



Library Impact Research Report

Open Access Publishing: A Study of UC Berkeley Faculty Views and Practices

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Abstract

This project focused on open access (OA) publishing, which enhances researcher productivity and impact by increasing dissemination of, and access to, research. The study looked at the relationship between faculty's attitudes toward OA and their OA publishing practices, including the roles of funding availability and discipline. The project team compared University of California Berkeley (Berkeley) faculty's answers to questions related to OA from the 2018 Ithaka Faculty Survey with the faculty's scholarly output in the Scopus database. Faculty Survey data showed that 71% of Berkeley faculty, compared to 64% of faculty nationwide, support a transition to OA publishing. However, when selecting a journal to publish in, faculty indicated that a journal having no cost to publish in was more important than having no cost to read. After joining faculty's survey responses and their publication output, the data sample included 4,413 articles published by 479 Berkeley faculty from 2016 to 2019. With considerable disciplinary differences, the OA publication output for this sample, using data from Unpaywall, represented 72% of the total publication output. The study focused on Gold OA articles, which usually require authors to pay Article Processing Charges (APCs) and which accounted for 18% of the publications. Overall, the study found a positive correlation between publishing Gold OA and the faculty's support for OA (no cost to read). In contrast, the correlation between publishing Gold OA and the faculty's concern about publishing cost was weak. Publishing costs concerned faculty in all subject areas, whether or not their articles reported research funding. Thus, Berkeley Library's efforts to pursue transformative publishing agreements and prioritize funding for a program subsidizing publishing fees seem like effective strategies to increase OA.

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Introduction

University of California Berkeley (Berkeley) Library published a strategic plan in 2017 that included a strategy to “champion and transform the practices of scholarly communication to increase access, reduce cost and improve dissemination of Berkeley scholarship.”¹ Around this time, there were numerous campus-level communications and conversations regarding transforming scholarly publishing and moving the University of California (UC) system toward Open Access (OA). In 2018 Berkeley Library launched the Ithaka Faculty Survey and found that 71% of the faculty respondents at Berkeley, versus 64% nationwide, indicated that they would be happy to see the traditional publication model replaced by an OA publication system.²

Berkeley faculty were especially positive about OA, which aligned with the library and UC’s visions to transform scholarly publishing, but were their publishing practices in line with their attitudes? On the topic of “(how) does the library help to increase research productivity and impact?,” we decided to investigate the OA productivity of University of California Berkeley (Berkeley) faculty and compare faculty’s views on OA and scholarly publishing to their actual publishing practices.

Accordingly, we begin with a summary of the Faculty Survey results that pertain to faculty views on OA, which provides a background for our current study. Our study then includes: (1) analysis of the survey respondents’ 2016–2019 publication output, including OA publications; and (2) analysis of a de-identified dataset that links survey responses with respondents’ publication data.

Background—2018 Ithaka Faculty Survey

The Berkeley Library partnered with national research organization Ithaka S+R to launch a survey of Berkeley faculty in October 2018. The 41-question survey was sent to 2,748 Berkeley faculty members and 811 faculty responded, which was a 30% response rate.

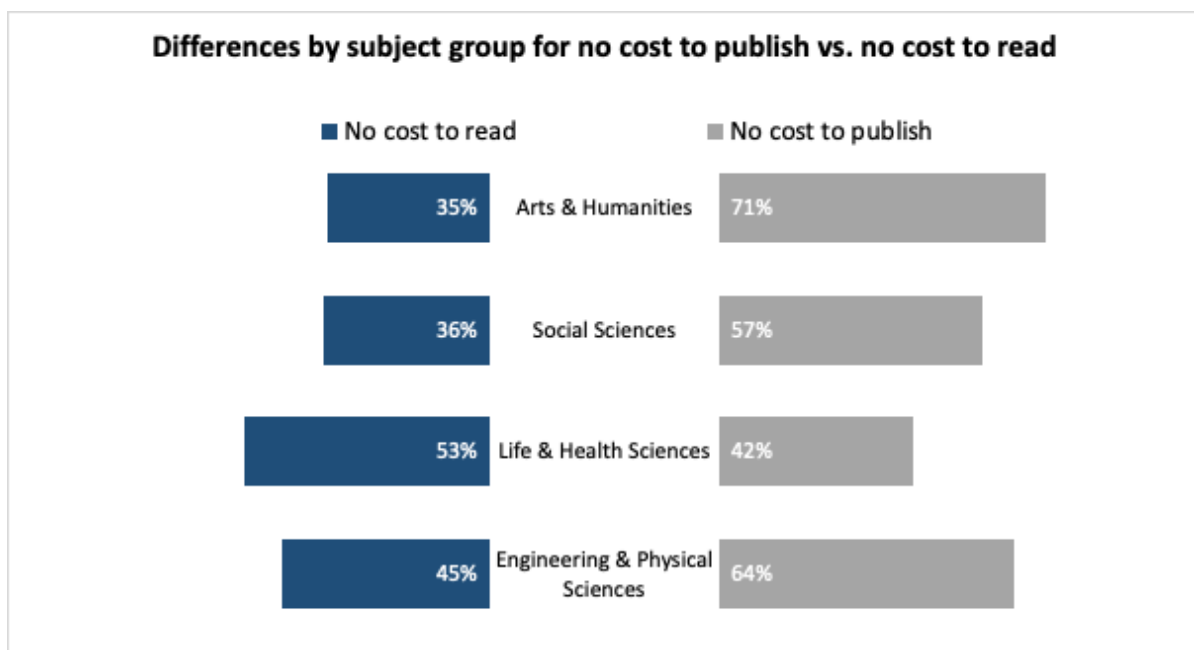
In order to understand faculty’s perception of OA, we considered faculty’s answers to specific questions about research dissemination and publication. One of the questions was about the factors that influence faculty’s decisions about journals in which they publish their articles. Out of 696 responses for this question, the top two (91%) influencing factors were: (1) the journal is widely distributed, and (2) the journal has a high impact factor or an excellent academic reputation, while the third choice (84%)

was that the coverage area of the journal is close to the faculty's immediate area of research.

In contrast, OA factors were ranked lower; 41% of the faculty respondents (compared with 38% nationally) indicated that a journal having no cost to read was very important, while 59% (compared with 70% nationally) indicated that a journal having no cost to publish was very important.

To look at disciplinary differences, we used four broad subject categories based on the faculty's department: life and health sciences (LHS), engineering and physical sciences (EPS), social sciences (SS), and arts and humanities (AH). Analyzing the two OA factors by subject groups, it is noticeable that a higher percentage of the faculty in AH value no cost to publish, while a higher percentage of the faculty in LHS value no cost to read (Chart 1).

Chart 1.

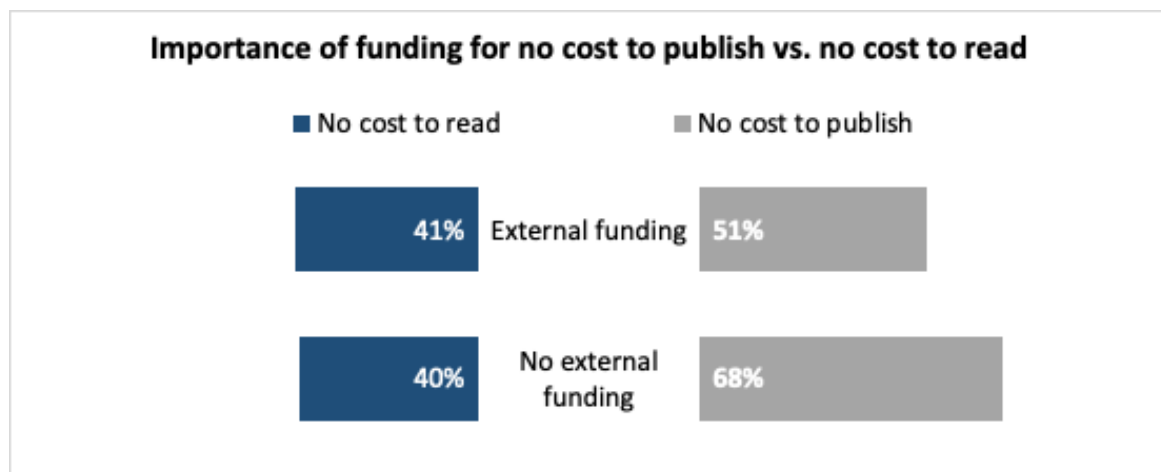


Research funding is relevant to a discussion about OA, since some OA publishing channels require costly publishing fees. In another question, faculty were asked if they received external funding for their scholarly research from a public or government grant-making organization (such as the NSF, NIH, NEH, etc.) in the last five years. A greater percentage of Berkeley faculty overall (54%) reported having received or

currently receiving external funding compared to their peers nationally (35%). There were strong disciplinary differences: 86% of the faculty in both LHS and EPS, versus 45% in SS, and only 22% in AH received funding in the last five years.

The importance of the cost to publish seems to vary based on if the faculty received external funding (Chart 2). Faculty with no external funding were more concerned about cost to publish, while the importance of no cost to read was similar whether or not respondents received funding.

Chart 2.



The survey research reveals the faculty’s views on issues relevant to OA, but not their actual OA publishing behavior. Therefore, our study focused on whether, and how, the perceptions and behavior are related.

Why It Matters to Research Libraries

We hoped that results of our study would provide insights into faculty’s attitudes and practices around OA publishing, including the roles of funding availability and discipline. Increased understanding of these relationships could help libraries better support OA publishing. Publishing OA makes research more accessible, and improving dissemination of Berkeley scholarship is a key component in our library’s strategic plan.³ Additionally, learning tools and methods to assess the OA publishing landscape at Berkeley informs our library’s future assessment projects.

Objectives

Our objectives were:

- To learn more about OA publishing at Berkeley, including how best to quantify it
- To study the relationships between faculty's OA attitudes and OA publishing practices, including the roles of funding availability and discipline
- To better understand relationships between OA publishing and cost (to-read and/or to-publish), which can help inform libraries' efforts to support OA publishing

Hypothesis

Our hypotheses were as follows:

1. Faculty who publish OA at a higher rate would express more positive views towards OA publishing in the Faculty Survey.
2. Research funding would be positively correlated with OA publishing and negatively correlated with concern about OA publishing costs.
3. There would be demographic differences: science faculty and early career faculty would publish more OA and have more positive views of OA publishing.

Literature Review

In order to place our results in context and refine our methods, we reviewed the literature on quantifying the OA landscape. To understand more about faculty attitudes and practices concerning OA publishing, including how these attitudes and practices vary across subject areas and years of experience, we reviewed studies on those topics. We hoped our literature review could complement our research project and provide insight into how libraries could better support researchers in publishing OA and making their research more available.

Assessing the OA Landscape

Techniques for calculating OA and definitions of OA are quite variable across published studies, which makes it difficult to quantify the OA landscape. For the purposes of this study, the following general definitions are used. Gold OA articles are published in a fully OA (Gold) journal. Most Gold OA articles are published in journals that require an Article Processing Charge (APC), even though a minority of OA journals require them.⁴ Some journals allow authors to pay an APC to make an article immediately free to read (Hybrid OA), whereas other articles in the journal are not OA (Closed). Authors can deposit a copy of their article (not always the final version) in a repository where it is free to read (Green OA). Some articles go through an embargo period before becoming available on the publisher's website or in a repository (Delayed OA). Publishers may also decide to make particular articles in a non-OA journal free to read, either temporarily or permanently (typically called Bronze OA). A review article that looked at OA calculations presented in other studies reported that overall OA levels for articles 2010 and newer have been estimated to be 29%–66%.⁵

Recent studies of OA found that newer articles were more likely to be OA, driven by growth in Gold and author-pays Hybrid articles.⁶ A large-scale study of rates of OA found that the proportion of Gold and Hybrid articles increased from 2009 to 2014,⁷ while another study found that there has been a substantial increase in both the number of journals offering a Hybrid option and the number of Hybrid OA articles.⁸ Author-pays Hybrid articles were estimated to be about 5% of articles in subscription journals in 2018, and the percentage is thought to be rising due to the increasing adoption of transformative publishing agreements.⁹

Other researchers, in attempting to replicate a 2004 study, found an increase in articles freely available online in 2017 compared to 2004.¹⁰ One factor they thought had contributed was a growth in the number of journals adopting Delayed OA. However, they also found that a large proportion of the freely accessible articles were publisher versions of PDFs found on independent sites, including academic social networks.¹¹ Availability of PDFs on non-traditional sites can complicate OA studies, and an article's OA status can be a moving target due to actions by authors and publishers that change the article's availability.

Factors influencing Authors' Publishing Decisions and Attitudes Towards OA

Factors that influence authors' choices of journals in which to publish their research have been explored in numerous studies. Several papers analyzed data from a survey that was answered by about 2,000 faculty, graduate students, and post-docs at four large research universities in 2015.¹² These researchers were asked which eight journal attributes were most important when deciding where to publish their research. Across disciplines and position types, a journal's reputation and fit (with the author's work) were the top two attributes, while OA was the least important.¹³ Respondents in the Ithaka S+R US Faculty Surveys, when asked a similar question, have ranked the journal's fit, circulation / readership, and reputation as top attributes over multiple iterations of the survey; a journal making its articles free to read has consistently ranked toward the bottom of the list.¹⁴ The large 2010 SOAP survey (a convenience sample of over 38,000 researchers biased toward the life and health sciences) also found that OA was one of the least important attributes, despite nearly 90% of the respondents agreeing that their research fields "would or do benefit" from journals publishing OA articles.¹⁵

Although OA may not be a top consideration when publishing, the growth of Gold and author-pays Hybrid OA suggests that many authors do value OA publishing. Broader societal benefits, like increasing access to research, and more personal benefits, like increasing the citations to one's papers, are possible reasons that authors might choose OA. Authors who have a positive attitude toward OA are more likely to publish OA, whether their positive attitude comes from moral conviction of OA as a public good, or from belief that OA serves an author's interests.¹⁶

Nevertheless, publishing in OA journals does not necessarily signify a positive attitude toward OA. Solomon and Bjork surveyed authors who had submitted articles to journals in the Directory of Open Access Journals. Although OA was a factor in their decision of where to publish (60% found it important), fit, quality, and speed of publication were substantially more important to the authors.¹⁷ From the 86 authors of OA articles from their university that responded to their survey, Heaton and colleagues¹⁸ found that a researcher's discipline and peers appeared to strongly influence whether they publish OA, as does availability of funds. But the OA authors were not necessarily OA advocates, and some were suspicious of OA journals as being predatory. However, 83% of respondents did place some importance on the journal being OA, and altruism was the most common motivating factor selected. Heaton et al.

concluded that “author motivations are multifaceted and complex,” so we should be careful not to generalize or make assumptions.¹⁹

Role of Discipline

Researchers in most STEM (Science, Technology, Engineering, and Mathematics) disciplines publish more OA than their colleagues in the humanities and social sciences.²⁰ There are a number of factors that may contribute to this imbalance. For one, researchers in STEM fields tend to be more positive about OA increasing readership of their work and potentially increasing research quality.²¹ One reason that STEM authors may be more motivated to increase readership is that they may feel their research has practical real-world implications. However, Bosman and Kramer²² looked at millions of articles indexed in Web of Science and found that some applied STEM fields had less OA than the pure sciences, so it is important to consider disciplinary differences within large subject groups.

Another factor contributing to the imbalance is that many non-STEM fields are more focused on monographs, which offer less opportunity for OA. Also, when publishing journal articles, non-STEM researchers may lack quality OA journals in their field. Additionally, STEM researchers may have more funds available to pay APCs. Finally, researchers in STEM fields may be more likely to receive funding from federal agencies that require that the resulting research be made OA, which could be achieved through publishing in an OA journal and/or depositing to a Green OA repository. Thus, even researchers that are neutral about OA may publish OA as a requirement of their grants.

Role of Years of Experience

One might expect differences in OA attitudes between younger, less-established researchers, who might be attracted to OA’s potential to make their research more visible, compared with more seasoned researchers who may be used to traditional publishing systems and resistant to change. However, past research on this is mixed. Nicholas and colleagues used a mixed-methods approach in a four-year longitudinal study of early career researchers (ECRs) and their publishing practices and preferences. They interviewed 116 early ECRs from seven countries and found that, though they supported OA publishing, they were more likely to prioritize the reputation of a journal when deciding where to publish.²³ The ECRs had positive attitudes about openness and sharing and embraced sites like ResearchGate.²⁴ In a 2019 survey of 1600 ECRs, they found that the majority had published OA and saw

more advantages than disadvantages of OA publishing; this led them to conclude that OA practices were catching up with attitudes.²⁵ Dalton and colleagues²⁶ found more negative attitudes about OA among those further in their careers, while Blankstein and Wolff-Eisenberg²⁷ found that older faculty placed more importance than younger faculty on a journal being free to read, but were less supportive of a transition to a fully OA publication system. Heaton and colleagues²⁸ found that tenure status did not correlate with any particular attitudes toward OA, and Olejniczak and Wilson²⁹ found that the effect of rank and years of experience on the rate of OA publishing varied by discipline.

Methodology

We had a head start on our efforts to study relationships between OA attitudes and behavior since we already had the Faculty Survey data that could be used as a measure of faculty's attitudes. The response data provided by Ithaka contained coded responses, but names, email addresses, or other personal information cannot be directly linked to the responses. Berkeley Office for Faculty Equity & Welfare provided faculty personnel data for the survey respondents, such as names, email address, departments, and titles, which were encrypted and kept as a separate file. We obtained Berkeley IRB approval for our research before we could link the respondents to their responses via separate files, since we were working with personal information.

To look at OA publishing behavior, we needed a way to retrieve the publication data for Berkeley's 811 Ithaka Faculty Survey respondents. Unfortunately, Berkeley does not have a campus-wide database of faculty publications. Lacking that, we would ideally have gathered publication data for each researcher individually using multiple bibliographic databases, CVs, etc., but we did not have the time or resources to track down publication data for hundreds of faculty. Instead, we explored vendor products, including OCLC WorldCat and Scopus. Using OCLC WorldCat, we checked a sample of faculty, and faced obstacles including that the faculty names were not standardized, there was limited affiliation data, and there was limited data on publications' OA status. We decided to use the multidisciplinary indexing database Scopus, which includes affiliation data, standardizes author names, and allows use of APIs. Limitations of Scopus are discussed later in this report.

For the work involving APIs, we thank the library student data analyst, Charis Chan, 2021, MA, information and data science program, who was supervised by Chan Li. Our

lack of experience with APIs would have slowed the project down, so it was helpful to have someone able to do this work for us. As Chan retrieved the data and downloaded it to a spreadsheet, Li created visualizations in Tableau, which allowed us to evaluate the results and revise our methodology as needed.

Chan first tried a few Scopus APIs to match faculty survey respondents to Scopus authors using their names as officially recorded by Berkeley (first and last names). We then examined the list of Faculty Survey respondents who were not matched to Scopus authors. Some of these faculty did not have publications in Scopus, but others did and were just not retrieved by the API because their name did not match an author in Scopus exactly. We were able to match additional respondents with their Scopus author profiles, and provided Chan with the author profile information to be used in the final data download.

Pilot Study

In spring 2020, Becky Miller, in consultation with Li and Mohamed Hamed, used data from 126 LHS faculty survey respondents to do a pilot study that she presented at the 2020 US Agricultural Information Network meeting. At the time, Li and Chan were still working through some difficulties getting the full data with the Scopus APIs, so Miller downloaded publication data for these LHS authors individually. The publication date range was limited to 2016–2019. The publication output was limited to journal articles and review articles—as they are the major OA output—and the question from the Faculty Survey was focused on journal publications.

We found that Scopus did not include adequate OA status information, so Miller used article DOIs from Scopus to query Unpaywall's database (articles lacking DOIs were excluded). Unpaywall defines different categories of OA as follows: Closed are non-OA articles; Green articles are OA in a repository but closed on the publisher website; Gold articles are published in fully OA journals; Hybrid articles are freely available in a non-OA journal on the publisher website under an open license; Bronze articles are also freely available on publisher websites, but without an identifiable license.

We originally wanted to include Hybrid OA in our analyses since the Hybrid OA category includes individual articles that are made immediately OA by an author paying an APC, which is a strong OA intention. However, under transformative OA agreements negotiated between libraries and some publishers, articles published by affiliated authors become Hybrid OA automatically, with less of an intentional decision on the part of the author. Also, Unpaywall's Hybrid and Bronze categories

include articles made available by the publisher after a delay. Green OA articles may also have undergone an embargo prior to being deposited. With Delayed OA in the mix, it is harder to understand the authors' OA publishing intentions. Plus, for categories other than Gold, articles may change categories as a result of shifts in embargos and licensing. Thus, the pilot and full studies primarily focused on Gold OA as this category most clearly reflects an intention to publish OA. Authors publishing in Gold OA journals know that their article will be immediately available OA and, in most cases, have paid an APC.

Final Data Download

The final data used in the results presented here was retrieved by Chan in August 2020 using APIs. Because an article's OA status can change, it was important to retrieve data for all publications at the same time. As in the pilot, the publication date range was limited to 2016–2019 and the publication output was limited to journal articles and review articles.

The Scopus article data included information on reported research funding. However, we noticed strange patterns in the funding data, so we reached out to Elsevier in March 2021. They informed us that their process to extract funding information from acknowledgments in publications was revised in early 2018 and it works best on documents added to Scopus beginning in 2018. Therefore, we limited the funding analysis to publications from 2018 to 2019.

Since we had settled on using Unpaywall for our OA status data, Chan used an API to match the DOIs of the articles retrieved by Scopus with the data in Unpaywall's database (articles lacking DOIs were excluded from our analyses).

After establishing the connections between authors' survey responses and publications, the file that contains personal information used as identifiers was deleted in accordance with the IRB. The resulting analyses are only in aggregate and cannot reveal any personally identifiable data.

Data

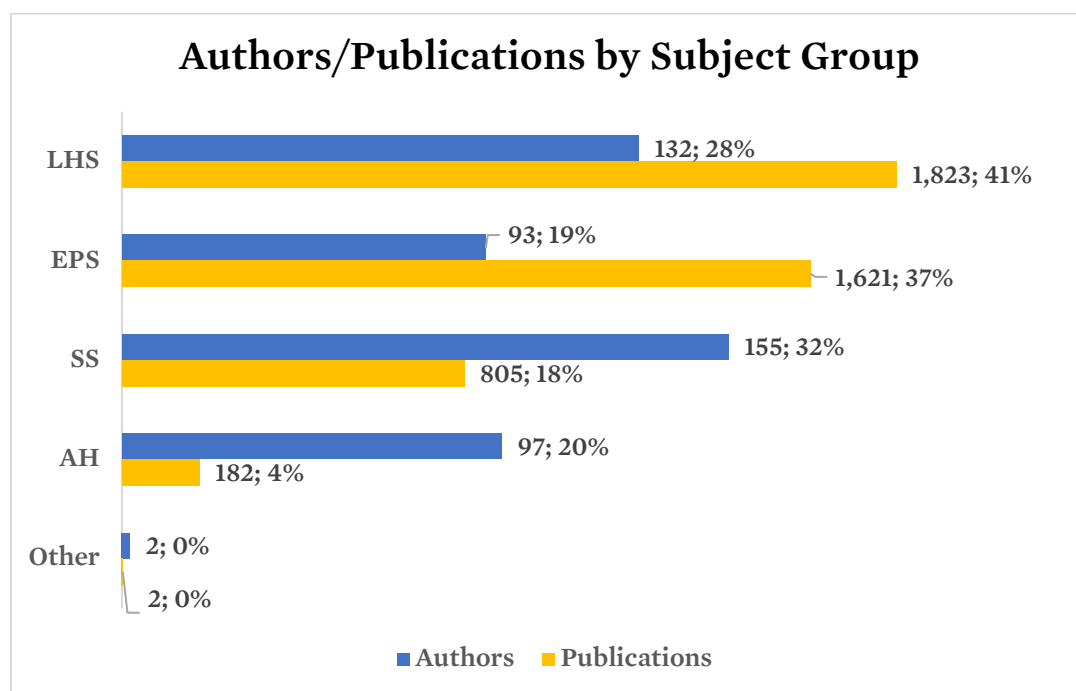
Out of 811 faculty respondents, 509 (63%) authors were identified in Scopus, and the same four subject groups were used to compare disciplines as used in the Faculty Survey. The ability to find authors in Scopus was not consistent across subject groups, 82%–83% for LHS and EPS, 55% for SS, and 43% for AH. Also, for certain disciplines,

especially in AH, even though some authors are indexed in Scopus, not all of their publications are, especially when journal articles are not the authors' primary publication output format.

Among the 509 authors who were identified in Scopus, 479 of them answered the question about journal publishing preferences. These 479 authors, their survey responses, and the 4,413 articles they authored are the focus of our correlation analysis and study. (Note that some of the articles are co-authored by multiple Berkeley faculty who are categorized in different groupings in our analysis.)

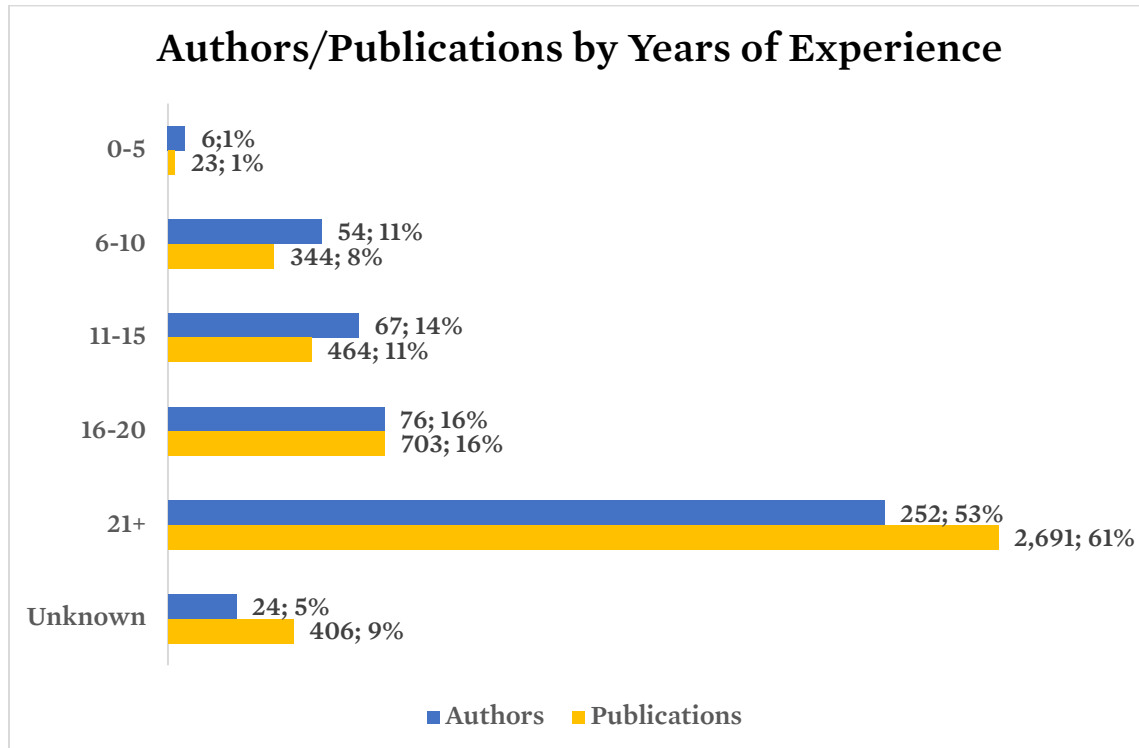
Overall, 78% of the total publications were authored by STEM faculty, with 41% by LHS authors and 37% by EPS authors (Chart 3). Even though 32% of the authors identified are from SS disciplines—the highest percentage—their publication output only represents 18%. AH publications are even more disproportionately represented in the dataset, as only 4% of the total articles are published by 20% of the faculty. Two faculty and their two publications do not fall into one of the subject groups, so they are excluded from the analysis.

Chart 3.



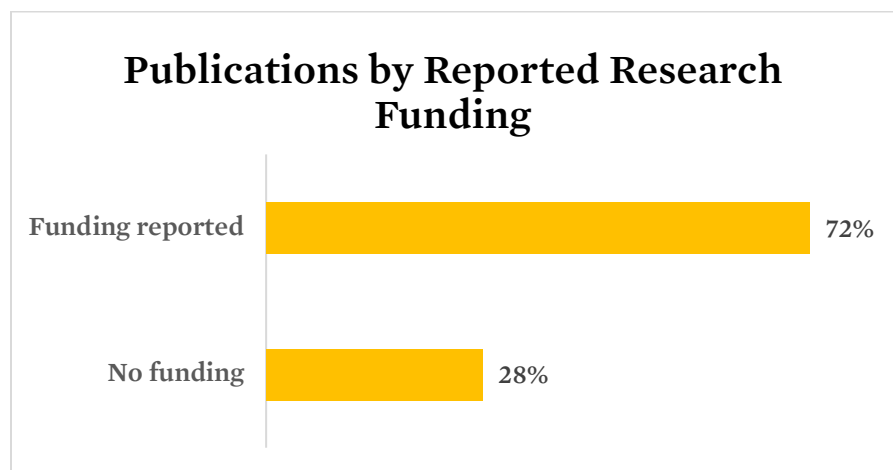
Looking at faculty's years of experience, faculty with at least 21 years of experience represent the majority of the dataset (Chart 4). The greatest number—55%—of the articles are published by the most senior faculty, followed by 16–20 years, 11–15 years, and 6–10 years.

Chart 4.



Overall, 72% of the 2018 and 2019 articles published by Berkeley faculty were coded with funding information in Scopus while 28% of the articles did not indicate a funding source (Chart 5). However, an article reporting funding does not necessarily mean that Berkeley authors received funding for their research, as the funding information is tied to the articles, not to individual authors.

Chart 5.



Findings

Large OA Output at Berkeley with Gold OA on the Rise

For the last four years, from 2016 to 2019, the total publication output has been stable, averaging around 1,110 journal articles and review articles per year published by the 479 Berkeley authors. The OA publication output, combining all four types of OA (Green, Gold, Hybrid, and Bronze), represents 72% of the total publication output (Chart 6). The OA output varies by subject group, ranging from 37% to 78%. LHS has the highest OA publication output, while AH has the lowest.

Chart 6.

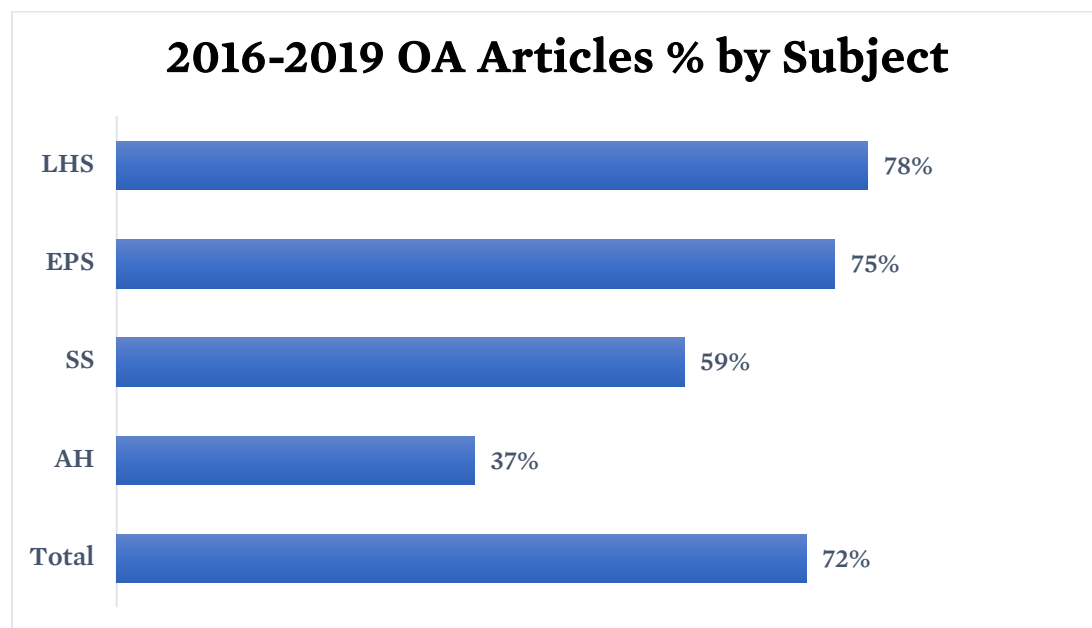
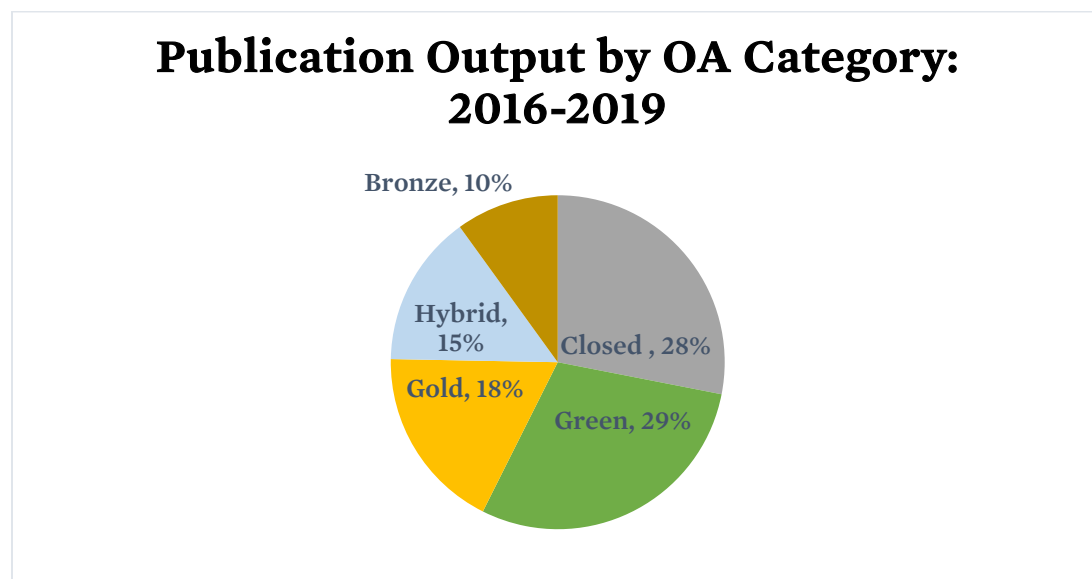


Chart 7 illustrates the output percentages by different OA categories. Among all of the published articles, Green OA, 29%, represents the biggest share. Unpaywall's Green category represents articles that are only available in a repository (not via the publisher), and there are likely articles in the Gold, Hybrid, and Bronze categories that are also in repositories. Thus, the actual percent of articles in repositories is likely higher than 29%. Gold OA publications are the second largest OA contributor at 18%. Hybrid and Bronze together represent over a quarter of the total articles.

Chart 7.



University of California adopted a Presidential Open Access Policy in 2015, which followed a 2013 OA policy covering all Academic Senate faculty. The presidential policy requires UC faculty and other employees to make their research publicly available, which can be accomplished by publishing OA and/or by depositing a copy of their scholarly articles in an OA repository. The OA policy and funder mandates undoubtedly have a direct influence on Berkeley faculty's high rate of Green OA, and both likely influence Gold OA publishing as well.

The overall levels of OA found in the study, 72%, were higher than the range (29%–66%) reported in the review of studies that calculated overall OA levels for articles 2010 and newer.³⁰ Since there are many methods of calculating OA, it seems appropriate to compare our study to other studies that also used Unpaywall (also called “oaDOI”) to determine an article's OA status.

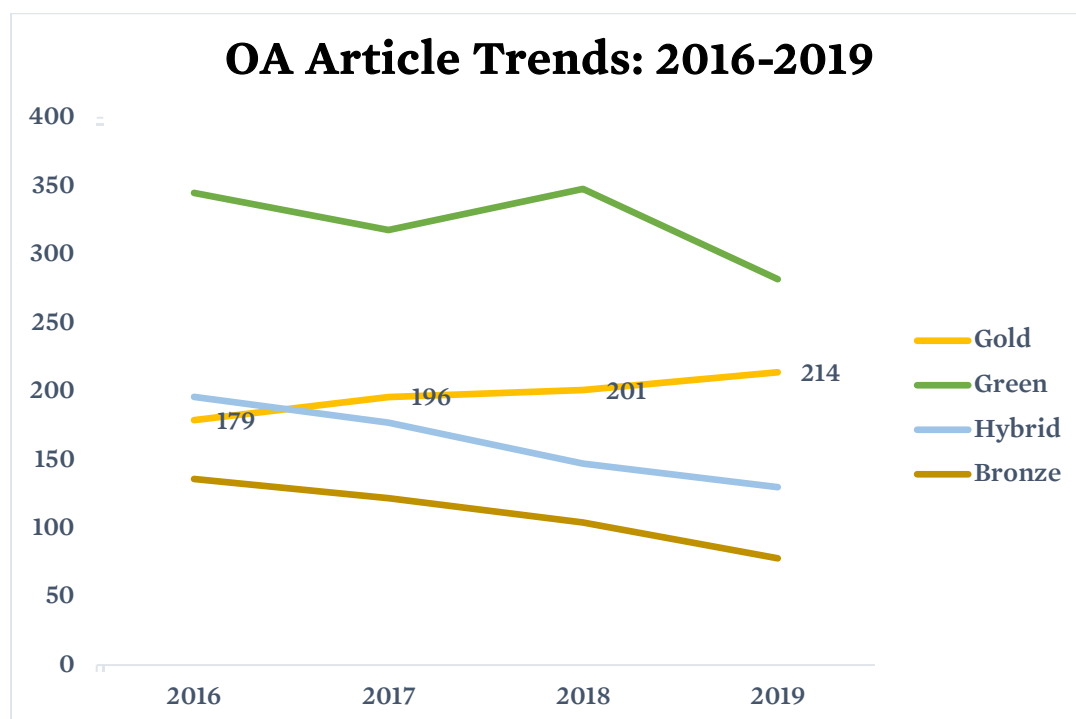
Piwowar and colleagues³¹ looked at a random sample of 100,000 articles accessed by users of the Unpaywall browser extension in 2017 and found 47% of the articles to be OA, with 14% Gold OA. Olejniczak and Wilson³² used Unpaywall data to look at articles from 2014 to 2018 authored by 182,320 faculty at research institutions, identifying faculty and articles using the Academic Analytics database. They reported an overall OA percent of 46%, with 12% Gold OA. Bosman and Kramer³³ used data behind Unpaywall to look at more than 12 million articles and reviews published 2010–2017

that were indexed in Web of Science. They found that OA levels increased from 2010 to 2016, with an overall OA percentage of nearly 30% in 2015 and 2016.

The aforementioned three studies looked at much larger sets of articles that were derived using different methods. These studies did not use Scopus, so the distribution of disciplines represented by the articles in these studies may have differed from ours, which was heavily biased toward the sciences. Nevertheless, it appears that Berkeley authors have an above-average rate of OA publishing, both overall (72%) and Gold OA (18%).

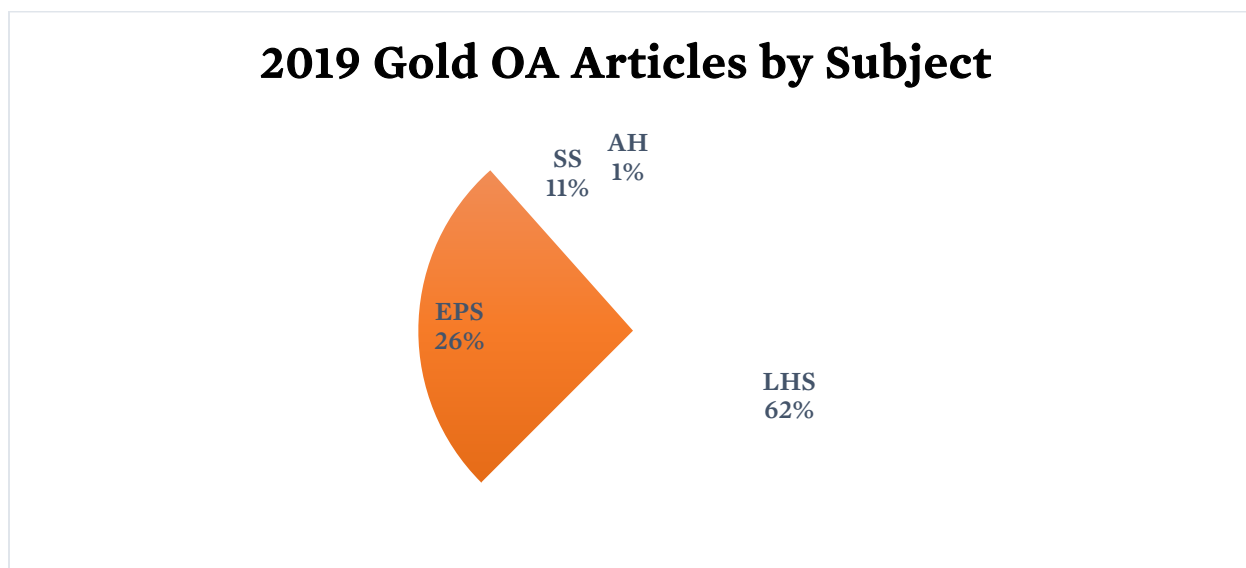
Gold OA output has been steadily increasing over the years (Chart 8), 20% more from 2016 to 2019. The downward trend in the other OA types is at least partly a result of embargos and Delayed OA; it is likely that the OA status of some newer articles will change from Closed to Green, Hybrid, or Bronze after an embargo period.

Chart 8.



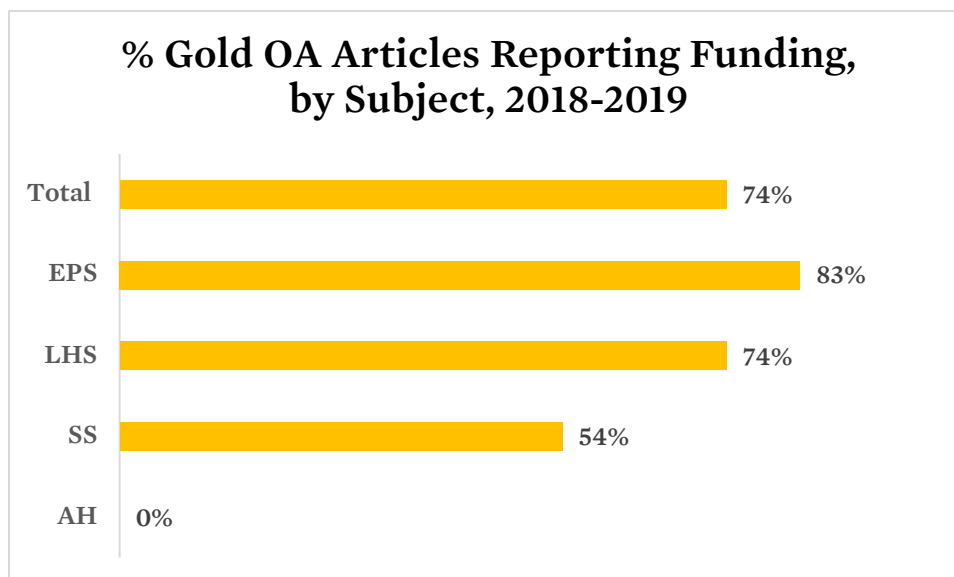
The majority of the Gold OA articles were published by authors in LHS fields. In the most recent year, 2019, 62% of the Gold OA articles were authored by LHS faculty, 26% by EPS faculty, and 11% by SS faculty (Chart 9). There were only two gold OA articles authored by AH authors in 2019.

Chart 9.



Based on Scopus data for 2018 to 2019, 74% of the Gold OA articles published by Berkeley authors reported receiving research funding (Chart 10). The highest percentage of Gold OA articles that reported funding are published by authors from EPS, 83%, followed by LHS, 74%, and SS, 54%. None of the three Gold OA articles by AH authors reported funding.

Chart 10.



The More Gold OA Articles Published, the Higher Support for OA

When asked in the Faculty Survey about how important it is that the journal make its articles freely available on the internet so there is no cost to read, 195 of the 479 authors, around 41%, indicated it was very important (Chart 11). They also produced the highest percentage of Gold OA articles: 21% of their publications were Gold OA articles. Neutral authors (40%) published 17% of their articles as Gold OA. Authors that did not consider it important to make their articles freely available, 19%, published 11% of their articles as Gold OA. Thus, faculty who publish more Gold OA feel more strongly that articles should be free to read, while those who publish less Gold OA place little importance on articles being free to read.

Chart 11.

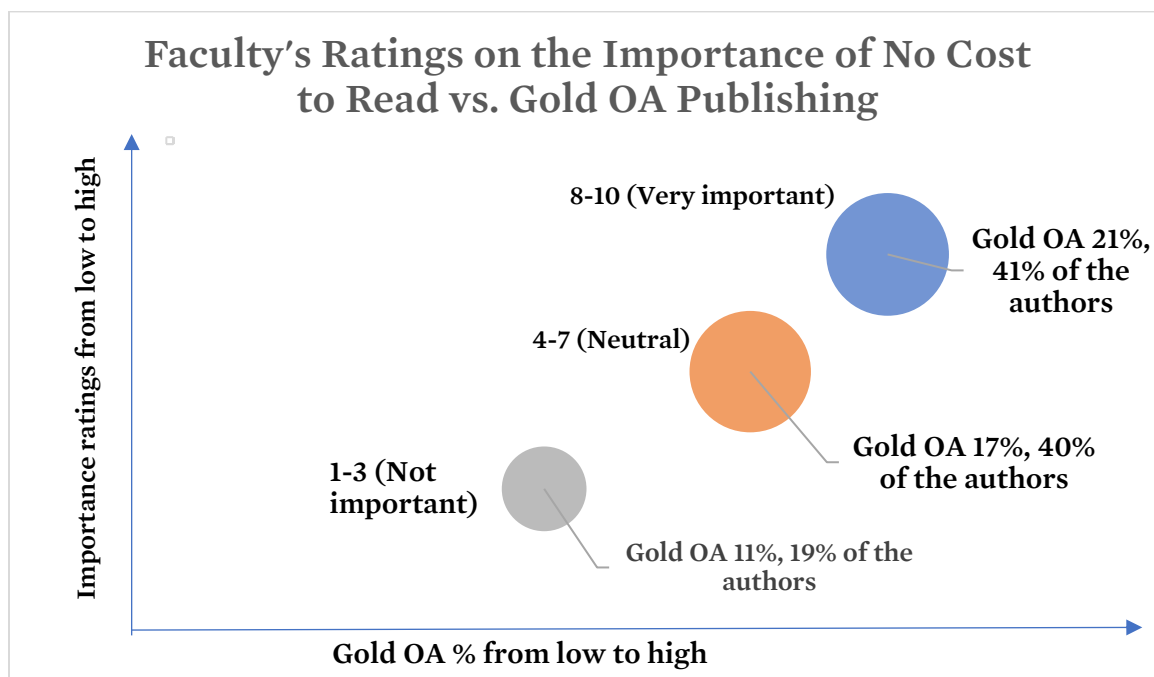
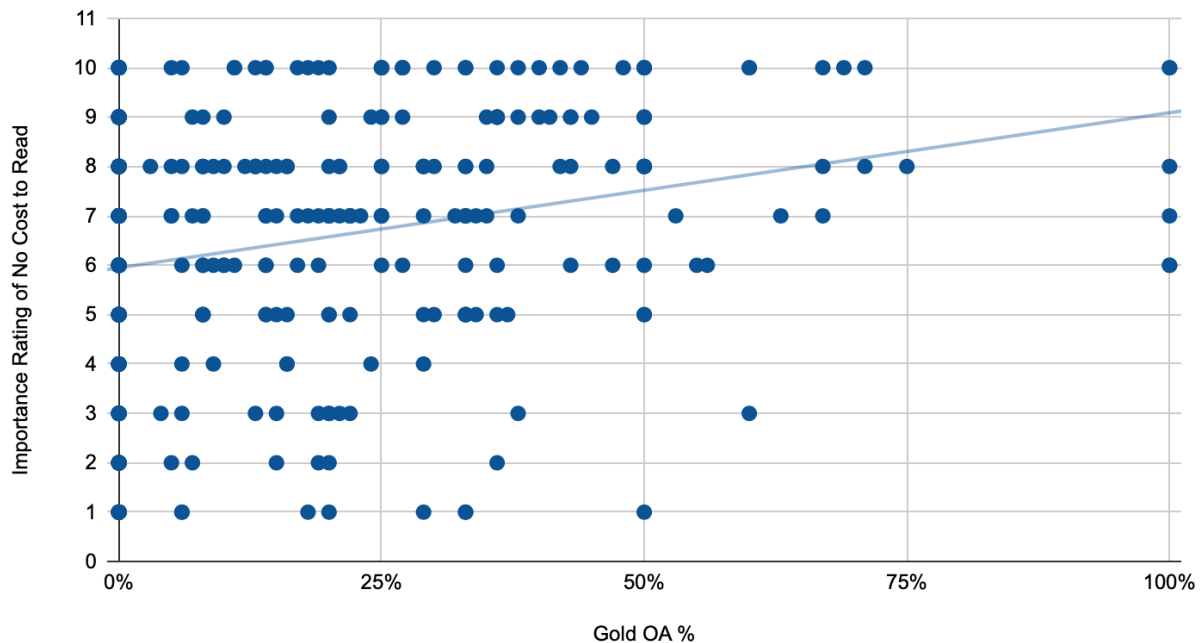


Chart 12 is another depiction of the correlation between faculty's Gold OA publication output and their support for OA, with circles representing each author. The upward trendline shows that the more Gold OA the faculty publishes, the more supportive they are toward OA. These authors may have experienced individual benefits of OA publishing, such as their articles having been read and cited more, or may feel a personal conviction that research should be openly available, or both. This agrees with other studies that found a positive relationship between OA publishing and pro-OA

attitudes.³⁴ These studies also found that peers influence authors to publish OA, so this positive relationship could lead to even more OA publishing at Berkeley.

Chart 12.

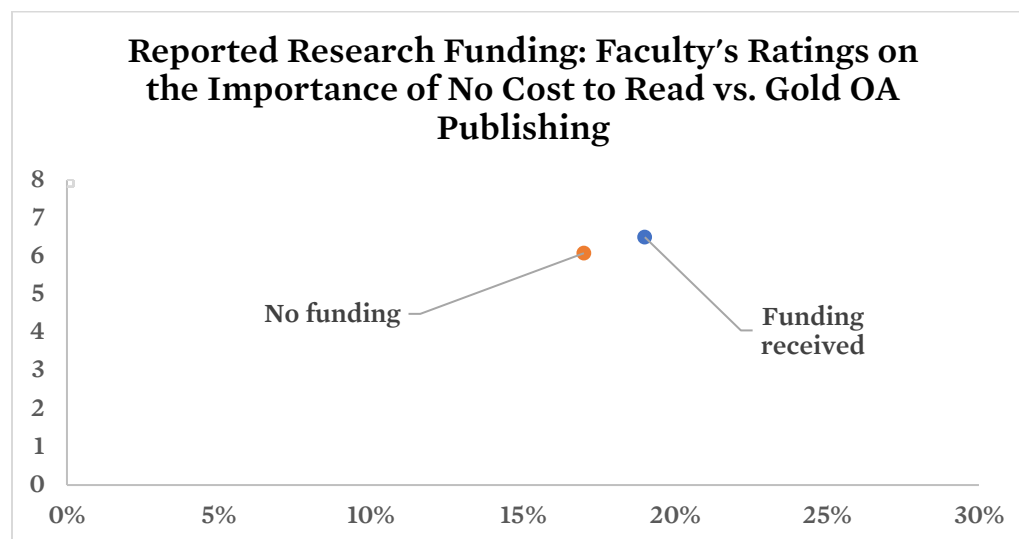
Correlation between Gold OA% and the Importance of No Cost to Read



Role of Research Funding

We also examined whether or not an article reported research funding and how that related to its OA status as well as the importance its author placed on articles being free to read. Faculty whose articles received funding considered OA slightly more important than the faculty whose articles did not (Chart 13). They also published more Gold OA. However, between the two groups, the differences in the Gold OA output and in the importance ratings for no cost to read are quite small.

Chart 13.

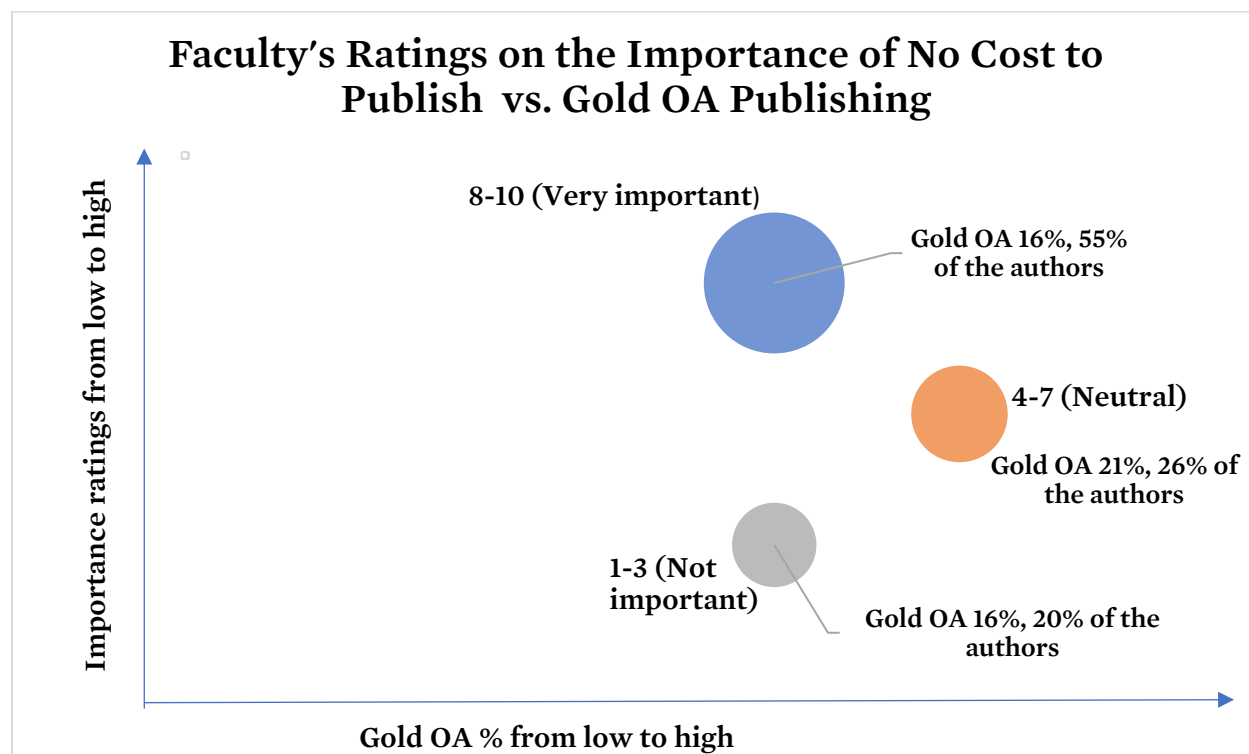


Olejniczak and Wilson³⁵ also found that researchers with grant funding were more likely to publish OA (both total OA, and Gold + Hybrid). Of the nearly 5,000 SOAP survey respondents who indicated a reason for not publishing OA, lack of funding for APCs was given as the most common reason for researchers in most disciplines.³⁶

Perceived Importance of No Publishing Costs

Even though Berkeley has a substantial OA output with Gold OA increasing, more than half of the faculty are still concerned about publication cost. When considering the importance of journals permitting scholars to publish articles for free (without paying APCs), 55% of the authors indicated this was very important, and 16% of this group's publications were Gold OA. The faculty that were neutral about cost to publish (26%) published 21% of their publications as Gold OA (Chart 14). Only 16% of the faculty considered publishing cost not important, and 20% of this group's publications were Gold OA.

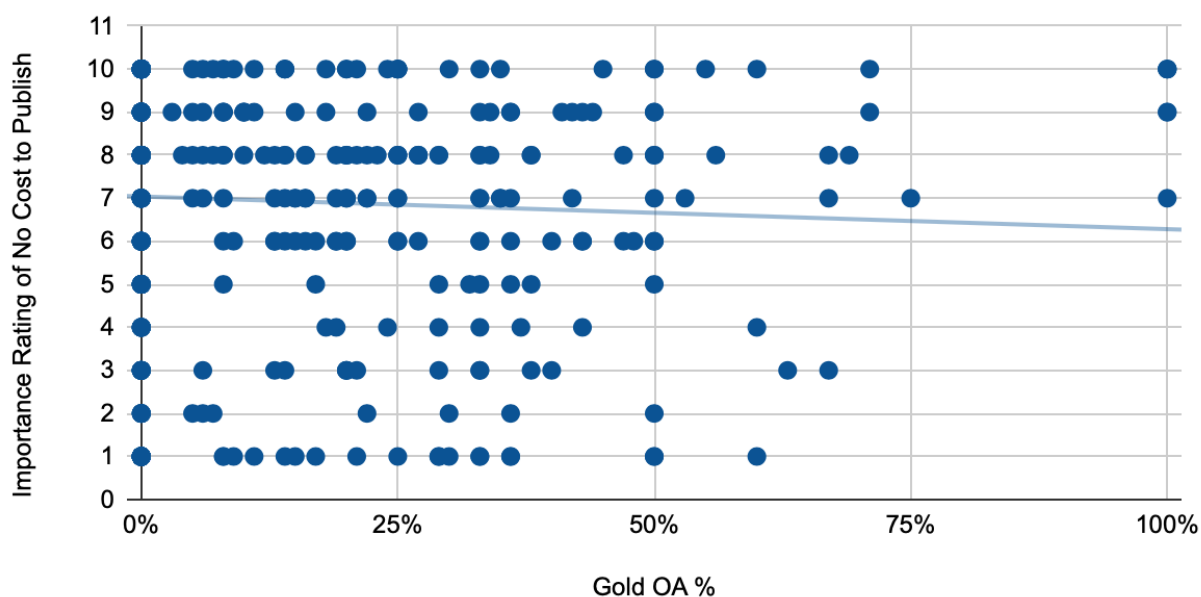
Chart 14.



There was a slight negative correlation between faculty's Gold OA publication output percentages and their perception of the importance of no cost to publish (Chart 15). The more Gold OA articles the faculty published, the less concerned they were about publishing cost. There was more variability in the relationship between faculty's Gold OA publication output percentages and their perception of the importance of no cost to publish than there was for no cost to read (Chart 12).

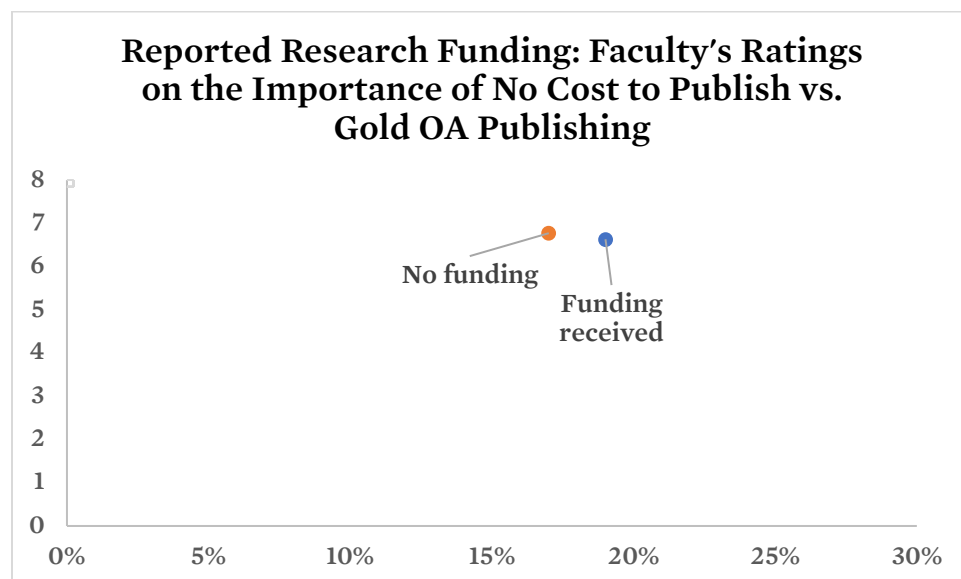
Chart 15.

The Correlation between Gold OA % and the Importance of No Cost to Publish



The data shows that the faculty whose articles did not report research funding considered no cost to publish slightly more important on average than the faculty with reported funding (Chart 16). However, the difference was quite small.

Chart 16.



The Ithaka Faculty Survey showed that Berkeley faculty, on average, are less concerned about paying APCs compared to their peers nationally (59% rated no cost to publish very important, compared to 70% nationally). The higher level of funding availability at Berkeley, shown in the Faculty Survey and in the high percent of articles reporting research funding, could make APCs more manageable for Berkeley authors. However, the 479 authors in our study viewed no cost to publish as slightly more important than no cost to read, an average of 6.7 vs. 6.5, and the importance level was high whether or not their articles reported research funding.

There are a number of factors that might explain why authors of articles reporting research funding are concerned about APCs. First of all, article-level funding information is not tied to individual authors. Second, faculty might have been thinking about their general funding situation when they rated the importance of no-cost publishing, which may or may not relate to whether the particular articles we found in Scopus were funded. Third, even Berkeley faculty who can afford APCs may have general concerns about APCs, thinking about, for example, other colleagues and their ability to pay.

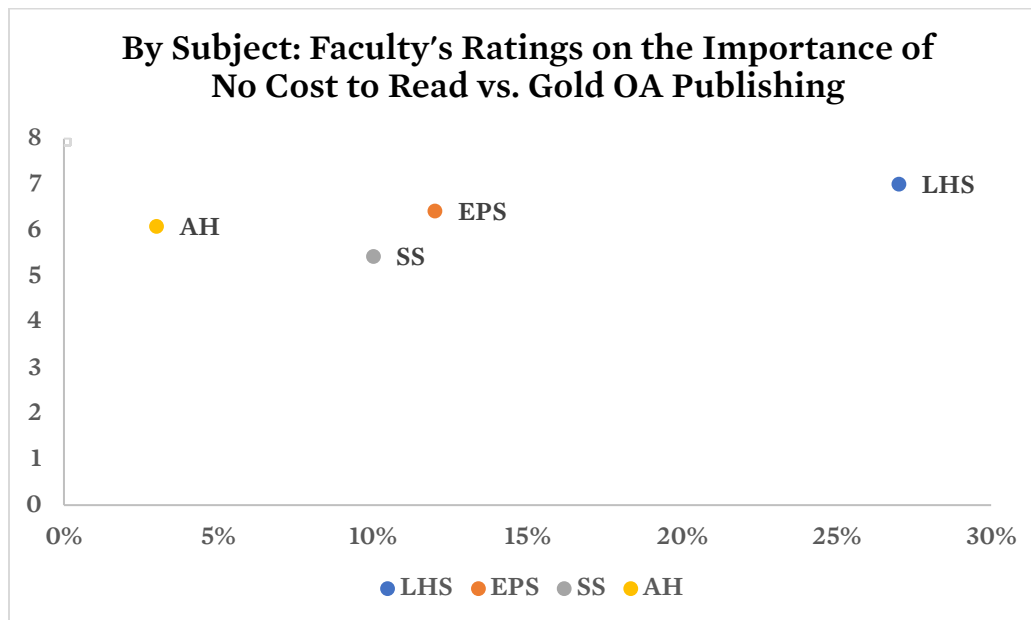
Lastly, even faculty who receive funding for their research might not want to, or be able to, allocate research funding for publishing costs. Of the 9,645 SOAP respondents who reported having paid APCs, only 28% said that the fees were included with their research funding, while 31% paid with research funds not meant for APCs, and 24%

reported that their institution had paid the APC.³⁷ We have found that authors of articles that report research funding in Scopus still apply to Berkeley Library's BRII program, which awards funds for APCs for articles in fully-OA (Gold) journals to researchers who lack other funding for APCs. This suggests that even if the research was funded, the funding may not be comprehensive, and there may not be money left for the APC by the time the study gets published. Further research looking into the other funding sources of BRII recipients might shed more light on these relationships.

Disciplinary Differences

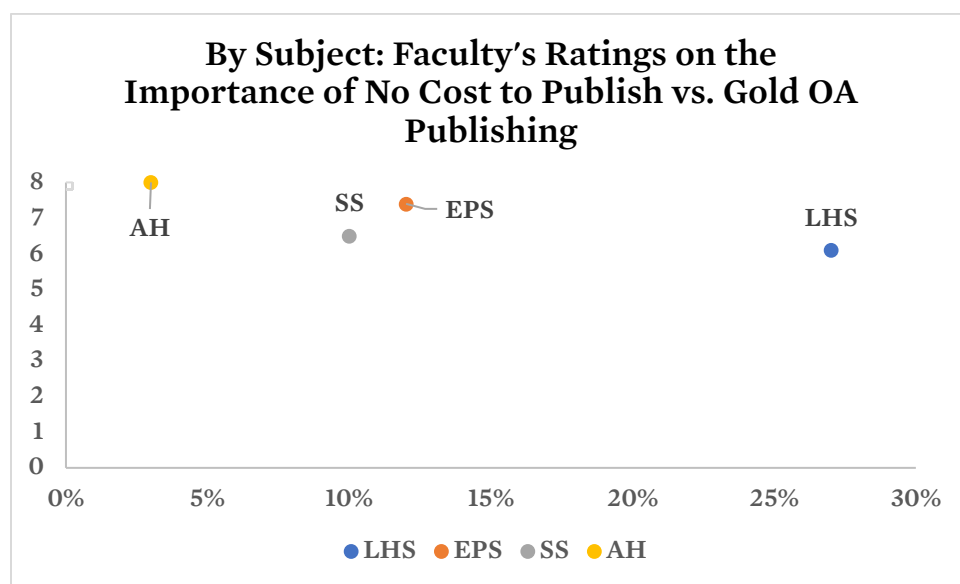
Among all the disciplines, LHS faculty not only are more supportive of OA, they also publish more gold OA articles (Chart 17). On average, LHS faculty rated higher the importance of no cost to read, and 27% of the LHS faculty's publications are Gold OA. AH faculty generated the lowest Gold OA output: only 3% of all the articles published by AH faculty are Gold OA. However, their support of no cost to read is not the lowest. The average rating of AH faculty on this survey question is close to EPS faculty and higher than SS faculty. Overall, the differences between the average rated importance among the subject groups ranged from 5.4 to 7.

Chart 17.



Faculty from different subject groups varied in the levels of importance they assigned to no cost to publish, with average ratings ranging from 6 to 8 (Chart 18). On average, AH faculty felt most strongly that articles should be free to publish, followed by the faculty from EPS. Faculty from SS and LHS considered being free to publish less important.

Chart 18.



Our LHS results agree with numerous other studies that have found that life and health sciences authors publish more OA and more Gold OA.³⁸ Erfanmanesh³⁹ found that the share of OA journals in Scopus is higher for LHS subject areas, which suggests that LHS authors have more options for Gold OA publishing. Larivière and Sugimoto⁴⁰ found that biomedical researchers had a higher rate of funding OA compliance than other disciplines, and that National Institutes of Health (NIH) had a higher OA compliance than other funders, with more than 40% of NIH funded research available via Gold OA. As one recent paper put it, “at least for the medical, life and natural sciences, OA mandates are usually combined with convenient open repositories for depositing articles and with sufficient funds for covering fees for publication in OA journals.”⁴¹ This contributes to a culture of OA publishing that may or may not correlate with positive OA attitudes on the part of individual authors.

EPS had a slightly smaller total OA percentage than LHS, but its Gold OA percentage was less than half of that of LHS. The culture of posting manuscripts in OA repositories (Green OA) that exists in some EPS subject areas like physics and math likely contributes to these differences. Studies have found that Green OA is the most common OA type for these disciplines, though not for chemistry and engineering, which tend to have lower levels of OA.⁴² Breaking up the EPS authors into specific disciplines could help us better understand OA publishing behavior in this subject group. Overall, EPS faculty felt more strongly that articles should be free to read than SS and AH, and more strongly that articles should be free to publish than both LHS and SS. This could imply that EPS faculty believe in OA, but, at least in some disciplines, prefer to make their research accessible through no-cost Green OA channels.

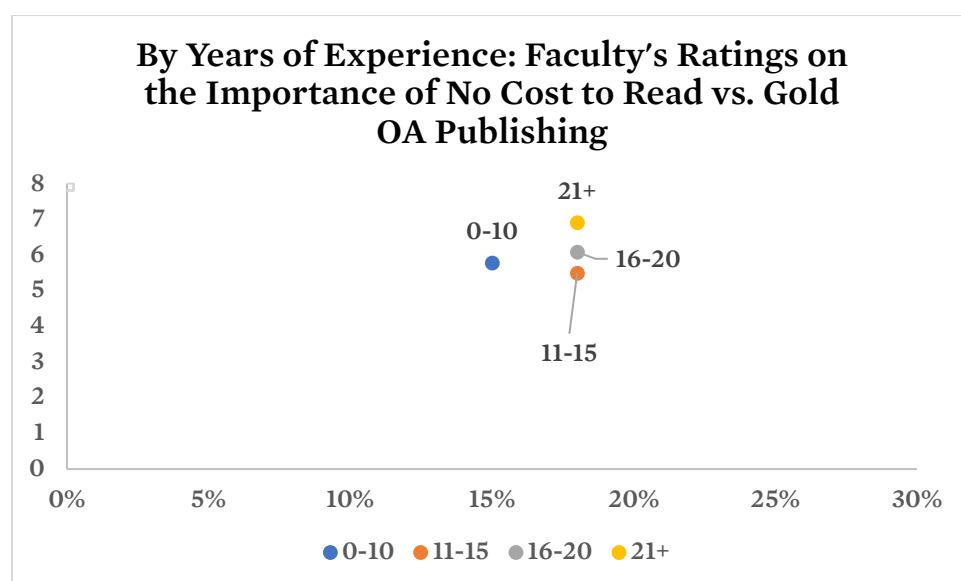
OA publishing in SS has been found to be higher than AH, but lower than most STEM disciplines, with Green OA being the most prevalent OA type;⁴³ our findings agree. We found that SS authors considered no cost to read to be less important when picking a publication outlet than the other three subject groups did, which is consistent with other studies that found low OA attitudes and publishing among SS researchers.⁴⁴ The infrastructure and culture of OA publishing is less established in the SS than in the sciences.⁴⁵ The 2010 SOAP survey found that lack of quality OA journals was more of a barrier to SS researchers' OA publishing than lack of funds, and not all OA journals in the social sciences require APCs.⁴⁶ Additionally, as our data showed, SS authors do not publish as many journal articles as their STEM colleagues.

Berkeley AH researchers were not well represented in our study since they authored few articles in Scopus, only 37% of which were OA with very little Gold OA. The AH authors in our study felt more strongly about articles being free to read than the SS authors, and more concerned about publishing cost than all three other subject groups. AH faculty lean heavily towards publishing monographs versus journal articles, which limits the number of their OA publications. Also, prestigious AH journals tend not to be Gold OA, and AH faculty, particularly those seeking tenure, may feel pressure to publish in prestigious journals. In addition, funding challenges likely contribute to their concern about publishing cost; according to the Faculty Survey, only 22% of AH faculty reported receiving external funding between 2013 and 2018.⁴⁷ Despite these impediments to Gold OA publishing, it is encouraging to see that Berkeley AH authors still made 37% of their publications OA, since Bosman and Kramer⁴⁸ found OA levels for AH researchers to be less than 20%.

Faculty Years of Experience

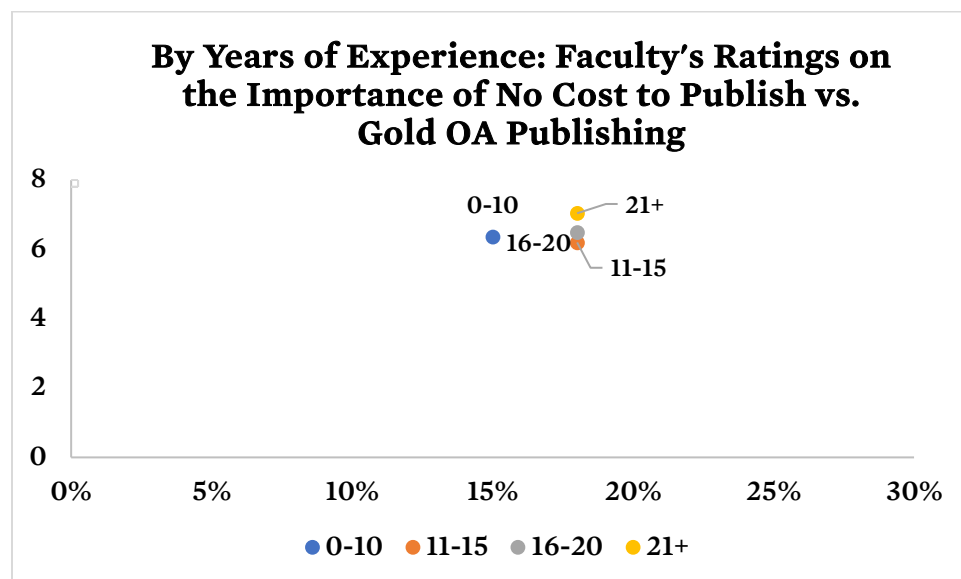
Faculty's support for journals having no cost to read varied by years of experience (Chart 19). Faculty with more than 21 years of experience demonstrated the strongest support for open access, with the highest ratings for the importance of no cost to read (6.9 on average). The differences in the level of support of OA among the three other groups with 0 to 20 years of experience are quite small, with the ratings ranging from 5.8 to 6.1. Looking at their Gold OA publication, faculty in the three groups with at least 11 years of experience have almost the same level of Gold OA publication output, with about 18% of their total articles being Gold OA. Faculty with 0–10 years of experience have a lower Gold OA publication output, with 15% of their publications being Gold OA.

Chart 19.



There were not many differences among faculty with different years of experience in their field on their perception towards no cost to publish (Chart 20). The average importance ratings for no cost to publish ranged from 6.2 to 7. The faculty with at least 21 years of experience rate the no cost to publish option slightly higher than their less experienced colleagues. As illustrated before, they were also the group who felt most strongly that articles should be free to read.

Chart 20.



More than half of the faculty authors in our study had more than 20 years of experience, and 61% of the publications in our study were associated with these experienced faculty. Due to low sample sizes for inexperienced faculty, it is harder to draw strong conclusions about their OA attitudes and behaviors. The group with the least experience, 0–10 years, had the lowest rate of Gold OA publishing. Less-experienced faculty, who are still trying to build their reputations, may be more focused on other journal characteristics, like the journal's reputation, than on OA. Additionally, publishing cost is of particular concern for early career researchers,⁴⁹ who may make their research available through other venues like Green OA or Academic Social Networks instead of paying APCs.

Value

Our study was small compared to large samples used to study patterns of OA publishing, and large surveys asking about OA attitudes and publishing preferences. However, it was unique in the way it linked attitudes and publishing practices for individuals, and for its focus on Berkeley. Despite its small size, our results generally concurred with other studies.

Our objectives were at least partially achieved, both through our study and our review of the literature: we learned methods to quantify OA publishing at Berkeley; we gained some insight into relationships between faculty's OA attitudes and OA publishing practices, including disciplinary differences; we have a better understanding of relationships between OA publishing and cost (to-read and/or to-publish).

There were a number of limitations in our methodology that impacted our ability to achieve our objectives. An important limitation related to Scopus coverage. Scopus reports that nearly three quarters of its content is in the STEM subject area,⁵⁰ and as discussed previously, Berkeley AH and SS authors were not well represented in Scopus. The uneven distribution of authors and, especially, articles means it is harder to generalize about Berkeley authors overall based on our results. Another limitation is that Berkeley authors were not necessarily first/corresponding authors, so they may not have made the decision on where to publish, directly received the funding associated with the article, or been responsible for the article's APC.

At the time we were analyzing the results of our study, we did a Scopus search for articles and reviews from 2016 to 2019 with authors affiliated with Berkeley. That search showed that 19% of the publications are Gold OA, which is comparable to the 18% Gold OA articles found in our study. Thus, the study's sample may at least be representative of Berkeley authors in Scopus overall.

Another limitation, which limited our ability to link OA attitudes and behaviors, was that looking only at Gold OA articles did not show all of the authors' deliberate actions to make their articles available. For example, we were unable to separate out Hybrid articles for which authors paid an APC to make the article immediately OA. Those articles represent a portion, but not all, of Unpaywall's Hybrid category. Also, articles that were immediately deposited in a repository, showing OA intention, would have been lumped together in Unpaywall's Green category with articles that became available after an embargo period. Unpaywall also does not capture articles that authors make available via independent sites like Academic Social Networks.

Another caveat concerning Unpaywall is that Akbaritabar and Stahlschmidt⁵¹ and Piwowar and colleagues⁵² found some discrepancies between Unpaywall data and the actual availability of article PDFs at publisher sites, with the latter study reporting that Unpaywall's data tended to underestimate actual OA levels. Thus, Unpaywall data may not be a perfect representation of an article's availability OA, and, for categories other than Gold, may just provide a snapshot of availability as licenses and embargos change.

Lessons Learned

OA at Berkeley

It was encouraging to see the strong support for OA and high rates of OA publishing at Berkeley. Not only is an above-average proportion of Berkeley-authored articles OA, the Ithaka Faculty Survey indicated that Berkeley faculty's support of OA is also above average (41% rated no cost to read very important, compared to 38% nationally). Although making articles free to read was not the journal characteristic that faculty rated most highly, the average importance for the 479 faculty in our study was 6.5 out of 10, which still indicates support for OA. Additionally, the top publishing characteristic for Berkeley authors in the Faculty Survey was that a journal is circulated widely and is "well-read by scholars in your field."⁵³ Wide circulation is, of course, a benefit of a journal being free to read, though researchers may not always make that connection.

One factor making an impact at Berkeley may be UC's Open Access Policy, and another may be the above-average ability of Berkeley faculty to secure research funding. Berkeley faculty who publish OA feel more strongly about it, so perhaps the experience of OA publishing spurs more OA publishing. Other journal factors are still more important to researchers than whether the journal is OA. It may take time before reputable Gold OA journals are available in all disciplines (and for Hybrid options in Closed journals) to be more widely available and more affordable. APCs are a concern for faculty in all subject areas, whether or not they have funding, so Berkeley Library's efforts to pursue transformative publishing agreements and prioritize funding for the BRIA program are appropriate. Of course, no-cost options such as Green OA and Academic Social Networks are also available to faculty who want to make their research more widely available.

Role of the Library

In the Ithaka Faculty Survey, 66% of Berkeley faculty respondents found it important that "the library provides active support that helps to increase the productivity of my research and scholarship."⁵⁴ Our study, and our review of the literature, gave us more insights into the roles libraries can play in boosting OA publishing. For example, libraries could address OA ambivalence by helping researchers recognize the difference between Gold OA and predatory journals.⁵⁵

Establishing dedicated APC funds and negotiating transformative agreements with publishers are ways libraries can help alleviate barriers posed by expensive APCs, since encouraging researchers to budget for APCs in their grants may not be enough. Transformative publishing deals covered APCs for only 3% of papers produced globally in 2020,⁵⁶ but as more and more of these agreements are reached, their role in OA will grow.

Additionally, making processes related to repository deposits and funding APCs as easy and straightforward as possible is important, since some researchers are inhibited by a lack of confidence in their copyright knowledge and by overly cumbersome processes.⁵⁷ Helping researchers understand copyright and their author rights is valuable, but easier, more automated systems requiring fewer decisions from researchers may be more impactful in increasing OA.

Lessons from the Research Process

This project showed us that studying OA is more complicated than it originally appeared. In the literature, there was a lack of consistency in definitions of OA, sources of OA data, and methods for calculating levels of OA. Not only does an article's OA status shift over time, but tools like Scopus change in what data they provide and how to access it.

We plan to make use of our improved understanding of the available data and methodology as we continue to assess OA publishing at Berkeley. For example, UC recently signed transformative publishing agreements with a number of publishers. Going forward, we can monitor what impact this has on overall OA levels at Berkeley and perhaps take a more thorough look at Hybrid OA. We could also monitor how Gold OA publishing evolves in non-science disciplines where the availability of OA journals has lagged. Our deeper understanding of OA data and methods also allows us to better critique methodology used in other studies.

Recommendations for Future Research

We realize that our conclusions and findings are more applicable to science faculty, since their articles were the bulk of our study. Exploring other methods to assess the OA publishing of SS and AH faculty would be important for anyone trying to do a similar study meant to apply to all faculty. Additionally, looking at author-pays Hybrid OA, proactive deposits to Green OA repositories, and sharing via Academic Social

Networks would be useful additions to Gold OA to assess intentional OA behavior. However, those paths to an article being free to read are harder to measure.

Attitudes towards OA publishing expressed in the 2018 Faculty Survey are likely not representative of Berkeley faculty currently. Faculty's perceptions of OA evolve, influenced by institutional support for, and attention to, OA publishing, as well as changes to the publisher and funder landscapes. If we wanted to do any further work linking attitudes and publishing behavior, we would want to use data from a newer Faculty Survey, or come up with another way of assessing attitudes toward OA publishing.

We do feel like tools and methods we used can be useful for librarians wanting to look at OA publishing practices for faculty in the sciences. Database products like Scopus evolve, so it may become easier to obtain accurate funding and OA status data from one source; for example, the OA status information in Scopus is now more granular than it was when we collected our data. However, the following caveats apply:

- Due to the tendency of science articles to have many authors, there will always be limitations in what you can infer, since not every author is linked to funding or involved in choice of journal. Limiting to the first or corresponding author may help address this, though it would also decrease the sample size.
- Looking within the science subject groups at individual disciplines may provide more insights into differences in OA attitudes and behaviors. However, dividing the data into smaller groups leads to smaller samples.
- OA mandates, particularly from research funders, are an important driver of OA behavior in the sciences, which complicates linking OA publishing to OA attitudes.
- We found that looking at reported research funding was not particularly informative, since much of science research gets at least some degree of funding. However, contemplating this has inspired us to try to gather more information from our BRII recipients on the relationship between receiving research funding and being able to pay APCs.

For the reasons discussed above, we would not recommend replicating this study. However, we hope our experience can inform others, since there is more to learn regarding OA publishing and its adoption by faculty.

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