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Varieties of diffusion in academic publishing: How status and legitimacy influence growth trajectories of new innovations

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Abstract

Open Access (OA) publishing has progressed from an initial fringe idea to a still-growing, major component of modern academic communication. The proliferation of OA publishing presents a context to examine how new innovations and institutions develop. Based on analyses of 1,296,304 articles published in 83 OA journals, we analyze changes in the institutional status, gender, age, citedness, and geographical locations of authors over time. Generally, OA journals tended towards core-to-periphery diffusion patterns. Specifically, journal authors tended to decrease in high-status institutional affiliations, male and highly cited authors over time. Despite these general tendencies, there was substantial variation in the diffusion patterns of OA journals. Some journals exhibited no significant demographic changes, and a few exhibited periphery-to-core diffusion patterns. We find that although both highly and less-legitimate journals generally exhibit core-to-periphery diffusion patterns, there are still demographic differences between such journals. Institutional and cultural legitimacy—or lack thereof—affects the social and intellectual diffusion of new OA journals.

1 | INTRODUCTION

The past two decades have witnessed the rise of Open Access (OA) academic publishing, which developed from a fringe idea to an omnipresent part of modern academic communication (Brainard, 2021; Moore, 2020; Suber, 2012). Exponential growth in various types of OA publishing has been observed over the past two decades, with continued growth projected in the future (Piwowar et al., 2018, 2019). Leveraging the efficiency, innovativeness, and immediacy of online dissemination, as well as low barriers to entry, numerous well-established and new academic publishers have emerged to publish OA journals. Even high-status for-profit publishers who have historically dominated the academic journal market have also founded OA journals, sometimes as complements to their valuable subscription journal portfolios. Academic institutions and stakeholders are increasingly mandating some sort of OA publishing as a condition of funding (Larivière & Sugimoto, 2018; Stoye, 2019). OA publishing is at least a partially *disruptive innovation* (Christensen, 1997). Although OA academic publishing has not entirely displaced dominant publishers and journals, it has changed behaviors and strategies of incumbents, while adding new competitive institutions and niches to the industry.[1]

The burgeoning success of OA publishing and concomitant changes in the culture and institutions of academic publishing raises questions of how this initial fringe movement

grew and became an important part of contemporary mainstream science. OA publishing was an initially peripheral—if not illegitimate—innovation now omnipresent in academia; a reputably professionally conservative and tradition-bound institution (Bourdieu, 1988). There is substantial diversity in the market and intellectual niches of new OA journals. This provides empirical opportunities to observe diffusion trajectories of multiple simultaneous new entrants into the professional and intellectual fields of academic publishing.

Academia is intellectually and socially diverse. In turn, we sampled 83 different OA journals to observe heterogeneity in scholars publishing. The wide variety of niches and missions of new OA journals in our study enables observing numerous possible status and legitimacy influences on diffusion patterns. In particular, we analyze the publishing histories of the 83 OA journals to examine if and how the demographics of authors change over time, from journal debut to later years. We also track changing author demographics in journals over time as a means of revealing possible factors conducive to different diffusion trajectories with new innovations. Just as there are many different types of successful academic publishers and innovations, there are also many different diffusion patterns that underpin that success.

2 | BACKGROUND

Scholars make intellectual and professional choices based on a variety of personal and social factors (Gross, 2002; Hermanowicz, 2009; Koppman & Leahey, 2019; Simonton, 1988). Merton (1973) posited that scholars are influenced by professional reward structures which involve symbolic and material rewards distributed among colleagues based on meritorious behaviors. These exchanges of rewards include funding, tenure, hiring and promotion in academic institutions, as well as credit bestowed through citations to the work of others in published articles. Citations involve flows of social and intellectual credit between scholars, and are disproportionately distributed to highly-central scholars and journals (Barabási & Albert, 1999; Lotka, 1926). Articles published in high-prestige journals tend to receive more citations than articles published in lower-status journals (Kim et al., 2020; Larivière & Gingras, 2010; Traag, 2021). Further, established scholars possess social and intellectual capital that can legitimate and promote new innovations, such as fledgling OA journals (Willinsky, 2012). In turn, intellectual and professional choices in publishing are influenced by the incentives, risks and rewards posed by academic reward systems. Social positions of scholars make certain risks and rewards more salient or appealing. Thus, publishing in early phases of a new journal—particularly when OA publishing itself was still viewed by many as illegitimate or downmarket—will be more attractive to certain kinds of scholars than others.

2.1 | Social status, risk-taking, and innovation

New products or innovations—such as OA publishing—tend to be adopted at different stages and in different manners by people and institutions of varying attributes (Bass, 1969; McCain & Salvucci, 2006; Rogers, 2003). New scientific ideas can diffuse—or fail to diffuse—in a wide variety of manners, depending on social and intellectual conditions (Burt, 2004; Cheng et al., 2023). Nascent scholars and innovations often face liabilities of newness—disadvantages and challenges associated with being a new market entrant (Stinchcombe, 1965). Particularly with less-legitimate innovations, higher-status actors tend to be relatively more prone to early adoption, since they possess greater material and social resources.

This professional security of high-status positions enables exploration and risk-taking. In contrast, middle-status actors tend to prefer conformist, orthodox choices, and behaviors (Leblebici et al., 1991; Phillips & Zuckerman, 2001). Further, higher-status actors are also often able to confer legitimacy and status upon new innovations (Menzel, 1960). Professionals that already possess legitimacy have less of a need for external sources of legitimacy than those that have limited, uncertain, or unestablished legitimacy. Higher-status scholars possess the academic capital to engage in "impure" professional activities with little reputational risk (Zuckerman, 2017, p. 41). Atypical practices are more likely to be perceived as creative and meritorious when enacted by high-status actors, thus mitigating risks and bolstering rewards for high-status actors (Sgourev & Althuizen, 2014). Frickel and Gross (2005) posited that Scientific/Intellectual Movements (SIMs) are most likely to emerge when high-status intellectual actors harbor objections about dominant intellectual orders in their discipline or field. In turn, founding and patronizing new and/or unconventional innovations should generally be less costly for higher-status actors and institutions vis-à-vis lower-status counterparts.

In science, evaluators are most likely to be influenced by particularistic characteristics of authors (such as gender or institutional status) under conditions of uncertainty (Long & Fox, 1995; Lynn, 2014; Pfeffer et al., 1977). The frontier of new academic research is rife with such uncertainty (Cole, 1983). This is especially true with innovations that initially lack categorical legitimacy, such as OA publishing. When innovations lack categorical legitimacy, they

are especially prone to diffusion via peer-oriented heuristics such as information cascades (Rossman, 2014). Numerous studies have identified influences of personal and institutional status on academic evaluations (e.g., Leahey, 2004; Peters & Ceci, 1982; Simcoe & Waguespack, 2011; Tomkins et al., 2017; Huber et al., 2022; Si et al., 2023. Given that new innovations—in this case, OA publishing—tend to be of uncertain value, it follows that higher-status scholars and institutions would be judged relatively favorably for unconventionality, and be more likely to pursue new innovations under conditions of uncertainty.

Academic journals carry brands and reputations, serving as conduits for the dissemination of information, while also emitting signals of academic status and legitimacy (Lynn, 2014; Meadows, 1979; Pontille, 2004). Publications in high-status academic journals are often explicitly linked to institutionalized reward structures, including quantitative journal rankings and metrics, scholarly indexing and professional remuneration (Martin, 2011; Moher et al., 2018; Quan et al., 2017). In particular, indexing in Scopus and the Web of Science—as well as the conferring of a Journal Impact Factor from Clarivate—are important legitimating milestones for new journals (Davis, 2017). Achieving such milestones involves the challenge of surviving nascent periods where the journal's markers of status and legitimacy are limited. For example, *PeerJ* publisher Jason Hoyt (2018) observed that after his OA journal received an official impact factor from Clarivate, there was a sharp increase in submissions. However, the demographics of submitters to *PeerJ* increasingly shifted to "late adopters" who previously could not financially and/or reputationally afford to publish in the journal without formalized institutional legitimation. Editors at MDPI (Multidisciplinary Digital Publishing Institute) observed similar dynamics, where influxes of submissions from peripheral scholars followed legitimating milestones, such as Web of Science indexing (Vazquez, 2019). Due in part to the importance of social legitimation for later adopters, innovations often diffuse from central, well-resourced people and institutions to more peripheral niches.

> **Hypothesis 1a.** Authors affiliated with higher-status institutions will be more likely to publish in early issues of OA journals than lower-status institutions. Mean status levels of authorial affiliations will tend to decrease over time.

> **Hypothesis 1b.** More-cited authors will be more likely to publish in early issues of OA journals than less-cited authors. Personal citation levels of authors submitting article to OA journals will decrease over time.

2.2 | Gender and innovation in science

Gender inequalities remain conspicuous in the professional composition and intellectual content of science (Long & Fox, 1995; Rossiter, 1993). Women's disadvantages in science can include prevailing cultural beliefs about gendered status characteristics, as well as underrepresentation and reduced access to resources and prestige. Status characteristics involve salient beliefs about social groups that influence individual cognitions and behaviors, even in the absence of direct discourse or social interactions (Ridgeway, 1991).[2] If women are deemed by certain people or institutions to have inferior or limited competence in scientific or professional contexts, this can exert downward pressure on both personal goals and self-perceptions of women, as well as attitudes of other academics towards women. In addition to status characteristics, women tend to be underrepresented in academic leadership positions (McCulloch, 2011), full professorships (Marini & Meschitti, 2018; Wijesingha & Robson, 2022) and elite graduate schools (Weeden et al., 2017). Underrepresentation of women and devaluing of women's issues have been identified as an ongoing concern since the incipience of the open science movement (Murphy et al., 2020; Steeves, 2017; Whitaker & Guest, 2020).

Empirically, Koppman and Leahey (2019) found that originators and early adopters of three unconventional innovations in academic sociology tended to be male scholars affiliated with prestigious academic institutions. Later, the innovations diffused more widely throughout the profession and discipline. Women tend to have less status and fewer resources to take reputational risks and assume risky leadership positions. In turn, given structural and status disadvantages for women in science, it is expected that women will tend to be later adopters of new OA journals.

> **Hypothesis 1c.** Men will be more likely to publish in early issues of new OA journals. Representation of women authors will increase over time after a journal's debut.

2.3 | Social marginality and innovation

Despite the previous hypotheses positing diffusion processes progressing from central, powerful actors to more peripheral actors, successful innovations have also diffused in different manners, sometimes originating in peripheral or semi-peripheral social positions. In some contexts, marginal or semi-peripheral status may be relatively conducive to early adoption, while central actors and institutions tend to be laggards. Marginal actors and institutions tend to be less invested in the status quo,

which can spark innovative interests and activities (Dogan & Pahre, 1990; Jeppesen & Lakhani, 2010; McLaughlin, 2001). Many mainstream innovations originated in peripheral social locations before diffusing and achieving widespread popularity (Leblebici et al., 1991; Phillips, 2013). Numerous OA journals were founded as acts of resistance against academic and economic hierarchies historically entrenched in print-based scholarly publishing (Price & Puddephatt, 2017).

2.4 | Innovative advantages of centrality versus peripherality: The influence of legitimacy

Just as new entrants to a field can face liabilities of newness, incumbents can face *liabilities of senescence* (Aldrich & Auster, 1986; Aldrich & Fiol, 1994), creating innovative potential for outsiders and new entrants. Different social positions and structures are advantageous for the development and diffusion of different innovations (Perry-Smith & Mannucci, 2017). Academia is a unique institutional and professional context with often conflicting forces of conservativism and innovation (Foster et al., 2015; Kuhn, 1962, 1977; Lamont, 2009). OA academic publishing is a contemporary innovation that sheds light on how new ideas and institutions diffuse and entrench in contemporary science. In theory, new innovations can diffuse from the center to the periphery or vice versa. This raises questions of what factors influence various new innovations to diffuse in different manners or directions. Based on established theories of innovation, we proffer social legitimacy of innovations as a key factor influencing innovative incentives for different demographics, and by extension, varying diffusion trajectories of innovations.

Past research has found that central actors and institutions tend to be early adopters of culturally legitimate innovations, while illegitimate innovations tend to be first adopted by marginal actors and institutions unconstrained by the status quo (Menzel, 1960; Strang & Soule, 1998). Attaining legitimacy is especially difficult for new entrants in a market, particularly when their new innovation—in this case, online academic publishing—is viewed with skepticism. The newness and complexity of the OA academic publishing industry has yielded numerous publishers and journals of varying levels of status and legitimacy in the 21st Century. OA journals can range on a continuum between high-status/legitimate to unambiguously illegitimate (Siler, 2020). In turn, OA publishing is a contemporary context to study how varying degrees of status and legitimacy influence the diffusion trajectories of new innovations. As per extant research on status, legitimacy and diffusion (Menzel, 1960; Strang & Soule, 1998), it is expected that higher-status journals will tend to diffuse from high-status actors and institutions to the periphery, while lower-status journals will tend to diffuse from periphery to core.

> **Hypothesis 2.** Higher-status OA journals and publishers will tend exhibit core-to-periphery diffusion patterns. Such journals will have relatively more male authors and authors affiliated with relatively high-status institutions as early publishers, and steadily increase representation from women, lower-status institutions, and less-cited scholars over time.

> **Hypothesis 3.** Lower-status OA journals and publishers will tend to exhibit periphery-to-core diffusion patterns. Such journals will have relatively more women authors and authors affiliated with lower-status institutions as early publishers, and steadily increase representation from men, higher-status institutions, and more-cited scholars over time.

3 | CASE STUDY: OPEN ACCESS ACADEMIC JOURNAL PUBLISHING

Social and technological changes—especially the digitization of knowledge—facilitated the conception and rapid expansion of OA academic publishing starting in the early 2000s. OA publishing refers to unrestricted online access to scholarly articles, freely available to anyone with an internet connection (Suber, 2012). The OA publishing model stood in sharp contrast to the traditional model of disseminating scholarly research through subscription-based print journals, which was entrenched since the 19th century (Baldwin, 2015). While online academic publishing was initially perceived as unconventional, if not also illegitimate, the popularity of OA publishing continues to expand. New OA academic publishers and their advocates strategically promoted OA articles, journals, and publishers to establish legitimacy and develop viable academic and economic niches vis-à-vis established journals in their fields.

The low barriers to entry and competitive advantages of OA publishing attracted numerous new entrants to the field of academic publishing. As the print-journal market consolidated into an oligopolistic structure (see Larivière et al., 2015), OA journals emerged as alternatives in academic publishing. The increased availability, lack of printed page constraints, economic efficiencies, innovations in peer review, and advantages in attracting attention and citations are all possible appeals of OA journals

vis-à-vis traditional print journals (Eysenbach, 2006; Holmberg et al., 2020; Lamont, 2016; Van Noorden, 2013). Given these advantages and opportunities in online publishing, different OA publishers developed both competitive and complementary niches vis-à-vis established print journals.

A wide variety of scholars and institutions have founded thousands of OA academic journals with differing academic niches, editorial philosophies, and business models (Siler & Frenken, 2020). There is substantial diversity in the types of institutions that publish OA journals. OA publishers span multiple continuums between for-profit and non-profit, large and small, upmarket and downmarket. Many OA journals and publishers are *hybrid organizations* (Battilana & Dorado, 2010), comprised of unique combinations of market and professional institutional logics driving scholarly and business decisions (Siler & Larivière, 2022).

The lack of page constraints in OA publishing turns levels of journal selectivity (or rejection rates) into a strategic matter, as opposed to being circumscribed by a fixed number of allotted printed pages. This underpins potential perverse incentives to publish as many articles as possible if journals receive Article Processing Charges (APCs) for every successfully published article and nothing for each rejected article (Gans, 2017; Siler, 2020). Although high selectivity is associated with quality control and exclusiveness in academia, the common APC-based model of OA publishing can make lower rejection rates more lucrative. In turn, OA journals make strategic tradeoffs with selectivity, price and quality, resulting in a number of different niches in the academic publishing industry. Consequently, different OA journals attract different demographics and types of scholars, as well as possessing different intellectual and business philosophies. Since many of the journals in our study possess different intellectual and economic niches, OA publishing provides a wide variety of contexts to study diffusion dynamics.

4 | METHODS

4.1 | Data

Academic articles from focal journals were retrieved via Clarivate Analytics' Web of Science. The same journals are repeatedly observed over sequential years, so we analyze panel data in our study. From the entire population of Open Access-only journals indexed by the Web of Science, we restricted analysis to journals with at least four full years publishing, and at least 500 total published articles. We recognize that there is a degree of survivorship bias in this analysis. In particular, it is challenging to observe "failed" journals, which often vanish from the internet (cf., Laakso et al., 2021). However, diffusion processes for successful and unsuccessful innovations are often similar (Greve & Seidel, 2015). Additionally, we preferred to focus on journals with adequate—if not ample—data to analyze.

A total of 83 exclusively OA journals covered by the Web of Science met these criteria. Full data was available from the inception of the earliest journals in our study in 2006 until 2017. Given that we are sampling journals that have survived long enough to develop a corpus—as well as achieving indexing in the Web of Science—we are examining relatively successful OA journals. We examined published research articles[3] for 83 of these journals, collecting information on the corresponding author for each article. We focus on corresponding authors, because corresponding authors are usually responsible for project leadership, and are most likely to finance the costs of OA publishing (Dance, 2012; Helgesson, 2021). This resulted in a dataset with corresponding author data for 1,296,304 total articles. Article authors were disambiguated according to the methodology developed by Caron and van Eck (2014). For more information on each of the 83 journals in our study, including journal metadata and summary statistics, see Table A1.

4.2 | Dependent variable

4.2.1 | Journal age

The dependent variable is the year of publication subtracted the by year an OA journal is first indexed by the Web of Science. In other words, we are measuring whether an article is published relatively early or later in a journal's corpus. Notably, when a journal is indexed by the Web of Science, previous articles and citations are retroactively indexed, so the first year of Web of Science indexing is usually the year of the journal's debut. Web of Science indexing is both a legitimating milestone, and also a means of producing the necessary metadata to conduct empirical analyses of journals. Early adopter scholars who publish in earlier years of a journal will have lower values of this variable, while later adopters will have higher values.[4]

4.3 | Independent variables

4.3.1 | Publisher type

Publishing is simultaneously an economic and professional activity. In turn, the publishing industry is characterized by

conflicts and contradictions between economic and professional priorities (Christin, 2018; Thornton & Ocasio, 1999). Numerous intellectual and business niches exist in academic publishing through different combinations of institutional logics. We distinguish between different publisher types by *high-status*, *gray*, and *small/independent* category. Among the 83 Web of Science-indexed journals in our study, we dubbed BMC and PLOS as high-status publishers. Both BMC and PLOS were well-funded early entrants in the OA publishing industry, and emerged as industry leaders. Due to similar links to high-status publishers and/or institutions such as the Wellcome Trust, Gates Foundation, and Howard Hughes Medical Institute, *eLife*, *Nature Communications*, *Scientific Reports*, and *PeerJ* were also categorized as high-status publishers. Siler et al. (2020) coined the term *gray journals and publishers* to refer to large, successful OA publishers with controversial or contested legitimacy. Strategies and behaviors based on uncertain or contested legitimacy are often successful—but downmarket—niches for people and organizations (Anteby, 2008). In our study, Frontiers Media, Hindawi, and MDPI are exemplars of gray OA publishers. All three publishers publish large volumes of articles, but have also faced questions and public contentiousness regarding profligate profit-oriented publishing and the overall legitimacy of their business models (Amrein, 2022; Brainard, 2023; Brockington, 2022; Crosetto, 2021; Horbach et al., 2022). Our sample of small/independent journals was derived from Björk et al. (2016), who identified numerous long-running non-profit independent scholar-published OA journals.

4.3.2 | Rank category of authorial institutional affiliation

Universities and colleges were classified according to the 2019 *Times Higher Education* (*THE*) rankings, which ranked 1258 institutions from around the world. Universities were grouped into seven status-based categories: (a) ranked 1–25; (b) ranked 26–50; (c) ranked 51–100; (d) ranked 101–250; (e) ranked 251–500; (f) ranked 501 or above; (g) unranked. The highest ranked group (1–25) has a value of 7, the next highest-ranked (26–50) has a value of 6, and so forth, with unranked institutions having a value of 1. These seven groups with descending status levels provide a discrete variable to analyze the status of the institutional affiliations of academics. While we acknowledge empirical limitations and normative concerns with university rankings in general, and the *THE* rankings in particular (e.g., Ioannidis et al., 2007; Saisana et al., 2011; Siler et al., 2018), such rankings are correlated with the financial resources and academic status of colleges and universities (Espeland & Sauder, 2016).

4.3.3 | Gender

Following the algorithm developed in Larivière et al. (2013), author gender was assigned according to listed first names, which were compared with United States Census lists and other gender-related names lists. Of 1,296,304 total observations in our dataset, the algorithm assigned a gender for corresponding authors of 1,099,491 articles. The remainder involved gender-ambiguous names (e.g., authors that publish solely with initials in lieu of a first name). In the total pool of articles published in the 83 OA journals where the algorithm assigned a gender to an author, 66.2% of observations were men, while 33.8% were women.

4.3.4 | Age

Professional incentives, cognitive skills and personal goals vary both through life courses and academic careers, which affects the work choices and output of scholars (Hermanowicz, 2009; Simonton, 1988). Merton (1973 [1942]) labeled science as a *gerontocracy*. Status and legitimacy tend to accrue over time in academia. Declines in funding and tenure-track professorships affect the work and career decisions of younger scholars (Daniels, 2015; Jones, 2010; Warren, 2019). The security and entrenched status of older scholars may predispose them to founding and patronizing new OA journals. Conversely, OA publishing may appeal more to less tradition-bound younger scholars who grew up in the digital area. The scholar age variable was calculated as the years elapsed since their debut in our Web of Science database, which has been shown to be strongly related to biological age (Nane et al., 2017). Scholar age was included as an additional independent variable in our models both as a control, and to examine these competing possibilities regarding the relationship—if any—between age and publishing in new OA journals.

4.3.5 | Career citations received

Career citation counts for authors (including self-citations) were retrieved from the Web of Science database, by summing the citations received by each of their articles.

4.3.6 | High-income English countries

Geography influences collaboration and intellectual choices in academic publishing (Frenken et al., 2009; Wuestman et al., 2019). Political and economic resources

of the home countries of academics and their institutions influence scientific output (Agarwal & Gaule, 2020; Hunter et al., 2009; King, 2004; May, 1997). Over the 19th and 20th centuries, English developed into the predominant language in modern science, and emerged as a lingua franca in academic communication, becoming central in most academic networks (Gordin, 2015). To measure linguistic, network, economic, status and political advantages associated with geography, we created a dummy variable for scholars affiliated with institutions in English-speaking countries listed as high-income by the 2019 World Bank country classifications.

5 | RESULTS

Figure 1 illustrates the expansion of articles and journals in our study over time. These figures also reflect the exponential growth of OA publishing in general over the last 15 years (also see Piwowar et al., 2018, 2019).

The significant expansion in gray journals over time is notable. Profit-oriented publishers have historically been proactive with founding journals in new scientific niches (Willinsky, 2005). However, accelerated growth in academic publishing often entails tradeoffs with selectivity. In turn, growth is a sign of success for many journals, but can also influence publishers into a downmarket niche, as less-selective OA publishers maximize revenue—but not necessarily quality—through increases in publishing volume. Relatedly, there have been numerous expressions of concern about the rapid and unchecked growth of "gray" OA publishers. Further, long-term growth is usually based upon lower-status later adopters. Affiliation with high-status alters is a source of value in many social contexts (Podolny, 2005). Journal rejection rates are sources and signals of prestige in academia (Sugimoto et al., 2013), as academics, evaluators, and their institutions commonly use journal status as a proxy for quality. The Journal Impact Factor (JIF) is an institutionalized metric produced by Clarivate that influences the behaviors and social status of journals and scholars alike, even though the normative and methodological foundations of the JIF are widely criticized (Archambault & Larivière, 2009; Martin, 2016; Siler & Larivière, 2022).[5] Further, attaining high JIFs and per-article citation rates—which are of both academic and economic value in scholarly publishing—is difficult with large publishing volumes (Antonoyiannakis, 2020). In turn, as OA publishing has become increasingly popular in academia, journal growth and selectivity levels are in part strategic choices for publishers.

Table 1 presents summary statistics of the OA journal metadata used in our study, grouped by publisher status: high-status, gray and independent.[6] As expected, high-status-journals have authors with the highest institutional affiliation status and the most cited authors. Notably, gray journals have relatively fewer authors from high-income English-speaking countries, suggesting geographic stratification in contemporary academic communication.

Table 2 summarizes the results of 83 multivariate analyses for each OA journal in our sample, reporting the distribution of statistically significant ($p < 0.05$) results. Each model included publication year since journal founding as the dependent variable, with author institution status, gender, age, citedness, and high income/English national affiliation as independent variables. Overall trends can be gleaned from these results, although there is also substantial heterogeneity in outcomes for all variables. In general over time, authors in our sampled OA journals became affiliated with less-prestigious institutions, more commonly women, less

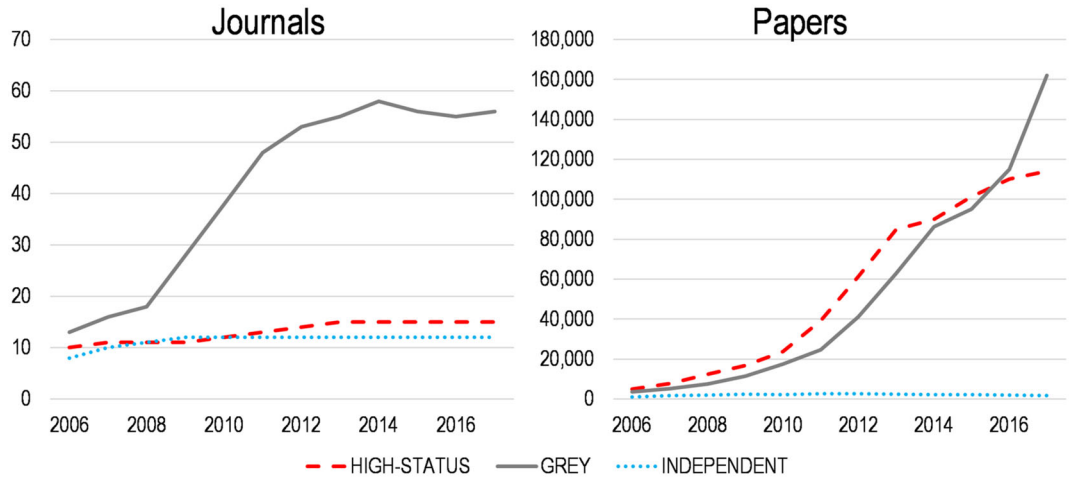

FIGURE 1 Quantity of sampled OA journals (left panel) and number of published articles in sampled OA journals (right panel), by type of publisher, 2006–2017

TABLE 1 Summary statistics of high-status, gray and independent journals

High-status journals (15 journals)	No. of observations (articles)	Mean	SD	Min	Max
Author institutional status	467,715	3.66	1.88	1.00	7.00
Woman author proportion	570,080	0.34	0.47	0.00	1.00
Author age	666,356	10.89	10.11	0.00	38.00
Author citedness	655,263	1.30	1.66	0.00	237.81
High-income English country	666,356	0.33	0.47	0.00	1.00
Gray journals (57 journals)					
Author institutional status	439,129	2.90	1.68	1.00	7.00
Woman author proportion	511,815	0.34	0.47	0.00	1.00
Author age	609,005	9.76	10.03	0.00	38.00
Author citedness	590,309	1.05	1.15	0.00	93.40
High-income English country	609,005	0.21	0.41	0.00	1.00
Small/independent journals (11 journals)					
Author institutional status	17,191	3.03	1.83	1.00	7.00
Woman author proportion	17,596	0.30	0.46	0.00	1.00
Author age	20,943	8.43	9.51	0.00	38.00
Author citedness	20,943	0.90	2.29	0.00	255.25
High-income English country	20,943	0.36	0.48	0.00	1.00

TABLE 2 Distribution of effect sizes in multivariate analysis of author demographics and publications over time in Open Access journals, 2006–17 ($N = 83$)

	Institution status/ranking	Woman author	Author age	Author citedness	High income/ English country
Significant increase	3 (4%)	36 (43%)	28 (34%)	12 (14%)	3 (4%)
Significant decrease	62 (75%)	6 (7%)	28 (34%)	41 (49%)	67 (81%)
No significant effect	18 (22%)	41 (49%)	27 (33%)	30 (36%)	13 (16%)

cited and less commonly affiliated with high-income English countries. These trends are especially strong for institutional status and high-income English national affiliation, which exhibited clear tendencies to decline over time. In contrast to these clear trends for four of the independent variables, there are essentially equal distributions of journals with increases, decreases, and nonsignificant age effects.

Despite the observed trends in OA journals towards decreasing authorial institutional status and citedness, and increased representation of women over time, there are exceptions to these general rules. A small number of OA journals defied trends and increased institutional status, representation of men and/or affiliations in high-income English-speaking countries over time. There are also substantial minorities of the journals in our sample that did not exhibit statistically significant changes in status, gender, age, citedness, and/or nationality. Even with the especially strong trends for institution ranking and high-income English-speaking countries, one-quarter and one-fifth of journals do not conform to the modal trend, respectively. Thus, even with very strong trends in institutional ranking, gender and nationality, there is also a clear minority of journals that do not experience—or even contradict—general diffusion trends.

Table 3 reports results of a multivariate fixed effects regression analysis of authorial characteristics conducive to earlier publishing in the OA journals in our study. Table 3 also distinguishes journals by legitimacy category—high-status, gray, and independent. The multivariate regression analysis applies fixed effects at the journal level. Fixed effects are used so the diffusion trajectories are measured within the unique history and author demographics of each individual journal. Further,

TABLE 3 Journal-level fixed effects analysis of author characteristics of publishing in Open Access journals over time (2006–2017)

	High-status	Gray	Independent
Author institutional status	−0.103*** (0.002)	−0.098*** (0.002)	−0.041* (0.016)
Woman author	0.207*** (0.007)	0.076*** (0.008)	0.230*** (0.058)
Author age	0.009*** (0.000)	−0.002*** (0.000)	0.028*** (0.003)
Author citedness	−0.039*** (0.002)	−0.057*** (0.003)	0.001 (0.010)
High-income English country	−0.274*** (0.008)	−0.570*** (0.009)	−0.641*** (0.059)
Constant	6.303*** (0.391)	6.184*** (0.192)	5.725*** (0.205)
Fixed effects	Journal	Journal	Journal
No. of journals	15	57	11
No. of articles	393,869	358,233	14,445

Note: Standard errors are in parentheses.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (2-tailed tests).

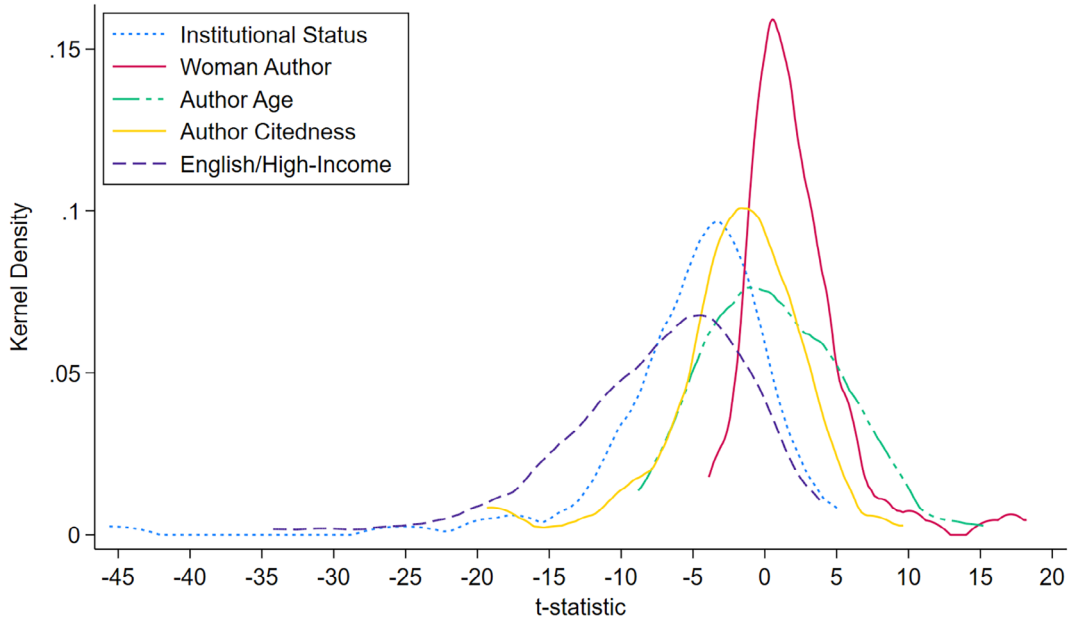

FIGURE 2 Kernel density plots of multivariate effect sizes for later publishing in Open Access journals, 2006–2017

a fixed effects analysis prevents larger journals (e.g., *PLOS One*, *Scientific Reports*) from having disproportionate influence on results. In Table 3, positive coefficients show an increase in representation over time, while negative coefficients show a decrease in representation in later years.

High-status and gray journals exhibit near identical declines of author institutional status over time, although high-status journals start from a higher initial mean institutional status level. Independent journals experience a slightly lesser decline in institutional status of authors. High-status and gray journals show a notable contrast in gender representation over time. While both high-status and gray journals exhibit increases in women representation over time, the coefficient for women authors is almost three times greater for high-status OA journals than gray journals in the multivariate model. Another important contrast between high-status and gray journals is that gray journals experienced over double the rate of decline of authors from high-income English-speaking countries over time. Authors in high-status and independent journals tend to get older over time, while gray journal authors get younger. Both high-status and gray journals experienced declines in author citedness over time, although gray journals experienced a sharper decline. Independent journals exhibited no changes in author citedness over time. Independent journals experienced similar increases in women authorship over time to high-status journals, while also experiencing a relatively large increase in author age over time.

Figure 2 shows an additional visualization of the variation of different factors influencing the diffusion of OA

authorship into different author demographics. Based on 83 separate regression analyses for each OA journal in our study, the figure illustrates kernel density plots of t-statistics from multivariate OLS regression analyses of institution ranking, woman corresponding authorship, author citedness, and high-income/English country. Once again, while there are general trends towards the authors in our 83 OA journals over time becoming affiliated with less prestigious institutions, becoming more frequently women and less cited, there is considerable heterogeneity in outcomes. For all independent variables, results range from significantly positive, significantly negative and no statistically significant relationship. However, as implied by Table 2, distributions of effect sizes vary. While author age effects assume a fairly normal distribution, the other four factors (institutional status, gender, citedness, home country) exhibit skewed effects with varying degrees of variation. Once again, this suggests that there are general demographic trends in the diffusion of OA journals through academic communities, with variation in both positive and negative directions around these general trends.

6 | DISCUSSION

Diffusion is a complex, variegated phenomenon. Our results align with past diffusion research (Bass, 1969; Menzel, 1960; Rogers, 2003) suggesting demographic and cultural differences between early and late adopters of new innovations. Empirically, our results generally align with Koppman and Leahey (2019), who also found that men and higher-status scholars affiliated with high-status institutions tend to be early adopters of new academic innovations. Although core-to-periphery diffusion was most common with our varying demographic variables for authors, there were numerous exceptions.

The OA journals in our study exhibited substantial heterogeneity in the academic niches and status levels of academic communities and innovations. Further, there was variation in degrees of change of author demographics over time. Declines in institutional status and high-income English affiliation over time were the strongest effects. There were also general trends towards increases in women authors and decreases in author citedness. While there were no clear general trends with changes in author age over the history of OA journals, there was substantial variation between journals, with equal numbers of journals remaining stagnant, accruing and losing more-experienced authors over time.

While the diffusion patterns for the 83 OA journals tended to move from core to periphery (decreased status, men authors, citedness, and high-income English countries), there was also substantial variation in diffusion patterns. Some journals exhibited no gender, age and/or geographic diffusion patterns. A few journals contradicted general trends and exhibited signs of a periphery-to-core diffusion pattern, with increases in men authors, highly-cited authors and authors affiliated with high-status institutions over time. The core-to-periphery diffusion pattern was most common across a wide spectrum of journal niches and status levels, although some journals were exceptions to these general trends. Thus, Hypotheses 1a, 1b, and 1c were generally supported. The relatively slower adoption rates of women in gray journals vis-à-vis high-status journals provides additional support for Hypothesis 1c. The modal outcome across our 83 journals was that after a new OA journal is founded, over time it exhibited decreases in male, highly-cited authors affiliated with high-status institutions and countries. However, many journals exhibited at least one deviation from this modal outcome.

Our findings also found that regardless of whether an OA journal was high or low-status, the most common diffusion outcome was a typical core-periphery model, where higher-status people and institutions adopt innovations earlier, while more marginal actors tend to adopt later. Notably, despite occasional legitimacy concerns, journals published by "gray" publishers also tended to exhibit core-to-periphery diffusion. This finding may contradict Menzel's (1960) hypothesis that less-legitimate innovations diffuse from periphery to core. Accordingly, while Hypothesis 2 was supported, as high-legitimacy journals exhibited core-to-periphery patterns, Hypothesis 3 was not supported, as journals with relatively lower legitimacy rarely exhibited periphery-to-core diffusion patterns. Egregiously fraudulent "predatory" journals (see Bagues et al., 2019; Siler et al., 2021) may possess different, less conventional diffusion patterns.

A weaker version of Hypothesis 3 positing that less-legitimate journals would experience relatively different diffusion patterns—albeit not necessarily periphery-to-core patterns—would have been supported. Gray OA journals exhibited contrasting trends with degrees and directions of changes in the gender, age and geography of authors over time vis-à-vis high-status journals. In particular, gray journals exhibited relatively slower adoption by women, and sharper decreases in author age, author citedness and representation from high-income English countries over time. Accordingly, legitimacy influences diffusion trajectories in OA publishing. Our research provides some support for Menzel's (1960) general notion that less-legitimate innovations diffuse in different manners than their higher-status counterparts.

Observed declines in institutional status and author citedness in most journals over time suggest potential downsides to successful diffusion. Growth can be a

double-edged sword, particularly when the product—in this case, publication in academic journals—is a positional good. APC-based OA publishing has altered incentives in the publishing industry. Publishers now must strategically balance costs and benefits from selectivity with costs and benefits from growth. High-status journals are imbued with pricing power and value through selectivity, while lower-status journals do not garner such benefits from selectivity and are thus incentivized to pursue volume-based publishing strategies (Siler, 2020). Affiliation with high-status alters—in this case publishing with high-status authors in shared academic journals—is a source of value (Podolny, 2005). Thus, it has been argued that OA journals exhibiting declines in the average status of authors are showing signs of professional decline (Heneberg, 2019). Since later adopters of innovations tend to be lower-status, journal growth may inevitably entail status loss.

Tradeoffs between growth and status involve strategic decisions for publishers and academic gatekeepers alike. Some publishers even attempt to strategically manage the social status of the scholars and institutions publishing in their journals. This is potentially ethically problematic, as for example, affiliations with developing countries have developed into a negative status characteristic in contemporary academic publishing (Butler, 2013). At worst, image-conscious publishers become reluctant to publish less-eminent authors from lower-status institutions.[7] Industry observers have argued that MDPI exploits a core-periphery diffusion life-cycle of new OA journals, where early issues are curated to render high Journal Impact Factors (JIFs) and positive reputations (Crosetto, 2021; Petrou, 2023). Those JIFs and positive reputations are then used to attract middle and late-adopters with profligate publishing policies (e.g., numerous "Special Issues") designed to maximize revenue over the short to medium-term. This business strategy is a sort of "vulture capitalism," where profits are extracted via declining quality and/or reputation of a reputable journal.

Analysis of the impact of later or lower-status adopters raises theoretical issues of whether middle and late adopters *enhance*, *alter*, or *degrade* the value of an innovation. For example, online social networks gain utility as more people participate. Likewise, the stadium wave at spectator events is enhanced by the participation of middle and later adopters. Social movements often depend on participation from later adopters to be successful (Granovetter, 1978; Strang & Soule, 1998). In contrast, the value of certain innovations may be diminished by middle and late adopters, particularly when innovations derive value from exclusivity or elite status (Podolny, 2005). For example, academic journals may suffer as positional goods as journals become less selective, diluting individual contributions with higher publishing volumes, and publishing authors of lower status, if not also lower quality. Given potential benefits and drawbacks to selectivity (or lack thereof), OA publishers strategically manage growth and selectivity. For example, in 2015, *PLOS ONE* reduced publications by 22% even though submissions were only down 9% (McCook, 2017). Rapid growth in OA publishing tends to raise suspicions of illegitimacy and predation (Brockington, 2022; Crosetto, 2021; Grove, 2023). In turn, the benefits and costs of growth vary for different actors, products, innovations and institutions.

Economic resources and incentives affect—and sometimes constrain—scholarly publishing decisions with OA journals (Siler et al., 2018; Solomon & Björk, 2012). However, some developing countries and institutions have developed publishing institutions to facilitate affordable OA publishing (Robinson-Garcia et al., 2019). For example, SciELO (Brazil) and Redalyc (Mexico) are examples of successful, long-established academic publishing infrastructures providing low-cost OA outlets for scholars and issues in Latin languages and countries (Packer, 2009). In some contexts, institutional rules dictate that journals not indexed by the Web of Science should not be recognized by universities (Quan et al., 2017), which strongly militates against faculty participating in new or peripheral journals.[8] The gradual legitimization and eventual encouragement of OA publishing by institutions and stakeholders in academia helped OA journals develop popularity and categorical legitimacy. The intellectual and publication choices of scholars are influenced by a variety of personal preferences and incentives set by institutions, including schools, academic disciplines and state laws. Thus, it is not surprising that the OA publishing world—like as a science as a whole—is characterized by extensive intellectual and social diversity, that can yield a variety of professional niches and diffusion outcomes.

7 | CONCLUSION

Our research adds empirical detail to the historic expansion of OA publishing in modern science, while also providing a case study to analyze how new ideas and products diffuse in science. There is considerable diversity in both institutional status and gender representation in authors of OA journals, as well as changing trajectories in status and gender over time. In general, the authors of articles in OA journals tended to become affiliated with less-prestigious institutions over time. Analogously, the OA journals in our study tended to exhibit increases in representation of women over time. These findings suggest that new OA journals tend to follow a core-periphery

diffusion pattern. However, there is considerable diversity across the spectrum of journals, with varying status and gender niches, as well as differing degrees—and directions—of change over time. While the core-periphery diffusion model was most common among the 83 OA journals in our study, there were numerous exceptions.

By examining the growth trajectory of varying OA journals, our research advances understandings of diffusion processes, while adding details about the lucrative and increasingly OA-based academic publishing market. Diffusion is a complex, variegated phenomenon. Legitimacy is a key factor that can alter diffusion paths of different innovations. However, reflecting the diversity between academic journals and communities, diffusion patterns can assume many different forms. Our research suggests that within general trends towards core-to-periphery diffusion patterns, there is substantial idiosyncrasy and variability in the diffusion patterns of new innovations. These varying diffusion patterns reveal insights into the diffusion of ideas and professional stratification orders in academia, as well as the competitive, heterogeneous multi-billion dollar academic publishing market.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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ENDNOTES

[1] Open Access publishing and the broader Open Science movement includes numerous different ideas and institutions. In our study, we solely focus on "Gold" Open Access publishing, when journals are founded solely to publish freely accessible articles via the internet. For more on the various types of OA publishing (e.g., green, hybrid), see Piwowar et al. (2018).

[2] For a detailed account on how gendered status characteristics influence risk-taking and perceptions of competence in professional contexts, see Koppman and Leahey (2019, p. 3).

[3] This excludes other types of articles identified by the Web of Science, including editorials, commentaries and corrections.

[4] The dependent variable has a 0.64 correlation with the overall year of publication, so the dependent variable is also highly correlated with the overall diffusion and legitimation of the Open Access movement over time.

[5] See Sauder et al. (2012) for an overview of the contemporary importance of third-party raters on the status positions of institutions and individuals being judged.

[6] All gray journals are for-profit institutions and all independent journals are non-for-profit. All of the high-status journals are for-profit, with the exception of *eLife*.

[7] For example, controversy arose in 2020 when MDPI's *International Journal of Environmental Research and Health* privately expressed a willingness to waive APCs for "top scholars from developed countries," but not from developing countries (Barrington et al., 2020; Marcus, 2020). MDPI also has employed a strategy of introducing new journals without APCs in hopes of attracting many early adopters, then imposing APCs once the journal has developed a corpus and a positive reputation.

[8] This strict emphasis on external legitimators is indicative of middle-status conformity (Phillips & Zuckerman, 2001). In this case, many developing nations and institutions in science seek to establish legitimacy and upward mobility.

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APPENDIX A

TABLE A1 List of 83 sampled open access journals

Journal	Average rank of author institution (scale 1–7)	Proportion women authors	Average author professional age (years)	Average author citedness	High income/ English country	*N*	Publisher	Coded tier	Journal debut year
Abstract and Applied Analysis	1.80	0.25	6.40	1.16	0.12	8358	Hindawi	Gray	2006
Applied Sciences	2.33	0.23	7.30	0.81	0.29	3762	MDPI	Gray	2011
Atmosphere	2.65	0.30	8.66	0.91	0.43	2490	MDPI	Gray	2010
Biomed Research International	2.44	0.37	9.10	0.74	0.31	27,741	Hindawi	Gray	2006
BMC Bioinformatics	3.87	0.22	8.26	1.78	0.50	14,169	BMC	High-status	2006
BMC Cancer	3.43	0.39	10.60	1.20	0.42	15,146	BMC	High-status	2006
BMC Genomics	3.70	0.31	10.27	1.58	0.49	19,820	BMC	High-status	2006
BMC Public Health	3.70	0.50	9.72	1.38	0.45	21,599	BMC	High-status	2006
Cancers	3.77	0.41	12.84	1.31	0.50	1968	MDPI	Gray	2014
Catalysts	2.43	0.28	10.83	1.10	0.32	3128	MDPI	Gray	2011
Comparative Literature and Culture	3.01	0.48	2.11	0.47	0.48	592	Purdue University Press	Independent	2008
Coatings	2.50	0.28	9.71	0.92	0.42	780	MDPI	Gray	2011
Critical Care	3.80	0.21	12.24	1.62	0.44	7231	MDPI	Gray	2006
Crystals	2.79	0.21	13.47	0.96	0.39	2902	MDPI	Gray	2011
eLife	5.37	0.30	12.60	2.01	0.47	8053	eLife	Unclassified	2012
Energies	2.56	0.22	5.99	0.98	0.32	19,402	MDPI	Gray	2008
Entropy	2.82	0.18	11.13	1.01	0.39	9194	MDPI	Gray	2008
Evidence-Based Complementary and Alternative Medicine	2.27	0.39	6.77	0.86	0.25	11,573	Hindawi	Gray	2006
Educational Technology & Society	2.33	0.40	5.32	0.81	0.38	2196	International Forum of Educational Technology & Society	Independent	2006

TABLE A1 (Continued)

Journal	Average rank of author institution (scale 1–7)	Proportion women authors	Average author professional age (years)	Average author citedness	High income/ English country	*N*	Publisher	Coded tier	Journal debut year
Electronic Communications in Probability	3.94	0.13	10.09	0.97	0.47	1271	Institute of Mathematical Statistics/Bernoulli Society	Independent	2006
Electronic Journal of Qualitative Theory of Differential Equations	1.65	0.24	8.83	0.90	0.30	1571	Bolyai Institute, University of Szeged/ Hungarian Academy of Sciences	Independent	2007
Electronic Journal of Linear Algebra	2.10	0.24	10.27	0.78	0.44	1210	International Linear Algebra Society	Independent	2006
Electronic Journal of Combinatorics	3.16	0.18	9.40	0.72	0.49	3823	Free Journal Network	Independent	2006
Frontiers in Aging Neuroscience	3.45	0.40	12.09	1.19	0.47	5638	Frontiers	Gray	2009
Frontiers in Behavioral Neuroscience	3.65	0.40	12.4	1.26	0.47	6842	Frontiers	Gray	2007
Frontiers in Cellular and Infection Microbiology	3.14	0.39	11.58	1.14	0.48	4860	Frontiers	Gray	2011
Frontiers in Cellular Neuroscience	3.38	0.40	12.84	1.20	0.45	7652	Frontiers	Gray	2007
Frontiers in Computational Neuroscience	4.08	0.18	11.25	1.15	0.49	3688	Frontiers	Gray	2007
Frontiers in Ecology and the Environment	4.25	0.32	12.87	1.88	0.42	2608	Frontiers	Gray	2006
Frontiers in Molecular Neuroscience	3.64	0.40	12.33	1.29	0.47	3630	Frontiers	Gray	2011
Forests	2.78	0.29	9.50	0.98	0.48	5342	MDPI	Gray	2010
Frontiers in Bioscience	3.54	0.32	12.30	1.18	0.49	9558	Frontiers	Gray	2006
Frontiers in Chemistry	3.07	0.33	11.98	1.16	0.44	1364	Frontiers	Gray	2013
Frontiers in Endocrinology	3.47	0.43	14.94	1.20	0.49	3318	Frontiers	Gray	2013

(Continues)

TABLE A1 (Continued)

Journal	Average rank of author institution (scale 1–7)	Proportion women authors	Average author professional age (years)	Average author citedness	High income/ English country	*N*	Publisher	Coded tier	Journal debut year
Frontiers in Human Neuroscience	3.85	0.36	11.63	1.35	0.49	16,910	Frontiers	Gray	2008
Frontiers in Immunology	3.85	0.44	13.57	1.39	0.48	17,016	Frontiers	Gray	2011
Frontiers in Microbiology	3.13	0.40	11.44	1.23	0.44	29,986	Frontiers	Gray	2010
Frontiers in Neural Circuits	4.35	0.27	12.96	1.33	0.50	3194	Frontiers	Gray	2007
Frontiers in Neurology	3.85	0.34	12.76	1.15	0.49	6100	Frontiers	Gray	2012
Frontiers in Neuroscience	3.91	0.32	12.26	1.35	0.49	11,004	Frontiers	Gray	2007
Frontiers in Pediatrics	3.93	0.38	12.21	1.06	0.50	1906	Frontiers	Gray	2013
Frontiers in Pharmacology	3.02	0.38	11.82	1.05	0.44	9128	Frontiers	Gray	2010
Frontiers in Physiology	3.43	0.33	13.05	1.07	0.47	11,336	Frontiers	Gray	2010
Frontiers in Plant Science	2.83	0.36	10.76	1.32	0.38	26,632	Frontiers	Gray	2011
Frontiers in Psychology	3.53	0.44	10.6	1.17	0.47	33,886	Frontiers	Gray	2010
Genes	3.17	0.40	11.51	1.12	0.47	2856	MDPI	Gray	2011
ISPRS International Journal of Geo-Information	2.80	0.25	5.01	0.74	0.38	1779	MDPI	Gray	2012
International Journal of Environmental Research and Public Health	3.05	0.44	8.95	0.97	0.46	22,354	MDPI	Gray	2009
International Journal of Molecular Sciences	2.48	0.38	10.17	0.91	0.33	23,135	MDPI	Gray	2006
International Review of Research in Open and Distributed Learning	2.19	0.45	2.70	0.49	0.50	1057	Athabasca University	Independent	2009

TABLE A1 (Continued)

Journal	Average rank of author institution (scale 1–7)	Proportion women authors	Average author professional age (years)	Average author citedness	High income/ English country	*N*	Publisher	Coded tier	Journal debut year
Journal of Artificial Intelligence Research	3.94	0.17	8.34	1.11	0.50	1310	AI Access Foundation	Independent	2006
Journal of Statistical Software	3.76	0.19	9.52	2.03	0.50	1462	Foundation for Open Access Statistics	Independent	2006
Marine Drugs	2.51	0.40	11.16	0.94	0.32	8944	MDPI	Gray	2006
Materials	2.59	0.29	9.45	0.92	0.33	16,934	MDPI	Gray	2008
Metals	2.40	0.24	9.06	0.80	0.30	4150	MDPI	Gray	2011
Micromachines	3.11	0.23	7.77	0.93	0.41	3412	MDPI	Gray	2010
Minerals	2.66	0.27	8.50	0.85	0.38	1894	MDPI	Gray	2011
Molecules	2.18	0.36	9.74	0.78	0.26	42,416	MDPI	Gray	2006
Mathematical Problems in Engineering	2.07	0.22	3.71	0.95	0.13	18,942	Hindawi	Gray	2006
Molecular Vision	3.35	0.37	10.22	0.86	0.48	5478	Emory University	Independent	2006
Nanomaterials	2.68	0.32	9.94	1.13	0.37	3402	MDPI	Gray	2011
Nutrients	3.07	0.51	12.17	1.16	0.43	14,176	MDPI	Gray	2009
Nature Communications	4.58	0.24	12.07	2.03	0.50	32,946	Nature	Elite	2010
PLOS Biology	5.14	0.28	12.20	1.91	0.48	4673	PLOS	High-Status	2006
PLOS Computational Biology	4.92	0.21	10.69	1.77	0.49	10,100	PLOS	High-Status	2006
PLOS Genetics	4.80	0.35	11.89	1.86	0.49	12,861	PLOS	High-Status	2006
PLOS Medicine	5.40	0.35	12.60	2.27	0.48	3138	PLOS	High-Status	2007
PLOS Neglected Tropical Diseases	3.77	0.39	13.03	1.42	0.47	11,271	PLOS	High-Status	2006
PLOS One	3.53	0.36	10.97	1.18	0.47	368,356	PLOS	High-Status	2006
PLOS Pathogens	4.65	0.35	12.63	1.62	0.49	11,743	PLOS	High-Status	2006
Polymers	2.58	0.30	9.62	1.04	0.35	6496	MDPI	Gray	2009
PeerJ	3.19	0.33	10.38	1.14	0.49	8105	PeerJ	Unclassified	2013
Religions	3.08	0.34	7.08	0.82	0.48	1776	MDPI	Gray	2010
Remote Sensing	2.97	0.24	7.66	1.29	0.42	17,576	MDPI	Gray	2009

(Continues)

TABLE A1 (Continued)

Journal	Average rank of author institution (scale 1–7)	Proportion women authors	Average author professional age (years)	Average author citedness	High income/ English country	*N*	Publisher	Coded tier	Journal debut year
Sensors	2.52	0.23	6.79	0.81	0.31	48,574	MDPI	Gray	2006
Sociological Research Online	3.51	0.57	4.95	0.76	0.40	973	Consortium before SAGE partnership in 2017	Independent	2006
Symmetry	2.54	0.24	11.30	0.78	0.39	2596	MDPI	Gray	2009
Scientific Reports	3.27	0.29	10.38	1.17	0.40	124,376	Nature	High-Status	2011
Sustainability	2.44	0.34	5.35	0.89	0.34	10,640	MDPI	Gray	2011
The Scientific World Journal	2.42	0.30	6.87	0.86	0.31	12,936	Hindawi	Gray	2006
Toxins	2.94	0.40	13.14	1.01	0.43	6676	MDPI	Gray	2009
Viruses	3.68	0.40	12.85	1.25	0.50	7866	MDPI	Gray	2009
Water	2.61	0.28	7.92	0.82	0.41	9348	MDPI	Gray	2009