

## **A Survey of U.S. Science Journalists' Knowledge and Opinions of Open Access Research**

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The growth of open access (OA) has been reflected through the use of OA research by the news media, especially as the COVID-19 pandemic spurred more researchers to share preprints in open repositories. However, little is known about what journalists, particularly science journalists, actually know of and think about OA research as it pertains to their work. This study seeks to help answer these questions by surveying science journalists working in the United States. Results show a broad awareness of OA and related concepts. They also show that a majority of respondents are willing to use Gold OA and Hybrid OA scholarly articles as sources, although they expressed more hesitancy in using Green OA articles, especially when they are preprints. Respondents showed awareness of the term “predatory publishers,” and a majority expressed concern about them.

*Keywords: open access, science journalism, preprints, predatory publishing, COVID-19*

The COVID-19 pandemic led to a number of changes in how researchers disseminate their results and how the news media report on those results. This includes the paradigm of open access (OA) research. With the need to get results of pandemic-related studies out as quickly as possible and to as many people as possible, scientists and science journalists turned to preprints. Preprints are scientific studies that have yet to be peer reviewed and are made OA by sharing them on open repositories such as medRxiv and bioRxiv. OA research was already a mainstream concept in scholarly publishing before the pandemic, and several studies show this trend had parlayed into science journalism as a growing number of news stories reported on OA research even before 2020.

Although many scholars recognize various levels and types of OA, the general concept, promoted by the initial definition from the 2002 Budapest Open Access Initiative, focuses on research that is both free to read and is licensed in some way for reuse by others (Chan et al., 2002). The intent is to help democratize access to scholarly research and remove barriers that prevent many from benefitting from it. Several routes exist for making scientific studies open, including the following:

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<sup>1</sup> The survey, data, and code used to analyze the data are publicly available (Schultz, 2023).

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- Green OA—Preprints, postprints (articles that have been peer reviewed but not published), and final published articles uploaded to open repositories
- Gold OA—Articles published in journals that makes all material OA
- Hybrid OA—Articles published in a paywalled journal for which a fee was paid to make the article OA

Some scholars have started to divide Gold OA into two subsets: Gold OA, or OA journals that charge authors a publishing fee, and Platinum OA, or OA journals that do not charge authors a publishing fee. However, this study opted to not make such a distinction to avoid increased confusion regarding so many distinctions (Collins & Cantrell, 2021).

Proponents of OA argue the benefits not only include removing financial barriers to important scientific knowledge that is often funded in some way by public tax dollars but also increase visibility and, especially in the case of preprints, faster dissemination. However, concerns and biases about each type of OA could potentially affect how journalists interact with it. For instance, some researchers argue that Gold OA journals have led to what they call “predatory publishers,” generally seen as those that charge authors to publish without providing actual peer review of their work. Little is known about what science journalists actually know about OA, their opinions of it, and their willingness to use OA research in their work, especially in generating story ideas, source selection, and source credibility. This exploratory study seeks to fill in some of this knowledge, as well as look at what effect the COVID-19 pandemic has had, by surveying science journalists (including health and environmental journalists) in 2021 and 2022.

## **Literature Review**

### ***Roles of Science Journalists***

Science journalists are known to play an important role as a main source for how the general public learns about the results and new findings of scientific research (Conrad, 1999; Liskauskas, Ribeiro, & Vasconcelos, 2019; Shoenberger & Rodgers, 2017). Researchers have applied various theoretical frameworks to understand this role, such as gatekeeping theory, which posits that all journalists act as mediators of information by determining what information reaches people and what information is excluded (Shoemaker & Vos, 2009). Viswanath et al. (2008) specifically connected gatekeeping theory to the work of science journalists by laying out how the theory applies to their journalistic process, including generating story ideas, determining which ideas to develop into stories, searching for resources to create the story, and then publishing the story.

However, others have pushed beyond viewing science journalists as simply gatekeepers. They instead argue for science journalists' roles as knowledge brokers who play a more active part such as by evaluating and interpreting scientific studies themselves, as well as by providing access to others through hyperlinks to scholarly articles (Gesualdo, Weber, & Yanovitzky, 2020). Science journalists also serve as knowledge brokers through their influence on policymakers (Yanovitzky & Weber, 2019). However, science journalists have not always accepted the role of knowledge broker. For example, Forsyth et al. (2012) found that Australian health journalists saw themselves as translators of research who can help educate the general public but not as critical evaluators of it, instead relying on academics and the peer-review process for this. Van Witsen and Takahashi (2018) discussed the problems of expecting science journalists to have

stronger expertise in their coverage areas; instead, they argued for interactional expertise, a knowledge level that does not require an in-depth familiarity with scientific topics but enough to allow an understanding of scientific processes and communication.

### ***Source Selection and Credibility***

An important part of these roles relates to what factors affect which sources science journalists use in their story creation and development and how they determine the credibility of sources. A number of factors have been found to play a role in all of these, including personal aspects of the journalists such as their education and experience, the audience scope of the news outlet, and type of news outlet (Shoenberger & Rodgers, 2017; Viswanath et al., 2008). Shoenberger and Rodgers (2017) also found evidence that how journalists viewed their knowledge when it came to health reporting played a role.

Although much research has focused on what factors influence journalists' use of various human sources, some researchers have looked at the usage of nonhuman sources, including scholarly articles. Wihbey (2017) found in a survey of U.S. journalists that 52% reported using scholarly articles as a source, with those from organizations with a national audience more likely to do so than those from smaller organizations. Broadcast journalists were less likely to do so, however. The study also found journalists often relied on secondary sources, including other people, to provide them with access to scholarly articles. A survey of U.S. health journalists found they were more likely to generate story ideas from human sources, press releases, and wire services compared with scholarly articles, but the survey also found national health journalists were more likely to use scholarly journals both for story ideas and as sources (Viswanath et al., 2008). The authors also found a correlation with format type, finding broadcast journalists in this case were more likely to rely on scholarly journals compared with print journalists. Gesualdo et al. (2020) found that journalists reported actively searching for sources, including on scholarly journal websites, but that journalists, especially freelancers, often got around journal paywalls by contacting researchers for copies.

Several studies have found that science journalists give mixed ratings to scholarly journals as sources. European science journalists rated scholarly journal websites more favorably than other websites, including those by governments and universities (Granado, 2011). Conversely, in another study, health journalists rated medical journals lower than most sources, including press releases (Len-Ríos et al., 2009). Gesualdo et al. (2020) found journalists showed an awareness of credibility by looking for who funded the research and whether it was conducted by industry, and Boss et al. (2022) argued that journalists often perform their own type of quickened peer review by checking with other experts. However, several studies have critiqued science journalists' reliance on a few well-known scholarly journals with high journal impact factors (JIF), which in turn can give the journals proportionally warped power in setting the news agenda (Conrad, 1999; Olvera-Lobo & Lopez, 2015). This can be especially problematic in that the journals are often in English and focused on research from the United States and Western Europe, leaving out knowledge produced from other areas of the world (Olvera-Lobo & Lopez, 2015).

### ***OA and the News Media***

Although these previous studies have looked at what various factors affect whether a journalist will use a scholarly article as a source, they often fail to look at the role access plays. Scholarly journals often

charge expensive fees to access individual articles that can quickly add up. Arbuckle (2019) argued that science journalists need better access to research. OA can help solve this problem, and a growing body of research provides evidence that the news media are indeed using all types of OA scholarly articles as sources in their stories (Alhoori et al., 2015; Haneef, Ravaud, Baron, Ghosn, & Boutron, 2017; Holmberg, Hedman, Bowman, Didegah, & Laakso, 2019; Robinson-Garcia, van Leeuwen, & Rafols, 2018; Schultz, 2021; Tai & Robinson, 2018). However, whether they are knowingly seeking out OA versions of scholarly articles remains unknown. As Arbuckle (2019) stated:

The Open Access movement will not grow to its full capacity if those who are unfamiliar with the research world do not know how to seek such openly available research, and have difficulty parsing the meaning once they do find research. (para. 8)

One area that plays a role in journalists' use of OA research is the rise of preprints and preprint servers, but they come with issues specific to them. Several researchers have argued preprints are both beneficial to journalists, thanks to the early and free access they provide, and concerning, in large part because of their lack of peer review (Besançon et al., 2020; Koerth, 2021). Some have suggested that journalists should take extra steps when citing preprints, including noting that the article has not been peer reviewed (Chawla, 2021; Koerth, 2021). However, others argue that peer review itself is an imperfect system that has granted credibility and authority to studies that were later retracted, such as in the case of vaccines and autism (Humphries, 2021; Puebla, Polka, & Rieger, 2022; Smith, 2010).

Some scholars argue that OA publishing, particularly Gold OA journals that charge a fee to publish, leads to predatory publishing, which poses a threat to the gatekeeping practice of peer review (Gasparyan, Yessirkepov, Diyanova, & Kitas, 2015; Shamseer et al., 2017). However, no one agrees on what makes a predatory publisher and how much of a problem they are (Cobey et al., 2018). Still others critique lists of alleged predatory publishers, noting that many of the criteria can apply to long-established paywalled journals and often reflect biases against new scholarly journals and those published by researchers whose first language is not English (Crawford, 2014; Houghton, 2022; Olivarez, Bales, Sare, & van Duinkerken, 2018). Despite the critiques of the issues surrounding the concept of predatory publishers, some news stories have reported on the issue, often reflecting many of the negative biases against Gold OA journals (Alf, 2021; Kolata, 2013, 2018).

### ***Effects of COVID-19***

The COVID-19 pandemic has impacted both scholarly communications and the news media. The need for information spurred not only an increase in the speed of publication of peer-reviewed articles but also an increase in the sharing of OA preprints as scholars sought to disseminate their findings as quickly as possible. Although the pace of preprint deposits has gone down since reaching a high in May 2020, it remains higher than before the pandemic began (Brainard, 2021; Fraser et al., 2021).

Partly as a result of this increase in the speed of publication, journalists had to quickly alter their work. Several journalists discussed coming up with new ways to handle the deluge of new research (Makri, 2021). One journalist noted an issue with the quality even of peer-reviewed articles, saying, "We all rely on

certain journals to be high quality, but during the pandemic even that's been tough; there have been papers in the *New England Journal of Medicine* and in *Lancet* that haven't really stood the test of time" (Makri, 2021, p. 17).

As the pace of preprints rose, so did their mentions in news articles. One study found that 10.7% of COVID-19-related preprints had been mentioned in a news article, compared with just 1.3% of non-COVID-19 preprints (Besançon et al., 2020). Various journalists have reported being more willing to rely on preprints during COVID-19 (Broer, 2020; Chawla, 2021; Makri, 2021). One journalist said that preprint coverage

was increasing even before, it's just that the pandemic has really accelerated the pace and visibility of preprints . . . That trend will probably continue and I don't think it's entirely a bad thing. It's almost like peer review in real time. (Makri, 2021, p. 19)

Fleerackers, Moorhead, Maggio, Fagan, and Alperin (2022) argue that this new paradigm can be considered post-normal science, which is partially defined by lack of scientific certainty and a need for quick political action. One study found 59% of COVID-19-related news articles in South Africa news media did not mention that the research was based on a preprint (van Schalkwyk & Dudek, 2022). Another study of news articles from Brazil, the United States, and the United Kingdom found that of 76 news stories that cited preprints, 65 referred to them as preprints (Massarani & Neves, 2022). The authors said one concern of news organizations using preprints as sources is that they rarely, if ever, go back to see whether a preprint was published or withdrawn. Fleerackers et al. (2022) found that 57.5% of news articles presented preprint sources with caution, and a large majority provided hyperlinks to the preprints. An international survey of science journalists found 55% reported using preprints as sources at least once, with more in Asia doing so (Massarani, Neves, Entradas, Lougheed, & Bauer, 2021). Of these, 59% said they approach preprints differently than other scholarly articles, often by either noting its lack of peer review in a news story or by relying more on experts.

Although prior studies have shown that the news media do use OA scholarly articles as sources, not much is known about their knowledge of OA or whether they are even aware that the scholarly articles they use are OA. This study seeks to address this gap by focusing on how science journalists view and use all OA research in their reporting, how they perceive their views have changed with the COVID-19 pandemic, and their thoughts on the term "predatory publishers." The study focused on answering the following research questions:

- RQ1: *What factors affect a science journalist's knowledge of OA research, including preprints and postprints?*
- RQ2: *What factors affect a science journalist's willingness to use OA research in a news article, including for specific types of OA articles?*
- RQ3: *How do science journalists feel their views on OA research have changed because of COVID-19?*
- RQ4: *What do science journalists think about the idea of predatory publishers?*

### Methodology

The survey was developed using Qualtrics, which is approved for human research by the author's institution. It was open to anyone who self-identified as currently working as a science journalist (including environmental and health journalists), either employed or as a freelancer, for a news organization in the United States. The project focused on science journalists with the assumption that they would be more likely to have heard of and have some knowledge and opinions of OA scholarly articles. Other than specifying that environmental and health journalists, which have their own professional associations in the United States, were included, the study relied on participants to decide whether their specific area counted as falling under science journalism. This decision was made to avoid being overly prescriptive and needlessly excluding any potential participants.

The first part of the survey focused on gathering background information that could affect respondents' knowledge and opinions about OA, including their education, type of news organization they work for, how much of their professional time is spent on science journalism, their knowledge of peer review, and how comfortable they are reading scholarly studies. The next section focused on their experience working as a science journalist and their practices in citing scholarly research. The third section asked them about their knowledge of OA-related terms and their practices in citing types of OA scholarly articles in their news reporting. The final section focused on their knowledge and thoughts of the term predatory publishing and how they determine credibility of scholarly research. Validity was established by testing the survey on two experts, a professor who has practiced in science journalism and a scholarly communications librarian.

The University of Nevada, Reno's Institutional Review Board granted the survey exempt status. The author identified three professional associations in the United States related to science journalism and contacted each for assistance in distributing the survey: the National Association of Science Writers, the Association of Health Care Journalists (AHCJ), and the Society of Environmental Journalists. Only one, the AHCJ, reviewed the survey and gave approval to the author to send out the survey through its member e-mail list. An e-mail advertising the survey was sent on October 4, 2021, and it remained open for a month. No incentives were offered to respondents. Only 15 people filled out the survey, however, and the author looked for other routes to recruit participants.

In December 2021, the author searched through the websites of various U.S. news publications—including newspapers, magazines, television and radio stations, and science-focused outlets—to identify anyone who had reported on science-related topics in the past year. The author then gathered their emails either from the news site or by searching for the individual in Google. The author also searched for lists of news outlets in the United States for more places to search. Finally, the author searched for "science journalist" in Twitter to help identify more potential respondents, especially with a focus on freelance science journalists. The final list included 500 people.

An e-mail was then sent directly to everyone on the list in February 2022, along with a second e-mail to the AHCJ e-mail list, again inviting people to participate with no incentive offered. The survey remained open until February 18, 2022.

The survey received a total of 98 responses over both periods it was open. Of these, nine respondents did not meet the inclusion criteria: selecting “yes” to working in the United States as a journalist, identifying as a science journalist, and/or consenting to take part. Another seven did not finish the survey, leaving a total of 82 responses.

The project used RStudio for both descriptive data analysis and running Fisher’s Exact Test to study possible factors affecting journalists’ knowledge of OA research and their likelihood of using OA research as sources. Fisher’s Exact Test is a nonparametric test for categorical variables that can be used in place of the chi-square test, especially for small data sets when cell counts have a frequency fewer than five (Bond, 2008). The publicly shared version of the data set has either taken out or aggregated possibly identifying information.

### ***Limitations***

Selection of participants cannot be considered randomly chosen, and participants might reflect self-selection bias, such as journalists already familiar with OA, which could affect the validity. It is also hard to draw any firm conclusions because of the small sample size. It is hard to say whether the limited number of survey responses reflects certain trends in the industry, such as a reduction of journalists dedicated to science reporting or general reductions in newsroom staffing overall. Therefore, this study does not purport to find any causative relationships or firmly establish a picture of how all U.S. science journalists view OA scholarly research. However, the author hopes the results can begin to provide a picture of how science journalists who work in the United States understand OA and how they use it in their own reporting.

The survey also focused on OA scholarly articles as sources for story ideas and as sources that were cited in the final news product. It does not include OA scholarly articles as sources for background research and therefore does not provide information in this area.

### **Results**

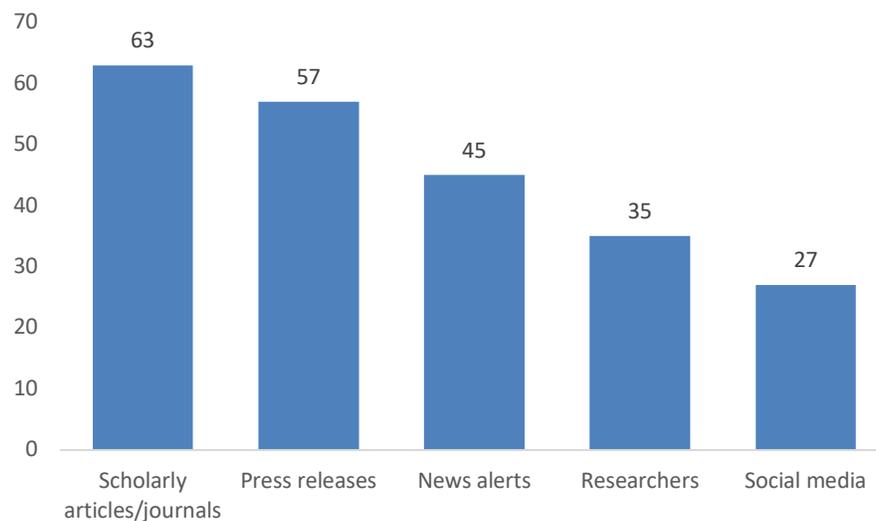
#### ***Journalist Background***

Respondents were equally split between working for a news organization and working as a freelancer (50% each). Just 2% reported their highest level of education as having taken some college classes, 36% had a bachelor’s degree, 49% had a master’s degree, and 12% had a PhD. Respondents had worked anywhere from 1 to 42 years as a science journalist, with 11.6 years as the mean. Half worked for an online news organization, followed by science-focused outlets (21%), print newspapers (13%), print magazines (10%), radio (5%), and television news (1%). The vast majority said their organization targeted a national audience (87%), followed by regional/metropolitan (11%) and local (2%).

More than two-thirds said they spend more than 75% of their work time on science journalism, 15% said they spend 50–75%, and another 15% said they spend up to half their time on it. They were then asked how comfortable they were with reading and understanding a scientific study, which the study defined as “an article or paper presenting original research that has been peer reviewed.” All but one said they are

somewhat or extremely comfortable. They were then provided with the definition of peer review as “the process of someone reviewing a study in their area of expertise as a means of quality control before a journal publishes the study” and asked if they understood what peer review was before the study. All but one said they understood what peer review was. The one remaining respondent said they partly understood the definition.

Participants could then choose their top three sources for generating science story ideas. Scholarly articles and journals received the most responses, with researchers and press releases rounding out the top three most popular sources (Figure 1). Nine people chose Other and, in a textbox, listed current events, talking with other people, conferences, and reading other websites. A majority (80%) of respondents estimated they cite or refer to a scholarly article in more than half of their news articles, with 62% saying they do so more than 75% of the time.

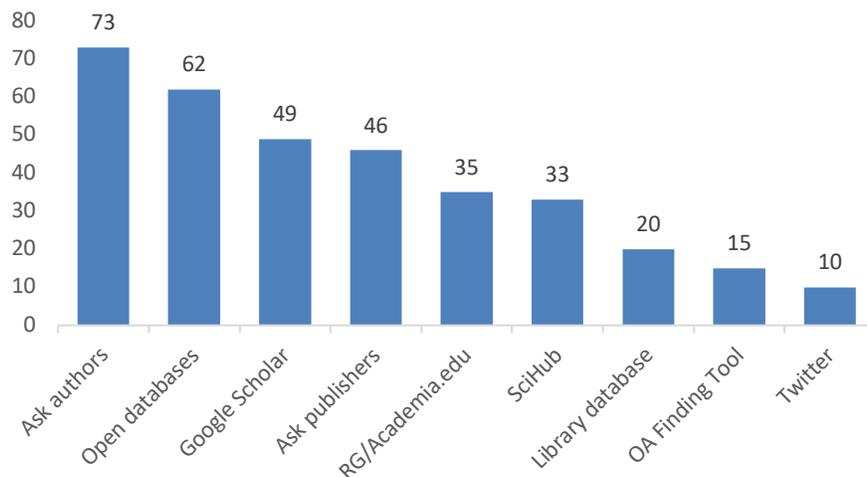


**Figure 1. Sources chosen by science journalists as one of their top three ways of identifying story ideas.**

### **Accessing Research**

In the next section, respondents were asked, “When citing or referring to a scientific study in a story you’re writing, how important is it to you to have the full text of the study vs. relying on a press release or a summary from another source such as the authors or a public relations office?” Most said accessing the full text of an article before citing it was important, with half saying they would not cite an article without being able to access the full text. Meanwhile, 44% said they take as many steps as possible to find the full text before relying on other sources. When asked, “How important is accessing a full text of a scientific study for free when determining whether you will seek it out before relying on another source?” 61% said very important, and 22% said pretty important.

Only 9% said they ever pay for an article themselves, and 20% said their company will pay to access a scholarly article. Authors of scholarly articles were the most common source for free copies, followed by open databases (like PubMed and arXiv) and Google Scholar (Figure 2). The least popular sources for free text were asking on social media and using OA-finding tools such as Unpaywall and the Open Access Button. Fifty-one percent said they thought finding free copies of scholarly articles had become easier over the past five years, whereas just 1% said they thought it had gotten harder; 23% said it had not changed. Twenty respondents did not answer this question.



**Figure 2. Sources for locating free full-text versions of scholarly articles. Respondents were not limited in how many options they chose.**

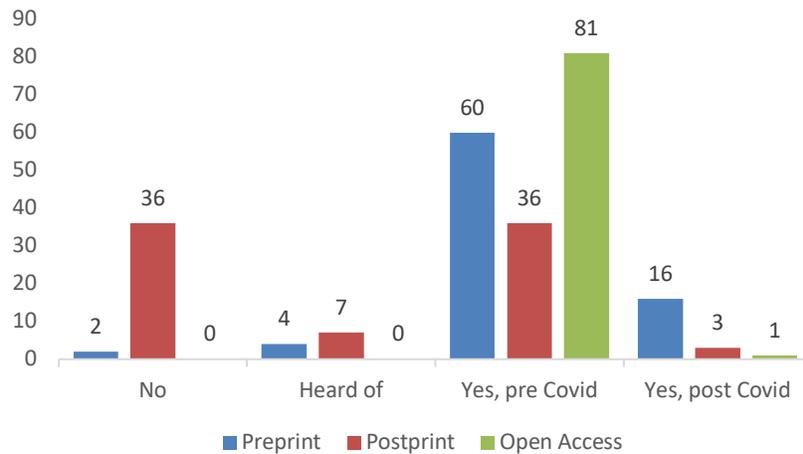
### **OA Knowledge and Use**

The study then asked the following questions:

- A preprint, sometimes called the submitted version, is a scientific study that has been made publicly available, often in an open repository, but not peer reviewed yet. Before this survey, did you know what preprint meant?
- A postprint, also called the accepted version, is a scientific study that has been peer reviewed and accepted for publication in a scholarly journal but has not been published yet and lacks the official formatting of the journal and usually any copyediting. Before this survey, did you know what postprint meant?
- Open access means to make scientific studies freely available to all readers, and often the scientific study is licensed for reuse, such as with a Creative Commons license. Before this survey, did you know what open access was?

Everyone knew the term "open access," and just one said they learned of it after the pandemic began (Figure 3). Most respondents were also familiar with the term "preprint," with 73% saying they knew

of it before COVID-19 and 20% noting they learned after. They were less familiar with the term postprint, with 44% not knowing the term at all and 9% reporting they had heard of it but did not know what it meant.



**Figure 3. Science journalists' reported knowledge of open access, preprints, and postprints.**

Because all but one respondent reported knowing about OA before COVID-19, the study did not attempt an analysis on this variable. It did analyze science journalists' knowledge of preprints and postprints in comparison with highest level of education, percentage of news article citing a scholarly article, audience size of the news outlet, whether the journalist was employed or a freelancer, percentage of the work time they spent on science journalism, their need for seeing the full text of an article before using it as a source, and their need to access the full text for free.

How often a journalist cites a scholarly article in their news stories had a significant correlation ( $p$  value < .05) in relation to their knowledge of preprints (Table 1). The same was true for their knowledge of postprints and audience size, how much of their work time they spend on science journalism, and their need for the full text of a scientific study before citing it. All other independent variables were found to not have a statistically meaningful correlation.

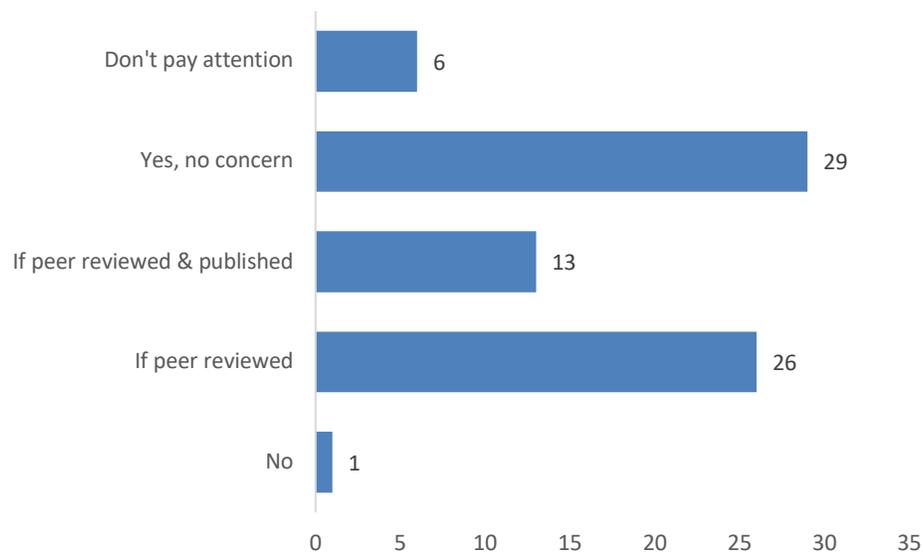
**Table 1.  $p$  Values From Fisher's Exact Test Results on Preprint and Postprint Knowledge.**

Independent Variable	Preprint Knowledge	Postprint Knowledge
Education	0.052	0.433
News articles citing a scholarly article	0.002	0.132
Audience size of news outlet	0.081	0.04
Employed vs freelancer	0.777	0.586
Time spent on science journalism	0.363	0.034
Full text needed	0.447	0.01
Free full text needed	0.882	0.784

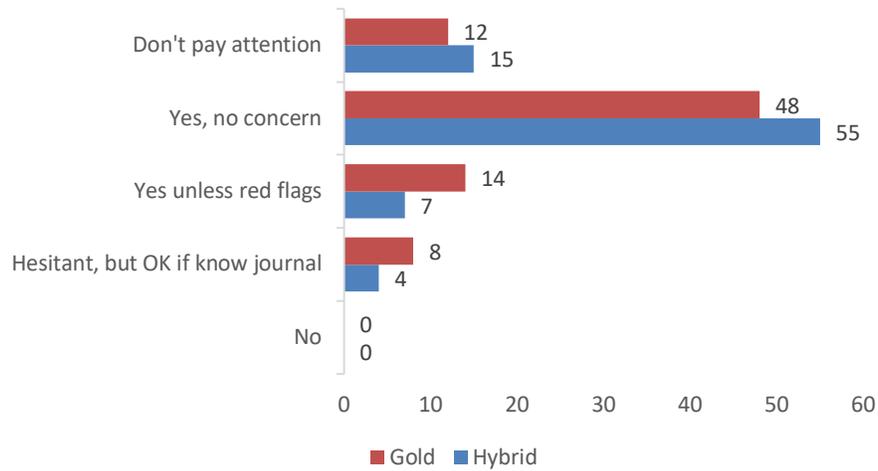
Respondents showed an openness to using OA scholarly articles at least some of the time in response to the next three questions representing the three main types of OA:

- Green OA—"There are several ways to make an article open access. In one route, authors can upload any version of their article to an open database, such as PubMed Central, arXiv, or bioRxiv. This includes the submitted and accepted versions of studies. What are your thoughts on including in a news story these types of studies?"
- Gold OA—"Another route to open access are journals that publish all material as open, such as PLoS ONE, Nature Communications, and eLife. How do you feel about including in a news story these types of studies?"
- Hybrid OA—"Many paywalled journals, such as *Nature* and *Science*, now publish some open access studies alongside paywalled studies. How do you feel about including in a news story these types of open access studies?"

Only one person said they would never cite a Green OA article in a news piece (Figure 4), and no one said they would not cite a Gold OA or Hybrid OA scholarly article (Figure 5). For Green OA, 32% said they would cite them if they had been peer reviewed, 16% would cite them if they had been peer reviewed and published, and 35% would cite them regardless of their peer review or publication status. Seven respondents did not answer this question.



**Figure 4. How willing respondents said they were in using a preprint as a source in a story (n = 74).**



**Figure 5. How willing a respondent said they were to use a Gold OA or Hybrid OA article as a source in a news story.**

Fisher's Exact Test was also run on the three dependent variables asking journalists to indicate how willing they were to cite a Green, Gold, or Hybrid OA article in a news study. What percentage of work time a journalist spends on science journalism was the only variable found to have a significant correlation ( $p < .05$ ) for their use of Green OA articles (Table 2). Percentage of news articles citing a scholarly article and news outlet audience size each also showed a significant correlation ( $p < .05$ ) in relation to journalists' willingness to use Gold OA articles. Finally, education level, percentage of news articles citing a scholarly article, audience size, and need for free access to full text all also showed a significant correlation ( $p < .05$ ) in relation to journalists' willingness to use Hybrid OA articles.

**Table 2.  $p$  Values From Fisher's Exact Test Results of Science Journalists' Willingness to Use OA Scholarly Articles as Sources.**

Independent Variable	Green OA	Gold OA	Hybrid OA
Education	0.368	0.05	0.0028
News articles citing scholarly article	0.164	0.016	0.011
Audience size of news outlet	0.054	0.009	0.045
Employed vs freelancer	0.1	0.435	0.85
Time spent on science journalism	0.016	0.82	0.418
Full text needed	0.055	0.941	0.587
Free full text needed	0.845	0.641	0.038

When asked, "Do you note if a scientific study you cite or refer to has been peer reviewed and/or its publication status?" less than half reported that they always note in their news stories whether a scholarly article has been peer reviewed (45%) or published in a journal (40%).

A majority said they had no concerns about using Gold and Hybrid OA articles as sources, although slightly more said this for Hybrid OA (67%) versus Gold OA (59%). Respondents were then asked which article version they found acceptable to cite in a news article and could choose any that applied. Sixty-four said the final, published version; 54 said the postprint; 36 said the preprint; and 7 said they do not pay attention to article version.

When asked how the pandemic has changed their impressions and views on OA research, most (73%) said their views have not changed, 21% said their views have improved, and 6% said their views have worsened.

### ***Thoughts on OA***

Respondents were provided an open text box to describe their general views of OA research in terms of their science reporting, and 48 did so. The vast majority of the comments were positive about OA. Some stated a general preference or liking for OA, and some noted how OA research helps their job by making it easier to access research. For instance, one person said:

I am almost always rushed and have little time to report and write my stories. Because of that, it's important for an academic article to be as quickly and easily accessed as possible. If I can't access it for free through open access, I may not have time to go to the trouble of tracking it down.

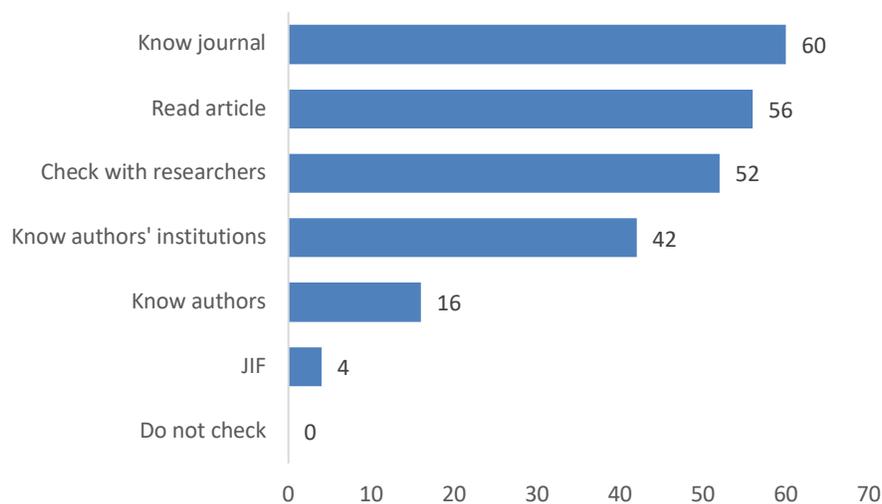
Others said OA helps improve their work through providing better context and making it easier to stay up to date with the research. Some discussed the importance of providing free access to taxpayer-funded research. One journalist said, "They are critical to public understanding of science. I can find my way around paywalls, but having to do so makes me really angry to be honest, particularly when the research is publicly funded." Others said that they did not see a difference between OA and paywalled scholarly articles in terms of quality, and two said they saw OA research as more trustworthy, with one noting the open peer-review process of journals such as eLife.

However, one common theme expressed concerns regarding preprints and the need for scholarly articles to be peer reviewed. Some took a lenient approach, saying news stories simply need to alert readers to whether an article has not been peer reviewed. Others noted that they would be more cautious in using a preprint article in their reporting, such as one who said they would want more expert opinion before using a preprint article. Finally, some expressed that they would never rely on preprints, including one person who said they refuse to assign stories based on preprints. Two comments also mentioned concern about predatory publishers.

### ***Predatory Views***

The most popular ways for science journalists to determine the credibility and veracity of OA scholarly articles were to see if they were familiar with the scholarly journal, read the article to see if it makes sense, and check with other researchers (Figure 6). Four people chose Other; in an open textbox, they listed researching the authors and topic, looking at the editorial board and other authors who have published in the journal, looking to see if the journal is peer reviewed, and checking to see whether the journal has been flagged as predatory.

Most (77%) had heard of the term “predatory publisher” or “predatory journal.” Those who replied yes were then asked how they would define the term in an open textbox, and 55 did so. A large majority of the definitions included two components: charging for publication (or a focus by the publisher on generating revenues) and a lack of peer review or quality control. A handful of definitions focused only on the financial aspect, whereas another handful focused only on the lack of quality control. Other themes that occasionally emerged were journals that solicit researchers for articles, fake editorial boards, and journals that are not cited. Most of the definitions did not mention the OA status of the journals or articles, although a few did, with one noting specifically that they find even “legitimate” OA journals that charge to be predatory. A few said they were not sure of the definition.

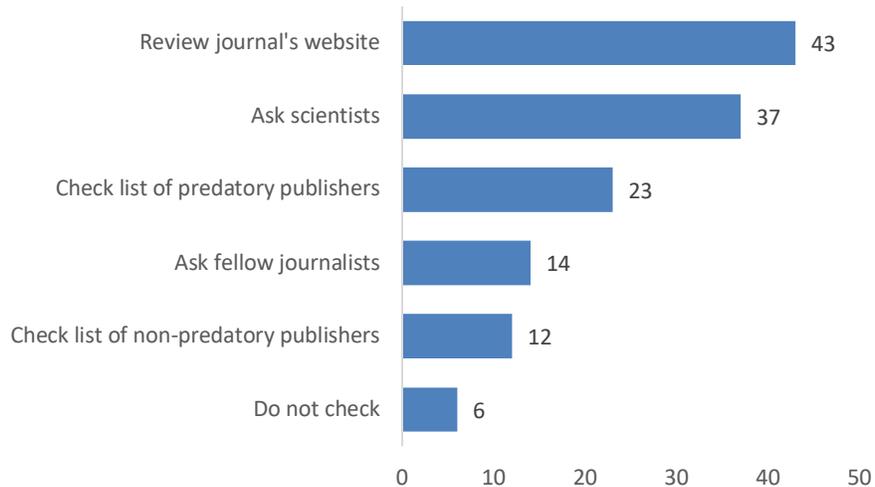


**Figure 6. Top three ways respondents determine the credibility and veracity of a scholarly article.**

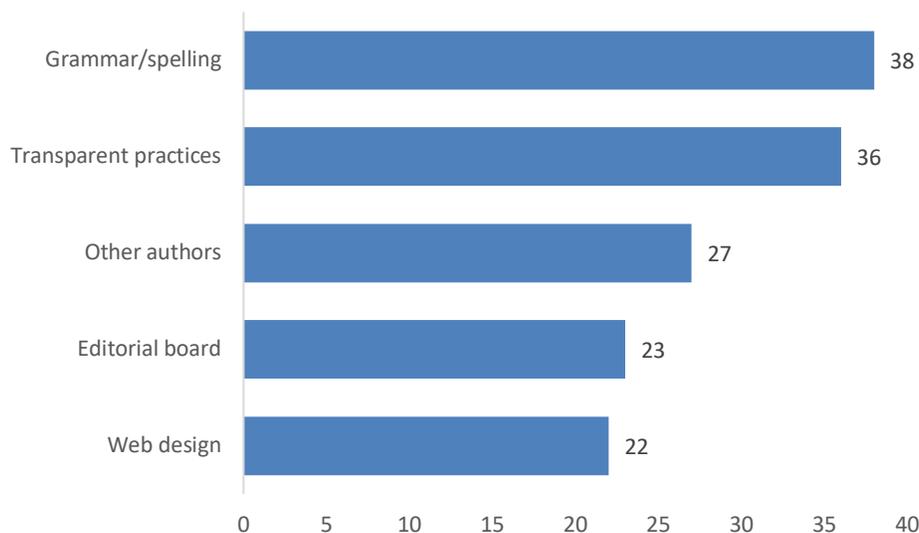
Those who said they had heard of the term “predatory publishers” were also asked whether they were concerned about them. Seventy-three percent said they were concerned about predatory publishers and journals, and 24% were somewhat concerned. These two groups were then asked how they checked to see whether a scholarly article was from a predatory source. The most common ways were reviewing the journal’s website, asking researchers for their views on the journal, and checking a list of alleged predatory publishers such as offered by Cabell’s (Figure 7). Less popular were asking fellow journalists for their views on the journal and checking lists of nonpredatory journals, such as the Directory of Open Access Journals. Eleven respondents chose Other and listed googling the journal, looking at the journal’s editorial board and publisher’s history, reading articles to evaluate them, and looking at the JIF.

Those who said they check the journal’s website to determine whether it is predatory were then asked what they look for in the website to determine this. Looking at the grammar, spelling, and quality of the writing; checking to see if the journal was transparent in its practices; and looking at other authors who published in the journal were the most common responses (Figure 8). Six respondents chose Other, further noting that they look to see where the journal is located, what other journals are published by the same entity, and searching for

details of complaints or warnings against the journal. One respondent stated, "There is a pattern of accepted language and style used in research, and it is very obvious when journals deviate from that."



**Figure 7.** For respondents who said they are concerned or somewhat concerned about predatory publishers and journals ( $n = 61$ ), they were asked which factors they check to see whether an article is from a predatory publisher or journal. They could choose as many as applied.



**Figure 8.** For respondents who said they evaluate a journal's website to see whether it is predatory ( $n = 42$ ), they were asked what factors they specifically look at on the website. They could choose as many as applied.

### Discussion

The study shows a broad awareness by science journalists participating in this survey of OA research, preprints, and (to a lesser extent) postprints. Many of the respondents also expressed a willingness to use OA research as sources, with more than half having no concern with using Gold OA or Hybrid OA scholarly articles. Their willingness to use Gold OA articles is interesting given that 61 of them said they were concerned or somewhat concerned with predatory publishers, which are often associated with Gold OA journals.

They expressed more hesitancy in using Green OA articles as sources, with just over a third saying they had no concern in doing so. However, about another third noted they would use them if they had been peer reviewed. The comments further support this: many of them expressed positive feelings toward OA in general, especially for helping them perform their jobs and because of its egalitarian objectives, while also showing hesitancy toward using preprints as sources. This evidence helps point toward a continued awareness and acceptance of OA research by science journalists but shows there is still debate about the use of preprints. This appears to reflect a similar debate among researchers as to how preprints should be handled not just by academia but also by the news media (Chawla, 2021; Humphries, 2021). Yet although journalists in the survey reported hesitancy about preprints, not all of them always note the preprint status or link to the preprint in their news articles, which could help readers determine for themselves the credibility of the source.

Data analysis identified several potential factors that might play a role in what science journalists know and feel about using OA articles as sources, particularly how often a respondent uses a scholarly article as a source in a news story and the news outlet audience size. Although the vast majority of respondents expressed being comfortable reading scholarly articles, it is likely that those who use them as sources the most are the most knowledgeable and most comfortable with them. This is similar to the idea that how journalists see their knowledge in relation to their coverage area impacts the likelihood that they will use medical journals as sources (Shoenberger & Rodgers, 2017). However, as stated previously, the small sample size could have affected the results of other potential variables and their impact, and it was not large enough to conduct a more thorough analysis that would have helped identify how much of a role they play. Another possible issue is the role self-selection bias played—those who are interested in OA research might be more likely to participate than those who are not familiar with it. Either way, more data is needed before drawing any conclusions.

Meanwhile, some respondents reported learning about OA after COVID-19, but most were already aware of it. Likewise, a large majority said the pandemic did not change their views on OA. Of the 27% who said it did, most (77%) said their views had positively changed. Paired with the generally positive feedback provided about OA research, this suggests the respondents were already positively disposed toward OA even before the pandemic. This suggests science journalists' willingness to use OA scholarly articles, especially preprints, as sources could continue in the long term, even as the need for immediate information and political action around COVID-19 wanes (Fleerackers et al., 2022). Other factors will likely also influence whether science journalists continue to use them as sources, including whether researchers continue to share their research as preprints, the speed of scholarly publishing, and the role of other members of the newsroom (such as editors) not favoring OA research as sources.

A majority of respondents indicated they were familiar with or had heard of the term “predatory publishers,” and a smaller majority indicated concern about them. This likely reflects fear over the idea of predatory journals in the scholarly world (Gasparyan et al., 2015; Puebla et al., 2022). The definitions provided by journalists reflected a general idea of predatory as expressed by some in academia—combining profit-seeking actions with lack of peer review—but as with academia, there were differences in the definitions. Perhaps more telling were the answers to questions about what they looked for in determining whether an OA article is predatory, with many relying on lists such as Cabell’s that are known to include criteria that can fit well-respected journals. Likewise, the most common response for what they look at when reviewing a journal’s website was grammar and spelling, even though scholars have argued this is a poor measure of quality of scholarly work and can reflect biases against journals run by people who do not speak English as their first language (Olivarez et al., 2018). Considering the proliferation of purported studies of predatory publishers that use these problematic criteria, it is unsurprising to see this concern reflected in the science news media. However, as noted previously, this worry does not appear to be enough to prevent them from using OA scholarly articles as sources, although more education for science journalists around the many issues with predatory publishing could be beneficial.

One perhaps surprising finding is how popular scholarly articles were as a source for story ideas, second only to researchers. This seemingly conflicts with prior studies showing a greater reliance on press releases (Viswanath et al., 2008). More research is needed, however, to say whether this is connected to OA research or other potential factors.

The study also found that a large majority of respondents both desired access to the full text of scholarly articles before using them as sources and accessing the full text for free. Journalists’ reliance on authors for providing these free copies reflects the findings by Gesualdo et al. (2020), but the fact that open repositories were the second most common source for free versions also likely speaks to their knowledge of and willingness to use preprints. The growth of preprint repositories could explain why just over half of the respondents said finding free versions has gotten easier in the past five years. OA-finding tools such as the Open Access Button and Unpaywall were not commonly used, indicating room for educating science journalists about these tools and how they can help them in their quest to find freely available versions.

Prior studies established the important role that science journalists play in communicating scholarly information to the public, and scholarly articles can serve as important sources. When access and costs limit which scholarly articles they use in generating story ideas and as sources, however, everyone loses out. Other issues remain, including the sheer amount of scholarly information being disseminated, but science journalists’ awareness of and willingness to use OA research, including preprints, as sources helps ensure that cost at least is less of a factor.

### **Conclusion**

One of the main goals of the OA movement has been to ensure that everyone can benefit from scientific discoveries, not just those associated with institutions that can afford access to the expensive paywalls. Previous studies have shown that the news media do indeed make use of OA scholarly research, and now this exploratory study helps provide some idea of not just whether science journalists in the United

States use OA scholarly articles as sources but also what they know and think about OA research as sources. The respondents to this survey showed they are aware of OA and related issues and make conscious decisions around which OA scholarly articles they use as sources. They know of open repositories, and many use them to find scholarly articles. Although some express concern around preprints as sources, many of them do engage with them to some extent. And although the COVID-19 pandemic saw a rise in preprints, evidence from this study suggests participants were already familiar with them. As both gatekeepers and knowledge brokers, science journalists play an important role in the communication of scientific knowledge to the general public. Therefore, ensuring they take advantage of the benefits of OA research can help ensure that the general public benefits as well.

However, as stated previously, this study alone does not provide enough information to create a broad picture of U.S. science journalists' knowledge and views of OA research. More work is needed. Future research in this area would benefit from studying more science journalists, as well as all journalists, on their knowledge of and thoughts on OA research. This should include both quantitative studies and qualitative studies, such as the use of interviews. Such studies could also further explore what factors affect this, including the possible connection found by this study of possible factors including audience size, how often they use any scholarly article as a source, and how much professional time is spent on science journalism.

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