainly evidence a widespread disregard of the illicitness of the service: Sci-Hub had the highest number of daily page visits, the highest daily time spent on site and the lowest bounce percentage; that is, the lowest rate of leaving the website without doing or completing an activity (Amin et al., 2021).

Although Sci-Hub's legitimacy is widely known to be questionable, it is popular, even in the rich United States and OECD countries, where library provision is adequate (Bohannon, 2016; Himmelstein et al., 2018), although it is yet to be seen if it remains so in the wake of the aforementioned COVID-induced budgetary cuts. According to Bohannon (2016), many users can access the same papers through their libraries but turn to Sci-Hub instead—for convenience rather than necessity. Findings, too, in the original *Harbingers-1* project, indicated that convenience and time saving were the main motivators for using Sci-Hub (Nicholas, Boukacem-Zeghmouri, et al., 2019).

This apparent willingness of scholarly users to opt for unlawful routes of obtaining literature is perhaps less surprising than it might look. After all, as Anderson (2018) points out, digital piracy

is arguably *mala prohibita*, that is, an act that is technically illegal but not morally wrong, rather than *mala in se*, an act that is 'bad in itself'. Add to it the popularly held view that there is no logical reason why publishers should get rich on the backs of researchers, which has gained Sci-Hub the distinction of being regarded as the Robin Hood of the scholarly information world (Oxenham, 2016), and it becomes clear why abiding by the law may not be a significant consideration when it comes to researchers' setting out to get hold of the literature.

For many universities worldwide, the pandemic has brought about a rise in costs in tandem with declining revenues. Unavoidably, as the greater expenditure on both urgent investments to support online instruction and public health measures has been coinciding with falls in university incomes, which stem mainly from a sharp drop in student enrolments, and the attendant losses in tuition fees and teaching grants, but also from tuition discounts or refunds granted to students unable to access campuses and facilities (Radecki & Schonfeld, 2020, 2021). Obviously, as Radecki and Schonfeld (2021) point out, talking specifically about the United States, but describing a situation that holds true everywhere, with library budgets derived from university general funds, whenever there is pressure on the general fund, financing for their services is at risk.

The impact of the pandemic on research libraries is felt in many countries. Thus, for example, even in the United States a survey of research libraries revealed substantial quantitative evidence of budget cuts in the 2020–2021 fiscal year. In fact, 75% of the libraries surveyed operated with reduced budgets, many of the libraries did not receive a timely budget and/or were under various forms of expenditure control. Under the circumstances, libraries had already reduced spending on collections and made reductions to staffing, and their directors expressed uncertainty about longer-term financial recovery; indeed, anticipated that budgetary cuts would not only continue, but deepen in the following year (Frederick & Wolff-Eisenberg, 2021; Radecki & Schonfeld, 2021).

Other studies provide evidence to the same effect. Thus, a survey of SPARC member institutions in the United States, Canada, and Australia indicated that by 2021 nearly 80% of libraries had to contend with budget cuts as a result of COVID, over 20% reported having experienced a cut of 10% or more, and the vast majority of those who experienced cuts anticipated that these reductions would likely be permanent (Maron et al., 2021). In the United Kingdom, too, according to the RLUK (Research Libraries UK), COVID-19 has had a significant impact on higher education institutions and their libraries, with the negative financial effects expected to continue throughout 2020/21 and well beyond, so much so, that many libraries were asked to model budget cuts of up to 40% (Research Libraries UK, 2020).

The endemic presence of alternative providers of research output certainly eases ECRs' aforementioned dilemma when they deliberate the use of alternative information provision services: now that these are gaining a strong foothold in academe, they feel free to use them, and why should they not, when their

mentors and senior colleagues do? After all, as novice researchers yet to prove their suitability to an academic career by producing an impressive research record, they are the ones more harried, more rushed (Müller, 2014a, 2014b). Indeed, as veritable research 'workhorses' (Jamali et al., 2020; Nicholas, Rodríguez-Bravo, et al., 2017), ECRs are often tasked with amassing the literature base of a project.

Millennials,<sup>3</sup> open to change, global in their perspective, intent upon making a difference in the world, community-minded and keenly conscious of the public good as they are (FEPS - Foundation for European Progressive Studies & ThinkYoung, 2018; Schewe et al., 2013), are likely to be champions of the values of equal, encompassing and unhampered access to knowledge. Their support of the principles driving the OA movement is in fact testimony to their appreciation of these values (Nicholas, Hamali, et al., 2020).

Moreover, for them, as the Google generation,<sup>4</sup> nothing but instant gratification of their information requests at a click will do. Wading through complicated and unintuitive information systems, sometimes encountered in academic libraries, is not for them (Gunter et al., 2009; Nicholas et al., 2011). It must be especially so these days, when they can meet their information needs via the likes of Sci-Hub, which, as Gardner et al. (2017) point out, is easy to use, offering simple and fast access to full-text articles in a manner that is more straightforward than those on library or publisher websites, albeit only if you have the DOI.

Neither ECRs' obvious affinity to the ideals driving alternative information providers, nor the inherent suitability of these platforms to their needs, necessarily mean that they will use them. However, in *Harbingers-1* it was found that ResearchGate and Sci-Hub were clearly gaining ground. ResearchGate was used by over 75% of ECRs, although not exclusively for accessing scholarly papers, and their use of Sci-Hub—where their aim could only have been getting hold of a paper—rose in the 4 years from 5% to around 25%. However, Sci-Hub usage was very much country-specific: the platform was the most popular with French ECRs, whilst making little headway with their counterparts from the United Kingdom, United States, Malaysia, and China; although in China's case this can be explained by it being banned (Nicholas, Boukacem-Zeghmouri, et al., 2019).

## METHODS

The *Harbingers-2* project continues the mixed methodology approach of *Harbingers-1*, as detailed in Nicholas, Watkinson,

<sup>3</sup>'Millennials', also known as 'Generation Y', are people born or experiencing their formative years just before the turn of the millennium. Millennials are people born between the early 1980s and late 1990s (FEPS - Foundation for European Progressive Studies & ThinkYoung, 2018).

<sup>4</sup>'Google generation' is a phrase that refers to a generation of young people, born after 1993, growing up in a world dominated by the internet and mobile devices (Gunter et al., 2009).

**TABLE 1** Characteristics of the early career researcher (ECR) sample (round 2 of the interviews).

Country	China	Spain	France	UK	Malaysia	Poland	Russia	US	All
ECRs	24 (14%)	20 (12%)	17 (10%)	24 (14%)	20 (12%)	22 (13%)	20 (12%)	21 (13%)	168
Subject	Maths	Physics	Chemistry	Life	Medicine	Environ-mental	SOCH*	SOCS**	
ECRs	23 (14%)	27 (16%)	14 (8%)	19 (11%)	32 (19%)	14 (8%)	20 (12%)	19 (11%)	168
Status	Doctoral	Post-Doc	Ass Prof	Research Fellow	Other				
ECRs	40 (24%)	18 (11%)	60 (36%)	23 (14%)	27 (16%)				168
M/F	F	M							
ECRs	84 (50%)	84 (50%)							168
Age	min	LQ	median	UQ	max				
ECRs	23	28	32	36	45				

\* Social sciences hard, including psychology, economics.

\*\* Social sciences soft, including politics, sociology, anthropology.

et al. (2019); Nicholas, Jamali, et al. (2020): an ongoing literature review; three rounds of semi-directed interviews, conducted at intervals of 6 months; and a follow-up questionnaire survey.

Here, we focus on the first two rounds of interviews and on how ECRs obtain scholarly papers, and for this purpose three sets of data are brought together:

1. A text-search and counting of occurrences (*mentions*) of 'ResearchGate' and 'Sci-Hub' in the responses to all questions. This provides a general overview to guide the subsequent textual analysis.
2. An analysis through a reading of *quotes and comments* proffered by ECRs in reply to a set of questions that probed where they search for formal scholarly publications, where they obtain them, alternatives to normal library access, and change in practices since the pandemic.<sup>5</sup>
3. *Desk research and observations* of the national interviewers, to provide the context in which the comments were made. Thus, for example, in the case of ResearchGate, the individual-level context was established via a comparison of the ECRs' ResearchGate profiles and CVs against their reporting in the interviews, whilst the national-level context was achieved through the interviewers' appreciations of the developments in their countries.

## Sample and recruitment of ECRs

The sample population comprises both ECRs who participated in *Harbingers-1* (36), and new individuals (141), recruited to fill the ranks of participants who have left research or no longer qualify as ECRs. New ECRs were recruited by the eight national interviewers, utilizing their local networks and connections, with numbers supplemented by mail-outs from scholarly publisher lists.

<sup>5</sup>For the full interview schedule, see [http://ciber-research.com/harbingers-2/20201202-H2-Interview\\_schedule-1.pdf](http://ciber-research.com/harbingers-2/20201202-H2-Interview_schedule-1.pdf). The questions on information discovery and usage are in section Q3.1–Q3.1.6.

Each national interviewer was provided with a quota of interviewees to ensure representativeness from an age, gender and disciplinary perspective, and to ensure that the demographics of national samples were as similar as possible. The recruiting target was between 20 and 24 interviewees.

As noted, 177 ECRs were recruited for round 1 (R1) of the interviews, with a rough gender balance (females 51% and males 49%), but more variation in disciplines, as shown in Table 1. Typically, ECRs were in their early thirties, ranging in age from 23 to 45. By round 2 of the interviews (R2) the number of ECRs fell to 168 with a 50:50 gender balance.

## Data collection

There were 54 questions in the interview schedule, a mix of closed, open and hybrid questions. The schedule was piloted. Most interviews were conducted remotely over Zoom (because of the pandemic), in each ECR's national language, except for Malaysia where English is spoken. Interviews, typically 75–120 min long, were recorded, with the transcripts returned to ECRs to ensure accuracy and to obtain further clarity. Essentially, interviews were an open-ended conversation, guided and punctuated by more direct questioning (i.e., semi-directed). Questions covered a wide range of topics pertaining to the impact of the pandemic on ECRs' job, status, career aims, assessment, research practices and working life, and scholarly communications.

Data on how pandemic-era ECRs gain access to scholarly papers emerged from the responses to a set of questions asking more generally about sources of formal publications. There was no attempt made to lead interviewees to talk about alternatives to the library as providers of scholarly papers or specifically about ResearchGate or Sci-Hub. The dividend of an open-ended questioning strategy is that our findings, emerging if and when ECRs saw fit, and in their own words, too, are accurate representations of their views, attitudes and practices. No less importantly, with interviewees feeling free to elaborate on topics they deemed to be of relevance, even if not directly asked about,

could and did bring up new information and provided fresh insights. Thus, for instance, when in R1 discussions of working from home during the pandemic led to interviewees' mentioning their use of ResearchGate and/or Sci-Hub, we were alerted to the need to take a closer look at the possibility that alternative services are more popular. This prompted us to ask in R2 a more targeted question that sought to establish where interviewees turned to obtain a paper when their library could not provide it.

## Data analysis

All the interview transcripts were transferred to a 'coding sheet', which closely matched the questions of the original 'interview schedule', but left room for information derived from additional enquiries or clarifications during the interview process. Thus, whereas the 'schedule' sets guided the conversational course of the interview, the 'coding' was the first stage of analysis, requiring the interviewer to interpret and add commentary to the transcript. A mapping was maintained so that same, revised, and new questions could be matched between schedule, coding and the three rounds of interviews.

Although we had asked about discovering and obtaining publications in both R1 and R2, no question had been asked specifically about alternative information providers, as represented by the ones that, according to *Harbingers-1*, were gaining ground among ECRs, ResearchGate and Sci-Hub (Nicholas, Boukacem-Zeghmouri, et al., 2019). In the data analysis we, therefore, searched for any mention in the free-text—comments or quotes—for 'ResearchGate' or 'Sci-Hub' (or variants thereof).<sup>6</sup> A 'mention' is defined as any occurrence of the search term in either the quote or comment given by an ECR in response to a question.

Mentions may be positive (that is, agreeing with the question), lukewarm, to the point of being a 'false' positive (mentioning, but only in passing or by example) or negative. This required inspection of the interview transcript, so that it is the subsequent analysis of the entire free-text quote or comment and its interview context that provides the detail and explanation. It is important to note that a quote may not mention the terms being sought, but the commentary of the interviewer left little doubt as to what they were referring to. For example, when an ECR talked about 'that place – where PhD students download papers illegally', and another about 'that black crow', it was quite clear which site they meant (Sci-Hub).

## Desk research

A check of ECR membership of ResearchGate was conducted by national interviewers to establish background details. It shows that ResearchGate has gone down well, with the large majority (87%) of ECRs members (Table 2). China has a lower proportion (71%) and Poland and Malaysia the highest (both 95%). Because ECRs become members does not mean they are active on the

<sup>6</sup>The SQL search was case insensitive and included variants such as Research-Gate, RG and Sci-Hub.

**TABLE 2** ResearchGate membership (as of round 2).

Country	Total ECRs N	Membership		Active membership	
		N	%	N	%
China	24	17	71	4	17
France	17	14	82	14	82
Malaysia	20	19	95	10	50
Poland	22	21	95	16	73
Russia	20	18	90	16	80
Spain	20	17	85	15	75
UK	24	22	92	20	83
US	21	18	86	9	43
Total	168	146	87	104	62

Abbreviation: ECRs, early career researchers.

platform. In order to establish this, national interviewers searched ECRs' profiles for signs of activity and engagement. Results are shown in columns 5 and 6. Active membership, unsurprisingly, is much lower, with around two-thirds of ECRs active. The country data differs with just four Chinese ECRs active, which compares with a very active British cohort of which 20 were active.

## Limitations

When evaluating the results, one should bear in mind that the results reported here are mainly based on qualitative data and although the number of interviewees was large compared to many other studies with interviews, no random sampling technique was used and we refrained from doing statistical tests of significance. Although numbers are presented here and differences between subjects, countries and genders are discussed, they are meant to be indicative of differences and by no means conclusive. The last phase of the study, which is an international survey, will test some of the findings in a large quantitative way.

## RESULTS AND DISCUSSION

### ECRs' mentions of alternative sources of scholarly papers

#### ResearchGate mentions

Altogether, over half of the interviewees in both rounds of interviews commented at least once on ResearchGate—102/177 (58%) ECRs in R1 and 96/168 (57%) in R2—though not necessarily on its role as a source for scholarly papers. However, as Table 3 shows, from among the main scholarly areas in which the name of ResearchGate cropped up in free-text answers to the questions posed in R2, its capability to serve as a source for obtaining information generated 55 mentions. For our ECRs, ResearchGate's role as a paper warehouse is an important one.

When the data was limited only to mentions pertaining specifically to the role played by ResearchGate as a provider of scholarly papers (Table 4), ECRs' growing awareness of the capabilities of the platform in this area was more pronounced. By R2 a third of the participants (55/168) mentioned ResearchGate as a possible source of scientific papers, compared to a fifth of them (35/177) just 6 months beforehand. True, this rapid growth can be put down in part to the introduction of a new question in R2, which sought further clarification on where ECRs went for papers when their existing sources could not provide them. However, the increase in

ECRs' perceptions of ResearchGate as an alternative provider of scholarly output is unlikely to be entirely due to technicalities, especially, as we shall see, a parallel growth in mentions has been taking place with regard to Sci-Hub, too. As the sub-analyses of the mentions indicate, there are differences between ECRs by country and discipline, though not by gender, although once we break down the data by demographics, numbers become small and percentages tend to exaggerate differences.

**TABLE 3** Main scholarly contexts in which ResearchGate is mentioned (only those with more than 20 mentions in round 2 of the interviews).

Scholarly activity	Number of mentions
Assessing reputation; enhancing visibility	60
Searching for and finding of papers	55
Sharing and connecting	38
Smartphone use	23

### ResearchGate mentions by country

Just how much countries differ when it comes to ECRs' using ResearchGate for obtaining papers is shown when we compare Russia or Spain, with 70% and 65% of the ECRs, respectively, mentioning it in this context, to the United States, where ECRs have no use for it in this context. This is somewhat surprising, as their ResearchGate membership figures, at 82%, are relatively high. According to the national interviewer, the typical refrains heard from ECRs in the interviews are: *I have an account, but I do not really use it, or even It's kind of a nuisance.* They are aware of the capabilities of the site where access to scholarly information

**TABLE 4** Numbers of early career researcher (ECRs) mentioning ResearchGate as a source of papers (Interview R2 vs. Interview R1).

	Round 2 (R2)			Round 1 (R1)		
	Total ECRs	ECRs' RG mentions	Percent	Total ECRs	ECRs' RG mentions	Percent
All	168	55	33	177	35	20
Country						
China	24	1	4	24	2	8
France	17	5	29	20	6	30
Malaysia	20	3	15	20	1	5
Poland	22	9	41	22	3	14
Russia	20	14	70	22	12	55
Spain	20	13	65	23	7	30
UK	24	10	42	24	4	17
US	21	0	0	22	0	0
Discipline						
CHEM	14	3	21	13	2	15
ENV	14	10	71	15	11	73
LIFE	19	5	26	21	1	5
MATH	23	4	17	23	4	17
MED	32	9	28	34	4	11
PHYS	27	15	56	30	12	40
SOC Hard	20	3	15	20	1	5
SOC Soft	19	6	32	21	0	0
Gender						
F	84	25	31	88	13	15
M	84	30	36	89	22	25

is concerned, as they do report something along the lines of *Every now and then I get someone asking for a copy of an article*, but they seem to be only on the receiving end of requests for papers. The reason may very well be the fact that the US ECRs mostly come from top research universities that have good library provision, so they have little need for complementary services.

The popularity of ResearchGate among Chinese ECRs is not much greater, with only 2/24 (8%) of the interviewees in R1 and even less, 1/24 (4%) in R2 citing the platform as a source of scholarly papers. This is very much in line with their having the lowest percentage of active members, 4/24, which the national interviewer for China attributes to their preference for using general social media platforms, such as WeChat and QQ, for scholarly purposes. Thus, even though some ECRs used it when they studied abroad, they do not use it now that they have returned to China. However, when they do use ResearchGate, obtaining the full-text papers is one of the reasons, as one ECR put it: *I use my ResearchGate to check what others are doing, and sometimes I sent the request on it to ask for full papers.*

In the case of France, where use of ResearchGate as a paper source, in terms of mentions (just 6 in R1 and 5 in R2), is not much

higher than in the United States or China, the reason was found to be different. As the local interviewer explains, in France ResearchGate has gone into the background, become so embedded, so much part of the scholarly dashboard, that it is not mentioned in respect to such a main-stream activity as obtaining papers. Indeed, they have high active membership, by R2 14/17 French ECRs being active; in fact, all of those with a ResearchGate membership were active on the platform. However, they mainly use it as a showcase and an observatory from which to see what others are doing.

Malaysia is an interesting case. Desk research shows that by R2, 19/20 of the ECRs were ResearchGate members, and although just half of the cohort were defined as active, only 1/20 (5%) in R1 and 3/20 (15%) in R2 mentioned the platform as a source of papers. This may be less surprising than it looks: as the interviews indicated, Malaysian ECRs are most interested in gaining visibility, with 13/20 in R2 saying so. Thus, although we are told by some (5) ECRs that their libraries do not meet all their needs, which sends them to alternative sources of scholarly literature, they do associate the platform mainly with increasing their visibility.

**TABLE 5** Numbers of early career researcher (ECRs) mentioning Sci-Hub as a source of papers: (Interview R2 vs. Interview R1).

	Round 2 (R2)			Round 1 (R1)		
	Total ECRs	ECRs' Sci-Hub mentions	Percent	Total ECRs	ECRs' Sci-Hub mentions	Percent
All	168	79	47	177	44	25
Country						
China	24	12	50	24	6	25
France	17	11	65	20	14	70
Malaysia	20	12	60	20	10	50
Poland	22	16	73	22	2	9
Russia	20	15	75	22	5	23
Spain	20	5	25	23	2	9
UK	24	4	17	24	4	17
US	21	4	19	22	1	5
Discipline						
CHEM	14	9	64	13	4	31
ENV	14	5	36	15	4	27
LIFE	19	12	63	21	4	19
MATH	23	10	43	23	5	22
MED	32	27	84	34	12	35
PHYS	27	3	11	30	5	17
SOC Hard	20	4	20	20	2	10
SOC Soft	19	9	47	21	8	38
Gender						
F	84	37	44	88	20	23
M	84	42	50	89	24	27



United Kingdom and Poland inhabit the middle ground in terms of obtaining scholarly papers, with ResearchGate attracting solid—and growing—interest, from 17% in R1 to 42% in R2 in the case of the United Kingdom and from 14% in R1 to 41% in R2, in the case of the Poland. Those British ECRs whose libraries did not hold everything in terms of journals—not a common occurrence, as this cohort comes largely from highly ranked research universities—turn to ResearchGate first to get access to the articles they cannot get from the library. In Poland, where, possibly, library provision of scholarly literature, is not as comprehensive, ResearchGate does play an important role, and, in fact, every ECR has an account. However, with the platform seemingly as embedded in the scholarly dashboard as in France, in this country, too, ResearchGate is a place to turn to when seeking a paper.

Spanish ECRs, too, with 13/20 mentioning ResearchGate as a source of papers by R2, are thought by the national interviewer to be similar to colleagues in France in many respects. For most, it is a tool that they use regularly and increasingly for the percentage of interviewers mentioning its capacity as a provider of scholarly literature more than doubled between the two rounds of interviews, growing from 30% to 65%. ResearchGate is an increasingly popular source of scientific papers among Russian ECRs, too, with 12/22 (55%) mentioning it in this context in R1 and 14/20 (70%) in R2. This is traceable to relatively poor library provisions in the country, which, as we are to see, has ECRs turning to Sci-Hub as well. ECRs' justification for using Sci-Hub (a practice clearly deemed to be in need of justification) is pertinent here too: inadequate access to paywalled scholarly journals as well as a general dislike of the idea of paying for information.

### ResearchGate mentions by discipline

When it comes to the disciplinary affiliations of ECRs who mention ResearchGate as a source of papers there are changes from R1 to R2. However, whilst in Chemistry and Environmental

Sciences the changes are so slight (below 10%) as to be negligible, and in Mathematics there was no change at all, in the other disciplines there is a discernible growth in ECR numbers. Thus, in Life Sciences the increase is from 5% to 26% of the ECRs, in Medical Sciences from 11% to 28%, in Physical Sciences from 40% to 56% and in the Social Sciences, hard and soft, from 5% to 15% and from 0% to 32%, respectively. There were some considerable differences between the disciplines, too. Thus, by R2, Environmental Sciences ECRs (71%) were the greatest users of ResearchGate as a provider of scholarly literature, followed by ECRs from Physical Sciences (56%), Social Sciences-soft (31%), Medical Sciences (28%), Life Sciences (26%) and Social Sciences-hard (15%).

### Sci-Hub mentions

Given that Sci-Hub is a 'one-trick pony' in scholarly terms, focusing as it does on just providing full-text papers, ECRs unsurprisingly mentioned it mainly in the context of information searching and finding. Plainly, as Table 5 shows, when it comes to the *raison d'être* of the platform, its centrality for the interviewees is on the rise: if in R1 25% of the ECRs (44/177) cited Sci-Hub as a possible resource when obtaining a scholarly paper, by R2 the percentage grew to 47% (79/168). If we allow for the 9 ECRs who dropped out by R2, the increase is more impressive. Here again this rise in the number of ECRs can partly be put down to the introduction of a change in the form of questioning in round 2, which sought to find out where ECRs went for papers when their usual sources (libraries and/or peers) could not provide them. Conceivably, too, whilst in R1 ECRs felt uneasy acknowledging a questionable behaviour, by R2 they trusted the interviewer more and could be more open. Nevertheless, the possibility of this rise being indicative of a growing reliance on Sci-Hub cannot be ruled out. Still, here too, there are country- and discipline-associated differences among ECRs, although gender differences are not significant.

### Sci-Hub mentions by country

There are large differences between countries, although the one common denominator is a clear increase in the number of ECRs mentioning Sci-Hub since R1—there are just two countries (France and United Kingdom) where the situation has remained largely unchanged. Thus, by R2, three quarters of the ECRs from Poland (73%) and Russia (75%) mentioned Sci-Hub, as did nearly two-thirds of the ECRs from France (65%) and Malaysia (60%) and half (50%) of the ECRs from China, whereas the comparative figure for the United States (19%) and United Kingdom (17%) was around a fifth. Poland's numbers have increased most, from just 9% to 73% over the 6-month interval between interviews, and China, Russia and Spain also show big increases, with figures doubling in the case of the former and tripling in the case of the latter two.

Looking at the data in the context of the national interviewers' appraisals of the local situation highlights possible

country	number of articles	country	number of articles
1  China	23,712,335	11  Japan	628,932
2  United States	8,919,666	12  Poland	589,031
3  France	4,265,975	13  Singapore	579,102
4  Brazil	2,210,009	14  South Korea	492,600
5  India	1,609,609	15  Canada	453,364
6  Indonesia	1,117,010	16  Russia	428,538
7  Germany	956,070	17  Malaysia	381,776
8  Mexico	711,224	18  Netherlands	376,942
9  Iran	690,680	19  Colombia	345,321
10  Turkey	677,382	20  Seychelles	304,189

**FIGURE 1** Number of Sci-Hub downloads by country: rank order. Figures might be used for promotional purposes. Retrieved from <https://us17.campaign-archive.com/?u=2c6057c528fdc6f73fa196d9d&id=bfe68d6f32&e=7dc9781383>.

reasons for the developments we have seen. Thus, French ECRs, found to be the most ardent supporters of Sci-Hub in a previous study on the topic (Nicholas, Boukacem-Zeghmouri, et al., 2019), remain so, with their numbers decreasing only slightly from 70% in R1 to 65% in R2, which is hardly surprising, given that France is the country that generates the third most downloads according to the latest Sci-Hub data (Fig. 1). As the two countries that come ahead of them in the chart—China and the United States—have much bigger populations, clearly the French have a special fondness for Sci-Hub, despite the fact that it is technically banned in France, with access to it blocked by order of The High Court of Paris (Van der Sar, 2019). Banned, yes, but there are no formal procedures for prosecution and universities have tried and failed to impose sanctions. The national interviewer's explanation for the ongoing great interest in the platform is that in France, at least in part courtesy of Sci-Hub, a new scholarly infrastructure is slowly being built, which is replacing the older, 'flawed' infrastructure—libraries. In fact, French users of shadow libraries see themselves as part of a 'rebellion' community, disciples of the new infrastructure, rather than members of the 'obsolete' library user community.

In Poland, too, the popularity of Sci-Hub is unmistakable, with the relatively small country ranking at 12th in the Sci-Hub downloads, and showing an eightfold increase in the percentage of ECRs mentioning Sci-Hub between R1 and R2, which cannot be attributed solely to the aforementioned more detailed questioning on the topics of searching for and obtaining papers in R2. As according to the national interviewer *nothing* has actually changed in terms of access to journals, it may very well be that ECRs in Poland are growingly aware of the affordances of Sci-Hub, perhaps because they are not so satisfied with library provision or simply finding the platform more convenient. We shall know more in round 3 of the interviews, where we opted for more direct questioning about Sci-Hub.

The situation in both Malaysia and Russia is more traceable to poor library provisions. Malaysia's ranking as 17th in the Sci-Hub table of downloads, which represents quite high levels of use given its relatively small population, looks like a function of poor and worsening library platforms. So much so, in fact, that use of the platform, far from being banned, is at times positively encouraged at universities, at least as individual initiatives. In Russia, too, although the download figures are relatively low for a country of its size (16th position in the Sci-Hub downloads table), possibly because the site is banned in the country, researchers are still using it. In fact, there is a significant increase in use of Sci-Hub, with ECRs justifying turning to the platform because of the inadequate access to paywalled scholarly journals, but an objection to the idea of paying for information is often heard, too.

The data on the two most mature scholarly communication countries, the United Kingdom and United States, lends further support to the high possibility that greater awareness/use of Sci-Hub is connected to the quality of library provision. Although, according to the Sci-Hub data, there is big interest in the platform in the United States, as it is second in the list (unlike United Kingdom, which is not among the top 20 countries), our

findings show that ECRs in both countries pay relatively little attention to Sci-Hub. This, when Sci-Hub is not banned in the United Kingdom and only banned in the United States by the American Chemical Society. The national interviewers attribute both countries' low interest to the fact that the ECR population is skewed towards those from topflight research universities that provide good library access, inclusive of VPN from home. They complained about libraries quite a bit, but not about this.

Aside from the adequacy of library provision, another factor that has a bearing upon Sci-Hub use is researchers' perception of and attitude to the platform. According to the Sci-Hub table, China is the biggest user of the site, and by some margin too, and it is increasingly popular with Chinese ECRs. When we last investigated Sci-Hub, it was banned and, consequently, use was quite low (Nicholas, Boukacem-Zeghmouri, et al., 2019). Now that it is no longer banned, Chinese ECRs see the platform as a modern-day Robin Hood, which is thieving for a good purpose—the free sharing of papers, and seen as representing a form of scholarly 'communism'. So much so, that there was not one negative comment raised by the ECRs when they talked about Sci-Hub; in fact, it was praised for its ease of enabling access to scholarly output, despite the fact that its URL frequently changes.

Not so in Spain, though. As both our data and that of Fig. 1 shows, Spain is lukewarm in regard to Sci-Hub. While not banned in Spain, there is a strong feeling of unease about using it, which explains the low numbers. However, the percentage of ECRs citing the platform in the context of its suitability for obtaining scholarly papers, growing from 9% in R1 to 25% in R2, is indicative of a changing pattern of awareness, possibly of use, too.

### Sci-Hub mentions by discipline

Although there are some apparently large differences between disciplines, there is also one common denominator for most of them: an unmistakable increase in the number of ECRs mentioning Sci-Hub as a source for scholarly papers from R1 to R2. In fact, there was just one instance of a slight decrease, in Physical Sciences, from 17% of the ECRs to 11%. However, there were large differences between disciplines. Thus, by R2 Medical ECRs (84%) were out ahead in their mentions of Sci-Hub as a provider of scholarly literature, followed by Chemistry (64%) and Life Sciences (63%) ECRs. Physical Sciences ECRs were the ones to show very little interest in Sci-Hub, with only 11% of them mentioning the platform.

### In their own words: ECRs on alternative sources of scholarly papers

ECRs' attitude to the alternative providers of scholarly output, ResearchGate and Sci-Hub, the extent of their utilization of the two platforms, and their reasons for doing so (or not) emerged in rich detail from the analysis of the responses to a set of four questions asking about accessing formal scholarly publications.

ECRs were first asked: *Where do you go to search for formal scholarly communications? List in order of importance.* Then came two follow-up questions, added in R2 at the request of national interviewers, in order to investigate the difficulties pandemic-era ECRs might be experiencing in obtaining journal articles. The first sought to discover where ECRs went to obtain the full-text paper once they had located it: *If different [i.e., if they go to a platform that is different from the one that they used to locate a paper], where do they obtain these publications from? List in order of importance.* The second then asked about the route they took if a paper was not available from customary sources: *If they are not available easily (through their library/virtual network?), where do they go next?* The final question in this set asked: *Has their practice changed since the pandemic?*

When ECRs search for formal scholarly publications, their preferred starting point is Google or Google Scholar, although in the life sciences PubMed is often preferred. When it comes to obtaining the full-text papers they need, the library is still the obvious resource they turn to. More often than not interviewees cited the library as their first choice when seeking to obtain information, as a Malaysian chemist put it: *...if is not open access, then I will move to and use our library. To get the access to online databases such as WoS or Scopus, Science Direct.* However, the library is no-longer their only option for getting hold of scholarly literature, as a British environmental scientist put it: *If not through my library, I use ResearchGate. 80% of the time I have access [via the library], but then ResearchGate or Sci-Hub (which is amazing).*

The interview data shows the just-cited strategy to be increasingly popular among ECRs: whilst in R1 16/177 (9%) and 6/177 (3%) of the interviewees cited ResearchGate and Sci-Hub (respectively) as places they go to search for scholarly papers, by R2 the comparative figures rose to 22/168 (13%) and 12/168 (7%). Moreover, by R2, 10 ECRs listed ResearchGate as first or second in importance, though none placed Sci-Hub first—it was typically listed at 3rd or 4th. When it came to searching for papers, ResearchGate was particularly popular with Polish, Russian and Spanish ECRs, and physical scientists, whilst Sci-Hub with the French ECRs and medical scientists.

The growing strength of the alternative providers of scholarly literature came to the fore when ECRs were asked where they went if they could not obtain the full-text of a paper from their university library. Their answers were clearly indicative of the important back-up role these platforms have. Thus, 18 ECRs said that under the circumstances they did turn to ResearchGate and 15 said that it was their first port of call after the library, for, even if the paper they wanted had not been uploaded to the site, they could always contact authors for the publication: *...in the age of RG you can ask any author for the text, no problem.* British (6), Russian (6) and Spanish (5) ECRs mentioned ResearchGate most in this context, and of the disciplines, physical science (5), again, featured and was joined by environmental scientists (6).

ECRs cited Sci-Hub, too, as a place to go to for papers that were not available through the library, with 44/168 (26%) of them saying so, considerably more than the 12/168 (7%) who

reported opting for it when searching for information. The majority of the 44 ECRs who turned to Sci-Hub for papers they could not get from the library—27/44 (61%)—ranked the platform first in a list of sources, if not the only one, which is another proof of its centrality when the customary way of gaining access to scholarly literature through the library proves to be problematic. However, use is very much country-specific: of the 44 ECRs, 12 were French and 11 Malaysian. Thus, for example, this is how a French medical scientist describes platform benefits: *Sci-Hub solves all my problems, especially for all the articles from other disciplines, it opens the access.* Another medical scientist, this time from the United States, is more guarded in their praises of the resource, but appreciative of its capabilities nevertheless: *If I can't find them on [PubMed], sometimes I'll go to Sci-Hub if I'm really desperate to get a copy of the PDF and I can't get it anywhere else.*

Not that all ECRs said that they had to be desperate to turn to alternative provision services, although they were very much aware of the fact that Sci-Hub is an illegal site (no interviewee raised any concerns regarding the legal standing of ResearchGate). So much so, that a Malaysian ECR, a hard social scientist, could not say the word Sci-Hub, as if it were taboo: *That place - where PhD students download papers illegally. Even in a workshop that I attended the lecturer told us about this place to go to last, if you want to get papers subscribed by libraries worldwide the easiest way. But the last place to go!* And yet, as the comment illustrates, the use of Sci-Hub is promoted by word of mouth, even in lectures, and, indeed, it is used. In fact, as noted, for French and to some extent for Russian, Polish and Spanish ECRs, Sci-Hub has become an integral part of their research work practices. Thus, in France, where almost everyone is using it without any concerns, we are witnessing a kind of 'obliteration by incorporation' phenomenon (Merton, 1968): Sci-Hub is so widely used and accepted that it has become a common source, like Google Scholar, barely mentioned and its illegality remembered only when asked about. Similar too with Russia, as this Life Scientist demonstrates: *We definitely had subscriptions to some publishing houses. But I, unfortunately, don't remember them. It's just that I use Sci-Hub most often, it's already somehow just a developed reflex, to be honest.*

Expectedly, the reason most often given by ECRs to explain opting for alternative providers of scholarly papers was, as the national interviewers' appreciation of the situation had already indicated, problems with library coverage. A British medic, who had moved universities, pinpointed the relationship between Sci-Hub use and the quality of the library platform that ECRs have access to: *Now I use Sci-Hub much less because I have access to most of the papers I am looking for.* Indeed so, as two Malaysian ECRs, from a country where the problems with library provision seem to be especially acute, explain: *If I still cannot get the full-text there [on library platforms], I'll ask my colleagues overseas, or if it is very urgent, I'll use the illegal path that's Sci-Hub. Apart from the ethics as an academic, I think it is essentially a good source of knowledge.* Echoing these sentiments, another Malaysian ECR, who had worked abroad, says: *I'll go to the library online databases, but to avoid disappointment, I'm not sure whether I should say this, but I also use Sci-Hub. It's kind of sad. As a person who*

came from places that can get all the sources freely. I am not happy with this condition where; I now cannot access many of the papers I'm looking for.

Another reason for turning to alternative sources is the complexity of library access systems. Take, for example, the lament of a US medical scientist: *We have a good library system, but you have to click like 10 different times and it's so infuriating, so if I go to PubMed and I cannot find the article I want, I go to Sci-Hub.* As a Malaysian life scientist remarked, very much in the same spirit: *Young researchers turn to Sci-Hub for example, it's free it's fast.* Convenience, then, is clearly an important consideration for users of alternative scholarly platforms, as it has been shown in the case of Sci-Hub (Andročec, 2017; Bohannon, 2016), which must be all the more so given the above-noted attributes and preferences of this generation of ECRs. As one Polish mathematical scientist sums it all up: *Sci-Hub, it is more convenient, although illegal.* Plainly, the essential asset/attraction of Sci-Hub is that it is a dependable last resort for getting full-text papers.

Little evidence was found to suggest that the pandemic and working from home and accessing the library remotely had made much of a difference to practices. Just one ECR, a Russian hard social scientist noted that the pandemic brought about greater awareness of the capabilities of these platforms: *I have begun to pay more attention to ResearchGate [...] During the pandemic, I realized that it is necessary to use these tools, because if everyone is sitting at home, if everyone is in lockdown, everyone is on their phones and computers, I think that it needs to be used.* However, asking interviewees about their current practices of accessing information did yield comments on the way Sci-Hub was providing 'open access'—a term they clearly misunderstand—which was found to be particularly helpful during the pandemic. For example, a French soft social scientist said: *I've found more foreign contents thanks to Sci-Hub, so I'm reading more contents coming from all over the world.* A Polish life scientist went further: *I appreciated OA during the pandemic, it's convenient to have access to everything from home. If I couldn't get to the full text due to subscription restrictions, I used Sci-Hub.* Perhaps then, a Chinese medical scientist had a point in claiming that alternative providers of scholarly literature are familiarizing OA, even if it is only the ideology behind it: *Sci-Hub has made us familiar with OA. Especially during the pandemic, when it is inconvenient to use the library, we will pay more attention to OA.* A Russian chemist provided a slightly different take, showing how intertwined things really are: *If I follow the link and there is no open access, then I use Sci-Hub.*

## CONCLUSIONS

This study had at its heart the possibility that ECRs have been supplementing library provision with alternative sources. Not too far-fetched a notion given the population being investigated: millennial/Google generation researchers. ECRs, holding dear, as our interviewees reaffirmed, the values of openness to change, community-mindedness and awareness of the public good, whilst also driven by a need for instant gratification, are likely

candidates to embrace services offering equal, wide-ranging and unhampered access to knowledge. No less importantly, they are also the ones likely to look for shortcuts in their information gathering, a task which often falls upon them, as the veritable 'workhorses' of research that they are. Unsurprisingly so: as hopeful entrants to academe, who still have to prove that they are worthy candidates for a scholarly career by publishing as much as possible as quickly as possible, they work in a climate of constant rush. Add to this the aforementioned willingness of scholarly users to opt for routes of obtaining literature that may not be strictly lawful, but certainly not morally wrong, and it becomes quite clear what might motivate ECRs to turn to alternative providers of scholarly publications.

Our findings leave little doubt that these alternative providers, as represented by ResearchGate and Sci-Hub, have established themselves with ECRs and, also, seem to be gaining popularity. Thus, if in the first round of interviews a fifth of the ECRs mentioned ResearchGate, and a quarter Sci-Hub, as a possible source of scientific papers, by the second round the share of the former grew to a third and that of the latter to almost a half of the cohort. Still, it is important to note that at least where ResearchGate is concerned, the situation, as it is now, may change. ResearchGate is now in partnership with publishers and moving to a deal where they will enforce subscription access rights (Crotty, 2022), which will mean that fewer papers will be freely accessible. This will inevitably have an impact on the popularity of the platform with ECRs.

However, the situation is more nuanced, with sizeable country- and discipline-associated differences among ECRs when it comes to their appreciation of both platforms as a source of papers. The picture needs to be seen against the backdrop of the idiosyncratic circumstances of the different countries. Thus, ResearchGate is most popular in Russia and Spain, followed by the United Kingdom and Poland, whilst the United States, China, France and Malaysia show relatively little interest in it. In fact, whilst on the whole the willingness to turn to ResearchGate for obtaining full-text papers can be traced at least partly to the quality of library provision in a given country, which can explain, for example, why US ECRs have little need for it, there are other factors that can play a part in shaping ECRs' attitudes and practices. It may be a matter of convenience- and time-saving driven preferences, as in China, where local platforms are seen as the better option for getting hold of papers, or the association of ResearchGate mainly with its capability to provide visibility, as in Malaysia. Still, the most prevalent of the reasons seems to be, self-contradictory as it may seem, that ResearchGate is by now so embedded in the scholarly dashboard of some of the countries, most notably France and Poland, that it is not seen as worth mentioning when it comes to such a common or garden scholarly activity as obtaining papers. Take, for example Poland, where, despite the fact that everyone has a ResearchGate account, less than half of the R2 interviewees mention the platform as the site to turn to for papers.

ECRs' country-specific perceptions of ResearchGate are borne out by their attitude to and usage of Sci-Hub, which

suggests that taken together, these may very well be indicative of their overall stance towards alternative providers of scholarly papers. In the case of Sci-Hub, too, it is Russia that by R2 has demonstrated the greatest need for the platform, with three quarters of the ECRs mentioning it, which evidences yet again the link between inadequate library provision and ECRs' opting for complementary services. The countries in which, according to the national interviewers, there might be issues with library provision for some ECRs—Poland and Malaysia—are also the ones with high percentages of ECRs opting for Sci-Hub in R2, 73% and 60%, respectively. However, in Spain, where library provision is deemed only as satisfactory (not all journals are supported), support of Sci-Hub among ECRs has tripled by R2, although it is still quite low at a quarter of the ECRs, with all that the local interviewer says that there is a palpable unease among them when it comes to turning to the platform. No such unease can be detected in France, though, where ECRs' affinity for Sci-Hub remains as high as ever despite adequate library provisions. The phenomenon is traceable to a characteristic hostility against publishers, seen as the enemy in French scholarly circles, whose 'greediness' erects barriers and thereby obstructs the advancement of science (Nicholas, Boukacem-Zeghmouri, et al., 2019). Elsewhere, though, unproblematic access via libraries to the scholarly literature renders alternative providers essentially superfluous, as the case of ResearchGate already indicated—hence the low percentages of ECRs turning to Sci-Hub in the United States and the United Kingdom, which come to less than a fifth of each cohort.

The findings are also indicative of some seemingly large differences between disciplines when it comes to gaining access to scholarly publications via alternative providers of scholarly papers. Thus, Environmental Sciences and Physical Sciences ECRs are the most likely to turn to ResearchGate for the purpose, whereas their counterparts from Chemistry, the Life Sciences and especially the Medical Sciences are the ones who are the greatest supporters of Sci-Hub. However, whilst among ECRs from other disciplines there are fewer keen users of these alternative services—Mathematicians and hard Social Scientists are a case in point where ResearchGate is concerned, and Physical Scientists and again hard Social Scientists in the case of Sci-Hub—there is nevertheless a trend towards greater acceptance of alternative providers across the board, with only a few outliers. In most of the disciplines there was a discernible growth between R1 and R2 in the numbers of ECRs who turned to ResearchGate, and the same pattern holds true for Sci-Hub, too. Some of this growth could be put down to the introduction of more specific questioning in the second round of interviews. Although in neither round were the two platforms mentioned.

The pandemic has left very little impact on ECRs' practices of obtaining formally-published scholarly papers. It did, however, alert ECRs, working from home during the lockdowns, to the benefits of OA to information, even if the concept is at times interpreted by them—mistakenly—as enabling an all-encompassing access to information, whether by lawful means or less so. Still, as it clearly emerges from the literature cited above, the financial

restrictions that have been coming and still threatening to come in the wake of the pandemic did not, indeed, could not possibly leave libraries untouched. Obviously, though, the effects of this on libraries' ability to maintain their provisions at an adequate level, not to mention to broaden them where necessary, may not be invariably felt right away, rendering the topic in need of follow up in the forthcoming third and final round of interviews.

Crucially, though, the developments towards a growing reliance among young researchers on alternative providers of scholarly information may signify a worsening of the problems with the existing system. Put simply, if alternative platforms are increasingly perceived as offering either more convenient or more comprehensive access to information—possibly both, as it seems to be indicated by the findings of this study—researchers are no longer guaranteed the all-important access to the literature that forms such a key part of the scholarly endeavour. Not for lack of willingness or ability on the part of the traditional providers of scholarly literature, though. Libraries, under-funded for quite some time now, have been fighting a losing battle, now that the pandemic is about to bring about further financial restrictions. It falls upon policy makers then to find and implement a holistic solution to this age-old problem of ensuring adequate access to information, without which no scientific progress is possible, mainly by seeing to it that budgets adequately enable library provision and by taking further steps to advance the OA movement.

#### AUTHOR CONTRIBUTIONS

EH led the study wrote the paper; DN conducted some of the data analysis and writing; DC conducted the data analysis; CBZ, BRB, AA, DS, AW, JX, GS and MS contributed the country sections; HRJ oversaw the methodology; CT and SA provided leadership.

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