Attitudes of North American Academics toward Open Access Scholarly Journals

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abstract: In this study, the authors examine attitudes of researchers toward open access (OA) scholarly journals. Using two-step cluster analysis to explore survey data from faculty, graduate students, and postdoctoral researchers at large North American research institutions, two different cluster types emerge: Those with a positive attitude toward OA and a desire to reach the nonscholarly audience groups who would most benefit from OA ("pro-OA"), and those with a more negative, skeptical attitude and less interest in reaching nonscholarly readers ("non-OA"). The article explores these cluster identities in terms of position type, subject discipline, and productivity, as well as implications for policy and practice.

Introduction

Publishing research results makes up a large part of scholarly identity for those in academia. Particularly in an atmosphere of "publish or perish," publishing may also propel a career toward tenure, promotion, and beyond.[1] Choices made about channels of scholarly communication, therefore, are important to academic careers. Given the pace of change in scholarly publishing, understanding researchers' perceptions, knowledge, and attitudes toward the various and emerging publishing formats helps publishers, librarians, administrators, and others make decisions about the future. Librarians play a key role in shaping both open access (OA) education and OA policy on campuses.[2] Understanding the nuances and needs of different types of scholars can enhance the focus of the education and policy efforts that lie at the core of the library's mission.

Scholars disseminate their work in a variety of ways,[3] including word-of-mouth conversations, conference presentations and posters, academic journal publishing, and

self-archiving through personal Web pages or such outlets as ResearchGate, Academia.edu, and arXiv. Authors across different disciplines and academic cultures also have differing ideas about what constitutes "publishing."[4] These ideas may be discipline- or institution-specific, and they may have implications for policies, such as those related to tenure and promotion. Journal publishing is the dominant channel in biomedicine and most natural sciences, while conference proceedings are important in engineering and computer science. In some areas of social science and humanities, monographs and book chapters are foremost.

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The current study, which was funded by a grant from the Andrew W. Mellon Foundation, examines the attitudes and opinions of authors working in research-intensive universities toward publishing in fully open access journals. Open access journals are defined here as those where the full articles are freely available on the Web immediately and with no restrictions, and often with liberal reuse rights. The term *gold OA* is frequently used to describe publishing in such journals as opposed to publishing in subscription journals with deposit of free manuscript copies in repositories (also known as *green OA*).

It is important to understand the factors that drive academic authors' choices when it comes to publishing their research outputs, including policy mandates, discipline, and experience level. This study analyzes attitudes toward OA using a quantitative cluster analysis to see how different types of authors group, based on items designed to capture their views. Specifically, it asks:

Research question 1: How do subjects cluster by opinions and attitudes about OA publishing?

Research question 2: How do resulting clusters differ in terms of academic position type, subject discipline, and productivity?

Literature Review

Historically, scholars' decisions about journal publishing outlets can be separated into two different eras because the advent of e-journals brought many new factors into consideration. Prior to the 1990s, during the age of print-only journals, in addition to reaching the right audience, authors considered only the speed of publication, scholarly reputation, and the physical paper quality of the journal. The advent of e-journals in the 1990s meant new possibilities and considerations for authors and readers.[5]

Open access publishing of scholarly journals started as soon as electronic publishing on the Internet became technically viable, around 1993. In the early years, major subscription publishers still distributed only print journals. Open access journals were founded

in niche areas by individual scientists or groups of researchers who were enthusiastic about the potential of the new medium for free global knowledge dissemination.[6] Just after the millennium, new professional OA publishers, such as PLOS (Public Library of Science) and BioMed-Central, emerged. Many of these publishers used article processing charges (APCs) to fund their operations. Page charges had already been common for decades in some

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subscription journals, particularly the journals of professional associations, but APCs were a new concept in some disciplines. Also in the first decade of this century, many society- and university-published journals, particularly outside the United States and United Kingdom, started making the electronic version of their journals open access, while continuing to sell or deliver paper copies to subscribers or society members. Since 2010, major developments in e-journals have included the rise of OA megajournals (for example, *PLOS One*), increased offering of APC-funded OA journals by major commercial publishers, the emergence of individually paid OA articles (hybrid OA), and, unfortunately, the rise of predatory OA publishers[7] who try to collect APCs for journals without offering true peer review.

Today, 18 percent of journals indexed in Scopus are fully open access, although the proportion of articles published in them is slightly lower. Just over 25 percent of the more than 12,000 journals listed in the Directory of Open Access Journals (DOAJ), a website that offers a crowdsourced list of open access journals, charge APCs.[8] However, since the journals that ask for APCs tend to have bigger volumes, the share of articles for which APCs are paid is much higher. In the early years, many scholars did not trust OA journals to be peer-reviewed at all.[9] For a long time, only a handful of OA journals were indexed in the Web of Science

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and received impact factors, which limited the willingness of authors to submit papers to such journals. *PLOS One* grew rapidly after it first received an impact factor in 2010. Currently, many viable, high-quality OA journals have high impact factors, particularly in the life sciences.[10]

Open Access Publishing Policies

The current study focuses on faculty, graduate students, and postdoctoral researchers at research-intensive universities within North America. The landscape of data sharing and publishing mandates varies, however, by both institution and geographic location and can impact authors' publishing choices. While encouraging or even requiring open access to research outputs does not guarantee author compliance,[11] it is worth examining

the scope of these policies as they vary across geographic regions. Looking at the number of OA policies across continents and countries, ROARMAP (Registry of Open Access Repository Mandates and Policies) reports 157 separate policies in North America, with 130 in the United States and 27 in Canada. By comparison, there are 463 across Europe.[12] Policy makers include both funding agencies and research organizations.

In North America, Canada led the way in establishing policy for publicly funded research. Currently, the International Development Research Centre and Canada's three major research agencies require either open access publication or availability of research outputs in a digital repository with a maximum 12-month embargo.[13] In the United States, the National Institutes of Health's policy has been in effect since 2008. It requires all articles (or manuscript copies) resulting from funded research to be deposited in and freely available within a maximum 12 months in PubMed Central.[14] The National Science Foundation (NSF) calls for research outputs to be available in a public access compliant repository designated by the NSF within 12 months of initial publication.[15] One of the most prolific private funders, the Bill & Melinda Gates Foundation, asks that both results and data be available immediately upon publication with no embargo period.[16] In the United Kingdom, the research charity Wellcome has similar requirements.[17] Both the Gates Foundation and Wellcome recently announced that they will no longer cover APCs for hybrid OA journals.[18]

In the European Union, Plan S is the most recent and radical open access initiative. Beginning on January 1, 2020, the plan required that all publicly funded research from leading national research funding agencies in the United Kingdom, France, the Netherlands, and eight other European nations be published in open access journals or made available through an open access platform. The plan and its proposed implementation policies have created controversy because researchers with grants would potentially be barred from publishing in subscription or hybrid journals.[19] Among public and private funders worldwide, more major agencies and research institutions have moved toward creating their own repositories to house research outputs. This may impact authors' motivation to choose OA journal outlets because their research could also become available via green OA copies, although the availability of repositories does not seem to erode the importance of publishing in peer-reviewed journals.[20]

Discipline, Generational, and Attitudinal Factors

The attitudes of academic authors choosing in which journals to publish have been explored in such projects as the Elsevier Author Feedback Programme[21] and the Ithaka S+R Faculty Survey series.[22] According to Elsevier's annual studies, authors are motivated by a journal's refereeing quality and speed of publication, followed by its perceived reputation and impact factor. In 2010, Bryna Coonin and Leigh Younce also found the fit and reputation of the journal important.[23] Fit, quality, and the journal's speed of publication were the dominant factors discovered by David Solomon and Bo-Christer Björk in 2012.[24] According

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to the Ithaka S+R studies, factors that have held steady in importance to authors over the years are that a journal is widely circulated and read within the scholar's field, as well as having a high impact factor. Interestingly, whether a journal is open access is not a high consideration among academic authors when evaluating publishing outlets.[25] Even the most recent Ithaka survey (containing data from 2018) found that only 4 in 10 authors rate OA as a highly influential consideration when choosing a journal outlet.[26] This raises questions about differences in the importance of accessibility and readership across institutions, position types, and disciplines.

Determinants of researchers' publishing attitudes and behaviors are multifaceted. For instance, an author's personality may impact his or her perceptions, intentions, and behaviors regarding open access publishing. Both agreeableness and conscientiousness directly affect trust in and perceived quality of open access outlets.[27] These same factors also impact the desire to keep research accessible to wide audiences and to maximize citations and recognition from peers.[28] Larger institutional and cultural factors also come into play, particularly OA policies, disciplinary practices, and generational norms.

Books, monographs, conference proceedings, journal articles, and other formats vary in importance from field to field, as does the perceived value of open access.[29] Cultural influences determine publishing practices and traditions, wherein different types of communication outlets vary in perceived credibility, usefulness, and need. Findings from the United Kingdom's 2011 Study of Open Access Publishing (SOAP) project showed that, based on publisher and DOAJ data, STEM (science, technology, engineer-

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ing, and mathematics) disciplines dominate the open access market. At the same time, international survey data indicated that over 90 percent of scholars in humanities and social science expressed that their fields would benefit from the availability of open access publications.[30] Another survey of U.S. authors who had published in OA journals in psychology, business, music, and women's studies found that nearly 15 percent of respondents had never heard of OA despite having published in an OA journal. Social science may be slower to adopt OA as a legitimate publishing model due to a lack of substantial grant funding to cover APCs or because of the close association between payment and "vanity" publishing.[31] It should be noted, however, that most humanities and social science OA journals listed in DOAJ do not charge APCs. The SOAP survey found that scholars in education, psychology, social sciences, and business were more concerned about the quality of available OA journals. Those in biology, medicine, chemistry, physics, and earth sciences, on the other hand, expressed greater apprehension about funding APCs.[32]

In their 2010 study, Diane Harley, Sophia Krzys Acord, Sarah Earl-Novell, Shannon Lawrence, and C. Judson King analyze interview data from 160 academics at 45 elite research institutions to provide a more nuanced view of scholarly communication across different fields.[33] Many scholars in biology and other sciences regard OA as a possible answer to the "serials crisis"—the rapidly increasing cost of journals plaguing scholarly

publishing and blocking the flow of scientific knowledge.[34] In other fields, participants did not express a need for OA. For example, those in astrophysics and political science operate in cultures where working papers and society-owned journals provide most of the necessary access to scholarship. In music and history, authors felt that most relevant scholarship was already published by scholarly societies, providing ample access for their intended audiences. [35]

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Younger and early career researchers, both students and faculty, are more interested in OA and tend to be more sympathetic to open research principles than older, more experienced faculty.[36] A 2005 international study by the CIBER (Centers for International Business Education and Research) research group surveyed nearly 4,000 academics, finding that older authors had less knowledge of OA and were generally less positive about it as a future publishing model than younger authors were.[37] Coonin and Younce's 2009 survey of social science authors found that many older academics considered OA journals less prestigious that traditional journals.[38] When it comes to actual publishing behavior, however, more recent studies show that early career researchers are often "shackled by convention," aiming to publish their work in well-established journals and acquiescing to the guidance of senior mentors. A 2017 study involving in-depth interviews with 116 early career academics reveals that, although they believe OA is a good idea, they would rather strive for higher impact factors and reputational credit.[39] This is not surprising given the vulnerable position of young researchers in their fields. Sticking to conventional publishing norms is the safest way to establish credibility.[40]

The proliferation of predatory journals in the past seven or eight years has cast a shadow over the world of academic publishing.[41] These journals exploit the author-pay publishing model and can be especially disorienting for the young and inexperienced scholars they most frequently target, who often fall prey to their demands. In a 2018 qualitative survey of 96 authors who had published in predatory journals, Serhat Kurt found that most are junior researchers from the developing world who act based on a need for affiliation, unawareness, high pressure to publish, and a lack of research proficiency.[42] The mushrooming of predatory journals has generated suspicion toward even legitimate open access publication outlets. David Nicholas, Blanca Rodríguez-Bravo, Anthony Watkinson, Cherifa Boukacem-Zeghmouri, Eti Herman, Jie Xu, Abdullah Abrizah, and Marzena Świgoń interviewed international early career researchers. The team posits that, due to a lack of familiarity with OA models, early career researchers in certain countries (for example, China) and disciplines (non-STEM) more likely associate OA with illegitimate "pay-to-play" journals.[43] This conflation threatens the open access model by undermining the perceived credibility of these journals and potentially damaging trust in any outlet which asks APCs.[44] These perceptions feed into cultural norms within different fields that determine which types of publication outlets are acceptable and can impact shared attitudes toward the open access publishing model.

Given the pace of change in the scholarly publishing world, the current study sought to understand how faculty, graduate students, and postdoctoral researchers across different disciplines at research-intensive universities view open access publishing in terms of their own scholarly communication behavior and beyond. Though previous research has examined the attitudes and beliefs of authors regarding OA, this study combines OA attitudes and familiarity with the additional factors of audience reach and the possibilities within an all-OA future to gain a more nuanced understanding of authors' perceptions.

Methods

Questionnaire Development

The content of the survey was informed by focus groups conducted prior to the survey at five North American research universities. These universities were collaborators in a large-scale research project, funded by the Andrew J. Mellon Foundation, in which faculty participated in surveys and focus groups and the universities provided journal subscription data to inform a hypothetical open access financial model for libraries.[45] The survey itself was created to inform that larger project. The study focused on large North American research-intensive universities because they produce a significant portion of the world's scholarship; therefore, as key players within the scholarly publishing marketplace, the resulting economic model could potentially be scaled to explore the feasibility of an OA conversion at different types of research institutions. Two focus groups were conducted at each university, one consisting of faculty and the other comprised of graduate students and postdoctoral researchers, for a total of 10 groups. Focus group participants came from a variety of arts, humanities, social science, and natural science departments and colleges. The goal of the focus groups was to gauge academics' understanding regarding OA publishing models and to gather information upon which to base the survey wording.

With this qualitative focus group data, the authors drew on the emergent topics, terminology, and scenarios to develop a focused survey instrument. The survey questions represented a more distilled, quantifiable exploration of the issues discussed in the focus groups. The authors developed the survey instrument during May 2015 with additional input and approval from the economic modeling team and principal investigator of the grant project. They used Qualtrics software to develop and distribute the online survey via an e-mailed link. Before launching the live survey, they sent links to a small subsample of academic researchers (faculty and graduate students, $n = 30$) at the four of the five focus group universities that participated in the survey. Multiple rounds of development and pilot testing ensured clear language and logical ordering of questions and helped mitigate any technical problems with the survey link. The survey ranged from 20 to 30 questions, dependent on skip logic and the subjects' demographic information. The full questionnaire can be found at the University of Tennessee's institutional repository, TRACE (Tennessee Research and Creative Exchange).

Sample

The authors aimed to achieve a representative sample of scholars from a broad range of subject disciplines. Three universities that participated in the survey were in the United States and one in Canada. Respondents included faculty, graduate students, and postdoctoral researchers. To participate, all respondents needed to be either employed as faculty or staff or enrolled as a graduate student at the university. The survey went to approximately 15,000 academics, resulting in 2,121 responses. For this analysis, the authors decided to include only PhD students, postdoctoral researchers, assistant professors, associate professors, and full professors, because these groups were significantly more active in publishing than other groups, such as masters' students, reducing the dataset to N = 1,819. Each item included in the analysis, all measured on a 1- to 5-point scale of agreement, also had a sixth answer option for "not sure" or "not applicable." Responses that answered with this sixth option were counted as missing because no level of agreement was indicated. Participants with missing data were automatically excluded from the cluster analysis, so the final N = 822 (see Table 1).

Table 1.
Participants' academic positions and disciplines

Academic position	*n* (%)
PhD student	279 (33.9%)
Postdoctoral researcher	94 (11.4%)
Assistant professor	103 (12.5%)
Associate professor	98 (11.9%)
Professor	248 (30.2%)
Total	**822 (100%)**

Discipline	*n* (%)
Arts/Humanities	85 (10.4%)
Engineering/Computer science	124 (15.1%)
Life sciences/Medicine	310 (37.9%)
Physical sciences	88 (10.7%)
Mathematics	17 (2.1%)
Social science (including business, education, and law)	195 (23.8%)
Total	**819 (100%)**

Procedures

As an incentive for participation, there was an option to be included in a prize drawing for an iPad mini. Participants were informed of this option within both the recruitment e-mail and the informed consent statement. After pilot testing, the authors relied upon librarian distributors at the four participating universities to launch the actual survey. After receiving the live Qualtrics survey link, one key librarian distributor at each of the four universities sent the link to all faculty via specific e-mail distribution lists that would ensure roughly equivalent sampling across different disciplines and position types (for example, faculty or graduate students). The survey remained open for approximately three weeks (May 20 to June 10, 2015). After two weeks, the librarian distributors sent an e-mail thanking those who had already participated and reminding others to take part.

Two-Step Cluster Analysis

Cluster analysis is a way of finding groups in data.[46] As an exploratory technique, it can partition and organize large quantities of multivariate information into groups, or clusters. It has traditionally been embraced for its ability to form relatively homogenous groups from heterogeneous entities, which can then be labeled to aid in classification and understanding of these groups.[47] The investigators chose two-step cluster analysis because of its ability to handle large data sets and because the analyst need not specify the number of clusters first. The two steps involve first grouping original data into preliminary clusters, which replace the raw data for hierarchical clustering. The second step involves grouping the preliminary clusters using the standard agglomerative clustering algorithm. Then, using Gideon Schwarz's Bayesian information criterion, a statistical tool used to choose among competing models, this range of solutions is reduced to the optimal number of clusters.[48]

Once the clusters had been formed, the investigators could examine the means and distributions of each item within the clusters to develop a label and interpretive description of each subgroup's profile. For the purposes of this study, it is useful to understand the profiles of these groups to gauge different scholars' attitudes toward the OA model of publishing. Therefore, it will be important to look at how subjects' positions and areas of study are distributed within the clusters.

Variables

Prior to the survey section specifically addressing OA publishing, both open access and article processing charges were defined as follows:

> Open Access is a form of publishing that allows unrestricted access to peer-reviewed scholarly research. Within this model, publishers may be compensated for their efforts by the author(s) or his/her institution(s) at the point of publication rather than charging subscription fees for access to their journals. An article processing charge (APC) is the fee that is typically paid by or on behalf of the author(s) to publish in an open access journal.

The current data set consists of relevant demographic information, attitudes and behaviors related to OA publishing, the audiences these scholars want to read their research, and questions that assess their opinions about OA publishing and what a po-

tentially all open access future would mean for them as scholars. For this analysis, the authors used SPSS version 24 to create clusters using 13 variables (items) pertaining to scholarly publishing: general opinions about OA publishing, the audience groups subjects care about reaching, and future open access scenarios. Specifically, the "OA opinions" items asked subjects to indicate their level of agreement with three different statements; however, only two of these were deemed relevant for this study because the third was more directly related to specific APC amounts. Items about reaching audience groups were introduced with "For each of the following groups, how important is it to you that they are able to access your research publications?" Items pertaining to opinions were introduced with the heading: "Finally, suppose the journals in which you typically publish became fully open access with article processing charges. If this were to occur, please indicate your level of agreement with each of the following scenarios" (see Table 2 for items). An item that asked participants to rank the importance of OA in selecting a journal was also included, as well as one indicating their level of familiarity with the OA model. None of these 13 items constitute validated scales but instead are groupings of statements meant to capture attitudes toward OA publishing.

Once clusters were formed, the investigators examined differences among cluster subgroups in terms of both categorical and continuous factors using Pearson's chi-square and independent samples t-tests. Categorical variables of interest include position type (PhD student, postdoctoral researcher, assistant professor, associate professor, or full professor), and area of study (arts or humanities, life sciences or medicine, social science, physical sciences, engineering/computer science, and mathematics).

Results

The current two-step cluster analysis yielded a two-cluster solution as the best model—that is, the optimal generalization—for the data. Therefore, the data indicate two basic types of subjects in their attitudes toward OA. One cluster contains 589 cases (71.7 percent), and the other cluster comprises 233 cases (28.3 percent). Table 3 provides the results of auto-clustering. Although the lowest Bayesian information criterion coefficient is the four-cluster solution, the SPSS algorithm shows that the two-cluster solution has the largest ratio of distance measures and is therefore optimal. Table 2 shows the mean scores on the final cluster centers for each scholarly publishing item in the two clusters. All but one of these, "Familiarity with OA," differed significantly between the two clusters. Tables 4, 5, and 6 show the subjects' scholarly profiles based on position type, subject disciplines, and productivity within each cluster in terms of proportion percentages.

Discussion

This is not the first study to examine author perceptions of OA journals, but with the rapidly changing landscape of scholarly publishing, it is important to continue asking about the needs and feelings of academics regarding dissemination of their work. In addition, this study is unique in its amalgamation of general attitudes, views to the future, and the importance of different audiences as indicators of the overall value of OA publishing to authors. After examining the means within each cluster, the investi-

Table 2.

Item means in cluster 1 (pro-open access or pro-OA) and cluster 2 (non-open access or non-OA)*

Item	Pro-OA (n = 589, 71.7%)	Non-OA (n = 233, 28.3%)
General OA opinions		
Paying article processing charges for open access is a reasonable alternative to subscription fees.	3.34	1.74
In general, articles published in open access journals are of lower quality than those published in subscription based journals.	2.76	3.88
Future OA scenarios		
More people would read and use my research.	3.75	2.09
The overall quality of published research would increase.	2.87	1.53
People from institutions with less funding would have limited ability to publish.	3.84	4.64
I would find alternative ways to publish my research.	2.95	3.64
There would be increased media coverage of scholarly research.	3.05	1.78
My ability to publish would be limited.	2.81	4.10
Importance of groups' access to research		
Practitioners in industry and business	3.89	3.39
The general public	3.56	3.12
Policy makers in government or NGOs	3.86	3.60
Other		
Familiarity with OA	3.58	3.44
Importance of OA as a journal attribute	3.17	1.91

*Pro-OA designates participants with a positive attitude toward open access, and non-OA indicates those with a more negative, skeptical opinion. Independent samples *t*-tests show that all differences are significant at the $p < .05$ level except for "Familiarity with OA." Significance is based on two-tailed tests.

Table 3.
Results of auto-clustering

Number of clusters	Schwarz's Bayesian information criterion (BIC)*	BIC change†	Ratio of BIC changes‡ measures§	Ratio of distance
1	2776.792			
2	2514.958	−261.834	1.000	2.144
3	2473.989	−40.969	0.156	1.079
4	2447.222	−26.767	0.102	1.583
5	2486.379	39.157	−0.150	1.594
6	2567.636	81.257	−0.310	1.076
7	2653.872	86.235	−0.329	1.312
8	2755.790	101.919	−0.389	1.071
9	2861.053	105.263	−0.402	1.135
10	2971.908	110.855	−0.423	1.113
11	3086.969	115.061	−0.439	1.120
12	3206.002	119.033	−0.455	1.012
13	3325.432	119.430	−0.456	1.035
14	3445.973	120.541	−0.460	1.163
15	3570.949	124.975	−0.477	1.050

* Schwarz's Bayesian information criterion is a statistical tool used to choose among competing models.
† The changes are from the previous number of clusters in the table.
‡ The ratios of changes are relative to the change for the two-cluster solution.
§ The ratios of distance measures are based on the current number of clusters against the previous number of clusters.

gators determined that one cluster consists of subjects with a more positive opinion of OA publishing and therefore labeled it the "pro-OA" cluster. The other cluster can be characterized as a more negative or skeptical view of this model and has been labeled the "non-OA" cluster. Looking at this set of survey items collectively, the data indicate that OA publishing is a polarizing topic. There is no distinct third cluster of participants to represent neutral attitudes.

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Cluster Profiles

To further elaborate, the items included in the analysis can be categorized as having either a positive or negative valence regarding OA journals (see Table 2). For example, agreement with the opinion item "Paying article processing charges is a reasonable alternative to subscription fees" suggests a positive feeling toward the open access model, while concurrence with the future scenario item "My ability to publish would be limited" suggests a negative perception. In addition, the model included the importance of reaching three different audience groups outside academia. These audiences, such as "practitioners in industry and business," could directly benefit from the open access model because they may not be affiliated with an academic library that allows them to view subscription-based journal articles.

To summarize, the pro-OA cluster had higher agreement on the following two points: (1) APCs are a reasonable alternative to subscription fees, and (2) OA would expand their own readership and perhaps increase media coverage of research in general. The respondents in this cluster placed significantly more importance on reaching policy makers, practitioners, and the public than did those in the non-OA cluster. They also cared more whether a journal is OA when choosing publication outlets. Those in the non-OA cluster felt that articles in OA periodicals were of lower quality than those in subscription-based journals and thought that an all-OA scenario would limit their own ability to publish. Therefore, they would have to find alternative ways to disseminate their research. They also felt more strongly that this scenario would hurt researchers with less funding.

Academic Positions, Disciplines, and Productivity by Cluster

The investigators looked closely at which types of scholars fall within each cluster. Chi-square tests revealed significant differences across position types [$X^2(4) = 44.247$, $p < .001$], areas of study [$X^2(5) = 39.838$, $p < .001$], and scholarly productivity, measured by the approximate number of journal articles published in the past three years [$X^2(4) = 22.762$, $p < .001$]. Table 4 compares column proportions of the different position types. PhD students and postdoctoral researchers had a significantly higher presence in the pro-OA group than did assistant, associate, and full professors.

While both clusters contain authors from all disciplines, pro-OA has significantly higher proportions of researchers in the life sciences or medicine, physical sciences, and

Table 4.

Position types within clusters

Academic position	Pro-OA* column N % ($n = 589, 71.7\%$)	Non-OA† column N % ($n = 233, 28.3\%$)
PhD student	38.5%‡	22.3%§
Assistant professor	11.4%‡	15.5%‡
Associate professor	10.7%‡	15.0%‡
Professor	25.5%‡	42.1%§
Postdoctoral researcher	13.9%‡	5.2%§

* Pro-OA designates participants with a positive attitude toward open access.

† Non-OA indicates participants with a more negative, skeptical opinion about open access.

‡ Values in the same row and sub-table not sharing the same symbol are significantly different at $p < .05$ in the two-sided test of equality for column proportions. Cells with no symbol are not included in the test. Tests assume equal variances. Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.

engineering and computer science (see Table 5). Those in arts or humanities and social science fall more heavily into the non-OA classification, along with a nonsignificant majority of mathematics scholars. Table 6 shows the different categories of article publishing frequency. Those who reported publishing only 1 to 5 articles in the past three years significantly more likely fall into the pro-OA cluster than those who published 11 to 20 articles, who more likely fit the non-OA cluster. Figures 1, 2, and 3 illustrate the proportions of groups within each cluster, corrected to account for the difference in cluster sizes (cluster 1, $n = 589$; cluster 2, $n = 233$).

Commonalities, Differences, and Implications

Commonalities

No significant difference appeared between groups in familiarity with the OA publishing model. Therefore, contrasts in opinion and attitude toward OA seem not attributable to unfamiliarity with the model. Both groups agree that the shift to an all-open access publishing world would be costly for authors who cannot afford to pay APCs. Those in the non-OA group, however, feel more strongly about this prediction. This is an interesting perspective coming from researchers who hold positions at well-funded, research-driven institutions. Overall, it is an important consideration: Without careful evaluation of how all authors are impacted, OA publishing funded by APCs may not be the democratic medium it is intended to be. Concerns have been raised about social

Table 5.
Academic disciplines within clusters

Area of study	Pro-OA* column N % ($n = 589, 71.7\%$)	Non-OA† column N % ($n = 233, 28.3\%$)
Arts and humanities	7.8%‡	16.7%§
Engineering and computer science	16.6%‡	11.6%‡
Life sciences and medicine	41.6%‡	28.3%§
Mathematics	1.7%‡	3.0%‡
Physical sciences	12.1%‡	7.3%§
Social science (including business, education, and law)	20.1%‡	33.0%§

* Pro-OA designates participants with a positive attitude toward open access.

† Non-OA indicates participants with a more negative, skeptical opinion about open access.

‡ Values in the same row and sub-table not sharing the same symbol are significantly different at $p < .05$ in the two-sided test of equality for column proportions. Tests assume equal variances.

§ Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.

Table 6.
Article publishing frequency within clusters

Article publishing frequency in the past three years	Pro-OA* column N % ($n = 589, 71.7\%$)	Non-OA† column N % ($n = 233, 28.3\%$)
None	9.4%‡	6.0%‡
1 to 5	46.6%‡	34.8%§
6 to 10	20.7%‡	20.6%‡
11 to 20	13.1%‡	24.0%§
20 or more	10.2%‡	14.6%‡

* Pro-OA designates participants with a favorable view of open access.

† Non-OA indicates participants with a more mistrustful assessment of open access.

‡ Values in the same row and sub-table not sharing the same symbol are significantly different at $p < .05$ in the two-sided test of equality for column proportions. Cells with no symbol are not included in the test. Tests assume equal variances.

§ Tests are adjusted for all pairwise comparisons within a row of each innermost sub-table using the Bonferroni correction.
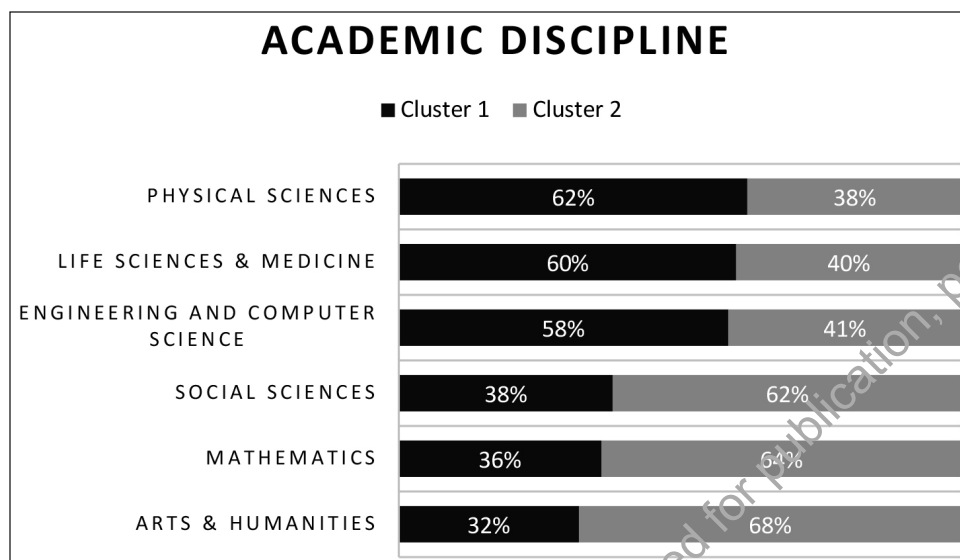
Figure 1. Proportion of scholars in each cluster by academic position. Cluster 1 consists of subjects with a more positive a view of open access (OA) publishing, and cluster 2 comprises those with a more negative, skeptical opinion of OA.
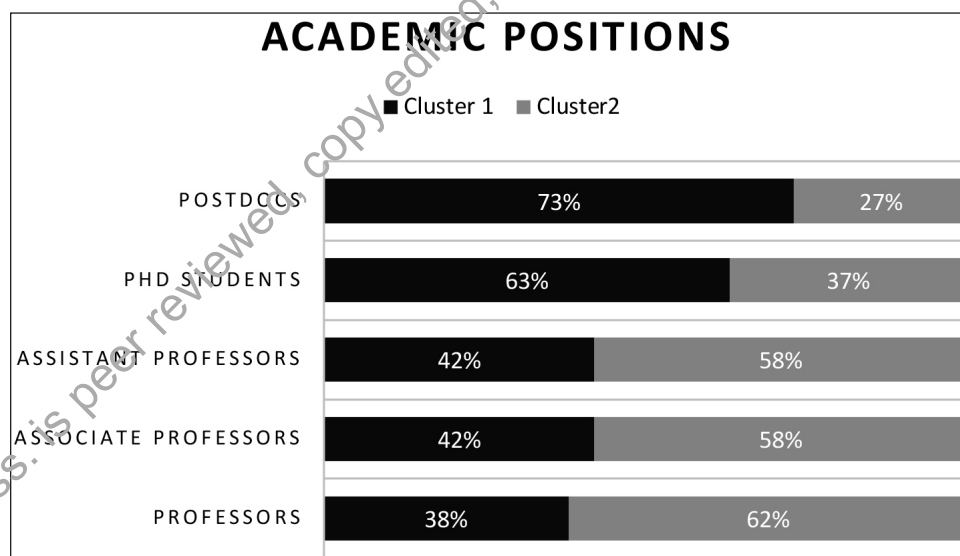

Figure 2. Proportion of scholars in each cluster by academic discipline. Cluster 1 consists of subjects with a more accepting attitude toward open access (OA), and cluster 2 is made up of those more mistrustful of OA.
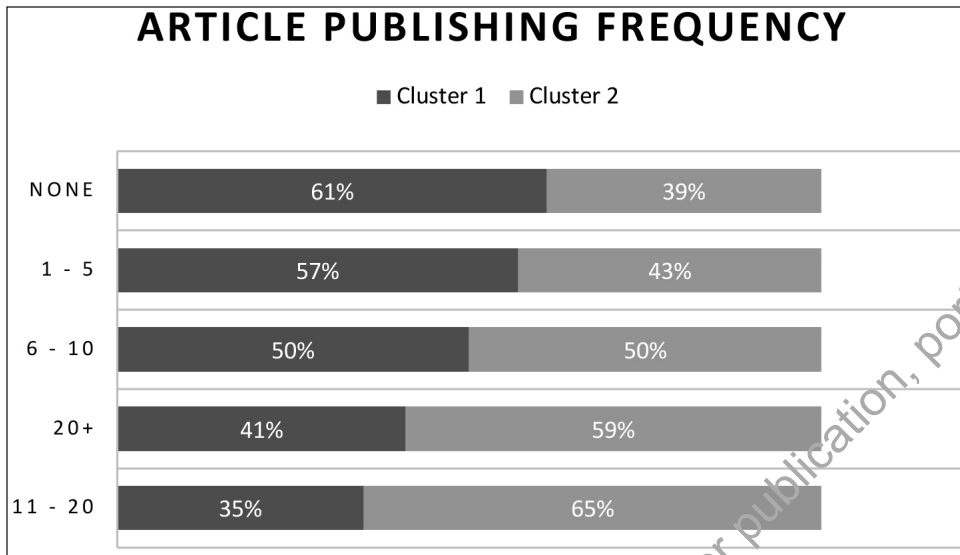
ARTICLE PUBLISHING FREQUENCY

■ Cluster 1 ■ Cluster 2

NONE	61%	39%
1 - 5	57%	43%
6 - 10	50%	50%
20+	41%	59%
11 - 20	35%	65%

Figure 3. Proportion of scholars in each cluster by article publishing frequency in the past three years. Cluster 1 consists of subjects with a more favorable assessment of open access (OA), and cluster 2 comprises those with a more doubtful view of OA.

justice issues perpetuated by the APC funding model.[49] While the system of publishers using article processing charges to fund their operations opens doors for many readers, it closes them for many authors, particularly in developing countries.[50] This concern fits with the hesitation expressed in other studies,[51] leaving scholars from both humanities and social science and STEM disciplines largely unsure about their future OA publishing intentions. In addition to the confusion and suspicion generated by OA options,[52] academics may feel too unsure of future funding to commit to the idea of OA publishing.

> **While the system of publishers using article processing charges to fund their operations opens doors for many readers, it closes them for many authors, particularly in developing countries.**

Note, however, that many OA publications, such as the PLOS (Public Library of Science) journals, offer discounts and fee assistance to those from developing countries and others who demonstrate financial need. In addition, research-intensive institutions from developed nations pay the lion's share of the APCs that keep OA journals afloat.[53]

Differences

The largest mean gap between clusters is the belief that, in an all open access world, "More people would read and use my research." Those in the pro-OA cluster, which is dominated by physical science, computer science, engineering, life sciences, and medicine, felt overall that their research would be more widely read (mean = 3.75), while

Arts, humanities, and social science writers doubt the potential for OA to expand their own readership …

those in the non-OA category, where many of the arts, humanities, and social science scholars fall, tended to disagree (mean = 2.09). This finding aligns with previous research that explicitly compared researchers in STEM with those in humanities and social science disciplines.[54] Arts, humanities, and social science writers doubt the potential for OA to expand their own readership, which may reflect how they believe their scholarship is used (and not used). The current data show that those in the non-OA cluster care significantly less about reaching policy makers, practitioners, and the public (see Table 2), perhaps reflecting a belief that their work is less useful for nonacademic audiences.

The next largest gap agreed with the statement "Paying article processing charges for Open Access is a reasonable alternative to subscription fees." The pro-OA cluster agreed more strongly (mean = 3.34) than did the non-OA group (mean = 1.74), which reflects similarities in previous findings about social science and perceptions of APCs. This statement lies at the core of the OA funding model and taps into a point of contention among scholars. To suggest that paying APCs is reasonable is to assume that shifting the cost of publishing onto authors makes sense. For such a shift to be reasonable, it must lie within the perceived realm of possibility. Researchers in such fields as medicine and life sciences, in particular, tend to have better overall funding, particularly with grant money, than those in arts and humanities.[55] Scholars in humanities and social science report that it is indeed difficult to come up with money to fund APCs.[56] Grant proposals in the life and physical sciences often include a budget line item for APCs (although these scholars have also expressed concerns about funding as a barrier to OA).[57] Therefore, while those in social science, humanities, and the arts may more likely express uncertainty about what the OA model means,[58] attitudes toward APCs and open access publishing may be driven by the perceived feasibility of this model in a given field. The ways in which medical, engineering, and physical sciences data are used, and the audiences who benefit from the information, differ from those of arts, humanities, and social science. As described by a faculty member who took part in the focus group portion of this project:

> That is exactly why I believe in [open access publishing]. My work is in [a third world country], and some of the best universities in [that country] don't even have access to do the work that I have published about their situations. It is ridiculous . . . When I got my interview here, I told them that I would no longer ever publish in a closed journal ever again. So, if they want me to eventually get tenure, they need to know that I will be publishing in open access publications or even newsletters, or whatever to get the information out.

For this author, the accessibility of research is a moral imperative.

For scholars whose work may not easily apply to practical problems, the draw and practicality of OA publishing may be more complicated than for researchers in such areas as medicine and engineering. A lower sense of urgency often surrounds dissemination of arts, humanities, and social science research, as evidenced by the tendency of researchers in STEM disciplines to value rapid peer review more highly than scholars in humanities

and social science.[59]Also, the need to reach policy makers, practitioners, and readers in low-income countries may be greater for researchers in medicine or engineering. With

less overall funding, the thought of paying APCs for article publication may steer arts, humanities, and social science authors elsewhere.[60] In addition, the proliferation of predatory journals has tainted the opinions of many, and APCs are often conflated with the concept of "pay-to-play" publishing and a lack of peer review.[61] In the focus groups held before the survey, this attitude tends to persist among scholars in arts, humanities, and social science fields, where gold OA publishing is less common.[62]

> **A lower sense of urgency often surrounds dissemination of arts, humanities, and social science research, as evidenced by the tendency of researchers in STEM disciplines to value rapid peer review more highly than scholars in humanities and social science.**

PhD students and postdocs loaded significantly more heavily into the pro-OA cluster. This is interesting given that 27.0 percent ($n = 75$) of PhD student participants were from social science, which clustered into the non-OA group, followed by life sciences and medicine ($n = 73$, 26.3 percent) and engineering and computer science ($n = 65$, 23.4 percent). Differences between clusters could be due to several practical and philosophical reasons. PhD students and postdocs may more willingly embrace the perceived risk of trying a newer journal because most do not yet have established reputations within their fields. They may represent a new generation of researchers who see value in the potential for

wider attention and accessibility to their work. Veteran faculty, in contrast, may have specific outlets with established reputations in which they feel comfortable publishing. This inclination appears to increase along with academic rank. Professors may also have to deal more directly with the reality of funding APCs than do graduate students or postdocs, who hold fewer leadership roles on large research projects. As described earlier, however, previous research

> **PhD students and postdocs may more willingly embrace the perceived risk of trying a newer journal because most do not yet have established reputations within their fields. They may represent a new generation of researchers who see value in the potential for wider attention and accessibility to their work.**

indicates that positivity toward and willingness to embrace OA does not translate into action for graduate students and other early career researchers. Though they appreciate OA principles, they feel too vulnerable to risk their careers by straying from the norms of their departments, institutions, or fields.[63] But, in the current study, when asked to rate the importance of OA as a journal attribute, PhD students rated OA significantly higher than did all three groups of professors [$F(4) = 8.304$, $p < .001$]. So perhaps this does indicate a shift wherein idealism begins to influence action.

Finally, this study examined differences in article publishing output between the pro-OA and non-OA clusters. Those who had published from 1 to 5 articles in the past three years ($n = 355$, 43 percent) had a significantly higher presence in the pro-OA cluster than those who had published between 11 and 20 articles ($n = 133$, 16 percent). A significant majority of those who fell into the 11-to-20-article category worked in life sciences or medicine ($n = 63$, 47 percent of the 11-to-20 range), a group which has a significantly higher presence in the pro-OA cluster. At the same time, scholars in arts, humanities, and social science, who tend to fall into the non-OA cluster, produced fewer articles, falling in the 1 to 5 range (arts or humanities $n = 56$, 66 percent; social science $n = 100$, 51 percent). In publishing frequency, position type seems to carry greater weight in influencing the cluster profiles: PhD students and postdocs, who also dominate the larger pro-OA cluster, significantly more likely fall into the 1-to-5 article range (PhD student $n = 173$, 62 percent; postdoc $n = 53$, 56 percent) than into the 11-to-20 category (PhD student $n = 10$, 4 percent; postdoc $n = 11$, 12 percent). Perhaps not surprisingly, professors and associate professors, who tend to belong to the smaller non-OA cluster, produce significantly more scholarly article output, more likely falling into the 11-to-20 range (professor $n = 69$, 28 percent; associate professor $n = 26$, 27 percent).

> ... positivity toward and willingness to embrace OA does not translate into action for graduate students and other early career researchers. Though they appreciate OA principles, they feel too vulnerable to risk their careers by straying from the norms of their departments, institutions, or fields.

Implications

There are ample opportunities to connect the findings of the current study to the broader picture of research and scientific development, both within academia and outside it. Among the most important implications of this study are the need to identify assumptions about the utility of research outside academic institutions, ideas for shaping educational initiatives on campuses, and the potential role of librarians as advocates in tenure and promotion. For instance, it would be useful for future research to examine in more detail the attitudes of those in the non-OA cluster and their lower level of concern for reaching nonacademic audiences with their work. The notion that some would-be users of research from the general population would not be interested in accessing research is correct: They do not bother consulting OA research because they find it neither applicable nor intellectually accessible.[64] But just as public understanding of and engagement with science has increased in the past few decades,[65] similar changes will likely happen in the arts, humanities, and social science fields (which dominate the non-OA cluster).[66] If making arts, humanities, and social science research available to the general population has the potential to enhance public engagement with these disciplines[67] and satisfies people's right to access this information,[68] then the perception that readership would not be

increased by open access is probably misguided. The potential exists for increased use of these types of scholarship in industry, government, and the nonprofit sector as well.

Shifts in the publishing industry happen rapidly, and it is important for scholars of all disciplines to keep abreast of changes as they happen. Education will be key in helping authors understand the difference between legitimate, peer-reviewed open access outlets and predatory ones. Librarians have opportunities to assist scholars at every level, from undergraduate students to faculty, in mapping this complex landscape of outlets. For students, education about open access resources is becoming a fundamental aspect of information literacy. It is touched upon briefly in the Framework for Information Literacy for Higher Education[69] as

> **Education will be key in helping authors understand the difference between legitimate, peer-reviewed open access outlets and predatory ones.**

part of articulating the value of information and distinguishing among different types of sources.[70] For faculty, navigating the ever-changing landscape of scholarly publishing choices in addition to their institution's own repository requirements can be a challenge without the help of librarians. Libraries can offer training sessions, hold educational meetings within departments, and point authors toward the free and fee-based services that monitor the mushrooming of predatory journals and highlight legitimate, peer-reviewed open access journal options.[71] For instance, Cabell's International launched a "blacklist" of journals to protect researchers from what it called "exploitative operations" (see http://www.cabells.com/newsletter-blacklist). Cabell's also maintains a "whitelist" of journals (see http://www.cabells.com). The Directory of Open Access Journals (DOAJ) provides another established whitelist approach, offering a free, Web-based service that lists and monitors legitimate open access journal outlets. Also, contrary to earlier years, the Web of Science indexes an increasing number of OA journals, which is a reasonable guarantee of quality.

Finally, the polarization in attitudes toward OA publishing can create problems for less established researchers. A key difference between the two cluster groups is that those in non-OA—where arts, humanities, and social science scholars clustered more heavily—expressed significantly more concern with the quality of OA journal articles. This reflects an attitude that has surfaced in previous studies: Not only do some researchers express concern about the quality and prestige of OA journals but also they often do not associate peer review with the publication process in these journals.[72] If the nature of advancement in tenure-track careers were simply to "live and let live" when it comes to publishing choices, this view would not matter. But if those with more negative, skeptical attitudes toward OA evaluate the work of those who actively publish in these

> **. . . a new role may emerge for librarians as advocates for the acceptance of legitimate, non-traditional scholarly publishing outlets as part of campus-wide tenure and promotion review policies.**

outlets, this bias could seriously derail an early career scholar's chances of advancement.[73] For this reason, education about changes in scholarly publishing should extend

beyond those engaging in active research to all members of the university community involved in tenure and promotion processes. For librarian educators, specific groups of faculty (such as those in arts, humanities, and social science) might benefit from more education about open access outlets across different fields. Beyond this, a new role may emerge for librarians as advocates for the acceptance of legitimate, nontraditional scholarly publishing outlets as part of campus-wide tenure and promotion review policies.

Limitations

The primary limitations of this study pertain to sampling and generalizability. Some degree of self-selection bias came into play. Life sciences or other highly represented groups may have been more interested in the topic or felt strongly about weighing in, and so decided to participate. In addition, this study includes only faculty participants in tenure-track positions as assistant, associate, and full professors and so does not reflect the actual distribution of all position types at the participating universities (approximately 44 percent tenure-track faculty), many of whom conduct research in other types of positions. Therefore, although the survey captured a variety of subject disciplines and experience levels, the results may not be extrapolated to all researchers at their respective universities. The universities in this study are all in the United States and Canada. Results may differ in regions, such as the European Union, where strong national and international initiatives mandate publication in open access journals. In countries where publication in Web of Science journals is encouraged through financial incentives to authors, opinions may differ as well. In addition, the data were collected in 2015. Although relatively recent, changes in policy and international attention to the topic may create a different picture if participants were surveyed today.

Finally, the survey included content pertaining to APCs, with the goal of understanding participants' experiences and expectations regarding amounts and sources of funding for OA publishing. Given that 15 percent of respondents had no familiarity with OA prior to the survey and 65 percent had no experience publishing in OA journals, some participants may have been primed to associate APCs with OA publishing even though many OA journals do not charge such fees. This could have shaped how the participants responded, particularly to questions about future OA scenarios.

Conclusion

A growing number of mandates from funders and institutions to publish results in open access outlets mean that authors are learning more about OA repositories and publication. Therefore, knowledge and opinions about OA will continue to evolve. The current study confirms what previous research has found about the polarity of the issue of OA across different fields. Less was previously known about differences across position types, although research examining age and attitudes toward OA has found that older researchers may be less aware of OA[74] and find it less prestigious than younger academics do.[75] Similarly, the current study found more negative attitudes among those more advanced in their careers. But, this study paints a holistic picture not only of researchers' opinions about OA but also of how the possibility of an all-OA future shapes the

perceived value of this publishing model. The findings reveal authors' concerns about and perceptions of OA in a way that previous research has not addressed, particularly concerning whether and how it will limit their publishing practices and the overall reach of their work in an all-OA scenario. In addition, although previous research has shown the importance of intended audience as a journal factor,[76] this study is unique in parsing out the perceived value of reaching the different types of nonacademic audiences who might benefit as consumers of OA research.

As one graduate student explained in the focus groups, the stigma that exists in some disciplines of paying money to publish, no matter what the outlet, is hard to overcome.[77] This imputation will continue to impact authors as they choose where to publish their research. Some early career researchers may feel conflicted about their commitment to open research ideals and their desire to advance within their fields. Education and continued monitoring of predatory journals may help mitigate these conflicts. Moving forward, future research should examine the impact of library educational initiatives on knowledge and attitudes toward the OA model. The continued development of quality indicators to assist faculty and other researchers is a promising direction for libraries as educational resources.[78]

Acknowledgment

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