The Diverse Niches of Megajournals: Specialism within Generalism

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Abstract

Over the past decade, megajournals have expanded in popularity and established a legitimate niche in academic publishing. Leveraging advantages of digital publishing, megajournals are characterized by large publication volume, broad interdisciplinary scope, and peer review filters that select primarily on scientific soundness as opposed to novelty or originality. These publishing innovations are complementary and/or competitive vis-à-vis traditional journals. We analyze how megajournals (*PLOS ONE*, *Scientific Reports*) are represented in different fields relative to prominent generalist journals (*Nature*, *PNAS*, *Science*) and 'quasi-megajournals' (*Nature Communications*, *PeerJ*). Our results show that both megajournals and prominent traditional journals have distinctive niches, despite the similar interdisciplinary scopes of such journals. These niches – defined by publishing volume and disciplinary diversity – are dynamic and varied over the relatively brief histories of the analyzed megajournals. Although the life sciences are the predominant contributor to megajournals, there is variation in the disciplinary composition of different megajournals. The growth trajectories and disciplinary composition of generalist journals – including megajournals – reflect changing knowledge dissemination and reward structures in science.

Introduction

The digitization of knowledge in the Internet age has led to several changes in academic publishing. The emergence of megajournals is a particularly important recent development. Megajournals – founded by a variety of publishers – are the fastest-growing segment of the scientific publishing market (Ware & Mabe, 2015: 156). Björk & Catani (2016) identified 6,913 articles published in megajournals in 2010, which increased to 45,656 in 2015. Megajournals are generally defined by the following characteristics: large publishing volume, evaluation criteria based mostly on scientific soundness, coverage of multiple subject areas, and full open access funded via Article Processing Charges (APCs) (Domnina, 2016; Wakeling et al., 2019). Acceptance rates in megajournals generally range from 50-70% (Björk, 2015). Such acceptance rates are higher than most journals; particularly high-status publications (see Sugimoto et al., 2013). Megajournals offer scientists unique evaluation and developmental practices, as well as new opportunities to disseminate research. Soundness-based refereeing and relatively higher acceptance rates can be of particular appeal to scholars desiring to publish work quickly. The modest rejection rates of most journals with soundness-only may also grant scholars relatively more authorial autonomy with their work, as editors and peer reviewers have less power and scope to be coercive with revisions. Further, soundness-based peer review is favorable to academic work that would be disadvantaged in 'traditional' peer review, where contributions are evaluated according to criteria beyond scientific soundness (e.g., novelty, impact).

The technical innovations of online publishing create new academic niches in scholarly publishing. Without page constraints and with soundness-based peer review, these journals also create new niches for research typically devalued by traditional peer review regimes, such as null and negative results, and replication studies. In turn, new peer review models have the potential to mitigate systemic problems in academic publishing, including publication bias and the file-drawer problem (Tsou, Schickore & Sugimoto, 2014). Megajournals fill a niche and provide institutions to facilitate interdisciplinary communication and interaction in academia (Lăzăroiu, 2017). Given the continued growth and proliferation of megajournals, as well as the unique peer review and legitimate professional niches megajournals have created, understanding megajournals is important to contemporary academic innovation and communication.

Digitization decreases marginal production costs in academic publishing and makes printed page restrictions in journals largely obsolete. In turn, journal rejection rates can be set strategically, as opposed to being circumscribed by printed page limitations. This technological change has generated new niches in scientific publishing. Wakeling et al. (2017a) identified both societal (e.g., open science) and business (e.g., system efficiency) benefits of the megajournal publishing model for academic stakeholders, including authors, publishers and funders. Björk (2018) argued that while megajournals are not necessarily revolutionary in academic publishing, they are now well-established as a legitimate option for scientists to disseminate their work. Authors choose to publish in megajournals for a variety of reasons (Spezi et al., 2017a; Wakeling et al., 2019) and tend to be pleased with their experiences, suggesting the long-term viability of the megajournal niche in contemporary science (Solomon, 2014). Since reward structures differ between academic communities (Merton, 1973; Whitley, 1984), megajournals vary in professional and scientific appeal to different scholars and fields. More specifically, this raises questions of which scholars and academic fields have been most likely to publish in megajournals, and which have been late or reluctant adopters.

This article examines the current and historical niches of megajournals, focusing on disciplinary differentiation and comparisons with prominent traditional journals. More specifically, the article identifies which academic communities have embraced megajournals—both in terms the publication space these journals have taken as well as of the scholarly impact of the papers they published—and how these trends have changed over time. More broadly, the article analyzes the historical trajectories and current states of prominent megajournals, comparing them with high-impact multidisciplinary journals. Analyzing megajournals provides a means of understanding a new and increasingly important scholarly niche for creativity and legitimate knowledge dissemination in contemporary academia.

Megajournals and Scientific Reward Structures

Merton (1968, 1973) posited that scientists are influenced by professional reward structures. Priority – being the first to publish a novel idea or discovery – is of particular value (Dasgupta & David, 2002). Academic journals act as conduits for disseminating new ideas and information, and also serve as symbols of academic status and legitimacy (Meadows, 1979; Pontille, 2004). Further, academic journals can function as institutions that spur societal change, as well as professional legitimation (Brienza, 2015). As per McLuhan (1964), the medium – where an academic article is published – is often a large part of the message conveyed by both the scientist and the journal.

Megajournals occupy both complementary and competitive niches vis-à-vis other academic journals, including established legacy journals, journals with narrow disciplinary orientations and other OA publishing options. Since most academic reward structures value publication in high-rejection traditional journals, this may limit growth potential of megajournals without large-scale cultural change in scientific norms of meritocracy (Wakeling et al., 2017b). Despite the entrenched pre-eminence of high-status print journals, megajournals have filled a viable niche in contemporary science, creating new opportunities and servicing previously unmet demand. Scientists tend to initially submit work to relatively prestigious journals, then cascade rejected papers down the status hierarchy (Calcagno et al., 2012). Despite this trend, megajournals are increasingly the first – if not only – choice for scientists attempting to publish peer-reviewed work (Wakeling et al., 2017b).

When deciding where to submit their work, scholars strategically consider megajournals in light of prevailing institutional reward structures influencing their careers, as well as the potential for interdisciplinary reach and evaluation (Wakeling et al., 2018). As the megajournal publishing model accrues legitimacy, megajournals rely less on cascaded submissions and publish more articles that were initially targeted for them. This suggests that megajournals offer some scholars a legitimate publishing option that is congruent with the professional reward structures of their intellectual and professional fields. In particular, peer review systems that evaluate submitted manuscripts solely on scientific soundness – as opposed to perceived novelty or impact – are of particular appeal to many researchers (Spezi et al., 2017b). Due in part to the speed and innovative advantages of soundness-only peer review, as well as the immediacy and ease of disseminating open access publications publicly, megajournals have established a viable niche in contemporary science.

The Unique Institutional and Intellectual Niches of Megajournals

Competitive ecologies can simultaneously support generalist and specialist niches (Freeman & Hannan, 1977). In the often highly-specialized scientific and professional fields of science, generalist journals have traditionally assumed a small, but prominent niche. Generalist interdisciplinary journals are relatively uncommon in science[1], and with a few notable exceptions, tend to be relatively low-status. Clarivate's Web of Science 'Multidisciplinary Sciences' category is comprised of only 64 journals out of 11,365 total journals indexed in the 2016 Journal Citation Report. Although most journals in this category are not widely-known, the category includes three of the most widely-read and cited journals in the world (*Science*, *Nature*, *Proceedings of the National Academy of Sciences*). Another new online-only journal, *Nature Communications* – an imprint with the high-status *Nature* brand – was founded in 2010 and quickly amassed a very high Journal Impact Factor (12.124 as of 2017), despite its short history. Given the high volume of articles megajournals publish, even a small number of successful megajournals represent a substantial uptick in the generalist niche in academic publishing.

[1] A possible explanation for the relative paucity of generalist journals in science is that fast-moving environments tend to increase the value of specialization (Teodoridis et al., 2018). Given that science is often fast-moving, gains to specialization may be expected for both scientists and publishers (see Leahey, 2007).

Online publishing – and the concomitant rise of megajournals – is an example of how academic opportunity structures and incentives have changed in the digital age. Megajournals have led to changing incentives in academia while establishing congruence with the reward structures of different fields. By garnering legitimacy and establishing credence in the hiring/promotion/tenure reward structures of science, megajournals have added to the available intellectual and professional opportunities for academics.

Megajournals as Peer Review Innovation

Rejection rates influence both gatekeeping and gestational processes in peer review by influencing evaluative cultures and incentives. In turn, rejection rates shape the types of science that survive peer review, as well as how peer review alters articles that are eventually published. For example, there are innovative implications of typical peer review philosophies in high-rejection print journals. Alberts et al. (2014) argued that low acceptance rates in scientific journals crowds out innovative research. Ellison (2002) posited that academic articles have two quality dimensions; *q* (main ideas), and *r* (other aspects of quality). *R*-qualities are more mutable than *q*-qualities. In turn, peer review tends to concentrate on *r*-qualities. Ellison argued that decreasing acceptance rates and intensifying competitive pressures in peer review result in disproportionate emphasis on *r*-qualities in the peer review process. This evaluative strategy favors more conventional contributions and is prone to homogenizing academic work. The competitive pressures of high-rejection journals have additional implications for scientific innovation. In a study of an elite social science journal, Strang & Siler (2015) observed that peer review disproportionately focused on rhetorical framing and other theoretical matters, underemphasizing data and empirics. Balietti et al. (2016) found that increasing competitiveness in peer review improved innovation, but also more unfair reviews and lower inter-rater reliability. In turn, there may be innovative and professional benefits with megajournals both systemically and for individual scholars, due to their relatively moderate rejection rates and evaluative criteria primarily focusing on scientific soundness.

From a journal's perspective, there can be risks and benefits associated with reporting new and counterintuitive results. Past research has shown publication biases towards publishing false positives and not releasing null results in science, which distorts the scientific record (Dickersin, 1990; Ioannidis, 2005). Brembs et al. (2013) argued that high-status journals with missions to disseminate leading, cutting-edge research are especially prone to publishing unreliable science. The competitive emphasis on novelty in high-rejection journals also contributes to longer papers and review times (Ellison, 2002). With new peer review cultures and gatekeeping philosophies, OA journals offer potential solutions to these potentially perverse incentives in science. Relatively less-selective journals based on soundness-only peer review also may also further enable the Ortega Effect in science, which posits that science is advanced incrementally via the work of relatively undistinguished scientists, as opposed to radical breakthroughs by eminent scientists (Cole & Cole, 1972). By providing a legitimate, moderately-selective publication outlet without demands for large innovative advances, megajournals have further amplified opportunities and incentives for undertaking and publishing scientific work not intended to be paradigm-shifting. In turn, megajournals have changed the publishing landscape and scientific opportunity structure by offering new peer review philosophies, diversifying the ecology of scientific publishing.

Despite steep hierarchies in journal and institutional status in science – where abstraction is highly professionally valued (Abbott, 1988) – scientific innovation often emerges via applied, non-theoretical work. In particular, scientific research often benefits from links from outside of academia, where scientific inquiry is not necessarily bound by prevailing academic cultures and orthodoxies (Evans, 2010). Thus, there may be gatekeeping and developmental advantages to peer review systems based solely on scientific soundness, relative to systems with additional filters for attributes like novelty and theoretical significance. Without obligations to frame articles vis-à-vis established perspectives in a field, the relative lack of constraint of a soundness-only peer review system can offer innovative advantages. With fewer canonical or theoretical fetters, scientists can disseminate new discoveries and innovations that may have been of less interest to the sometimes abstract and idiosyncratic preferences of highly-selective print journals.

Peer review influences academic reward structures and in turn, impacts creative and career decisions by individual academics. Varying peer review filters can refract different incentives and types of creativity. For example, peer review regimes can vary in regards to toleration of failure (Azoulay et al., 2011), preference for polarizing contributions (Langfeldt, 2001), authorial autonomy granted to authors (Bedeian, 2003), elements of research scrutinized in peer review (Ellison, 2002; Strang & Siler, 2015), preference for specialist or integrative work (Guetzkow et al., 2004) and rejection rates (Hargens, 1990). Megajournals represent a new and unique model for scholarly gatekeeping, manuscript development and dissemination in contemporary science. Given the unique scholarly philosophies and innovations of megajournals – and related OA journals – this raises the question of how such publication outlets have developed and diffused in contemporary academic publishing.

METHODS

The central research question we examine is: what are the disciplinary niches of megajournals in contemporary science? More broadly, we are also analyzing how various types of journals occupy different professional and intellectual niches in the scientific landscape. In particular, we examine the published output – articles and reviews – of various megajournals and compare them with leading multidisciplinary journals. Seven journals are analyzed: three leading traditional multidisciplinary journals (*Nature*, *PNAS*, *Science*), two established large-scale megajournals (*PLOS ONE* and *Scientific Reports*), and two prominent fledgling multidisciplinary journals (*Nature Communications*, *PeerJ*). *Nature Communications* is a unique case among new academic journals in general due to its relatively high Article Processing Charges (APCs) and high rejection rate. In these regards, despite its generalist and Open Access nature, *Nature Communications* contrasts with the archetypal megajournal, offering an 'upscale' identity within the generalist Open Access publishing market. Table 1 summarizes general information on each of our focal journals. Table 2 categorizes our focal journals based on the four main criteria of megajournals: large publishing volume, soundness-only evaluation, coverage of multiple subject areas, and full open access articles funded via APCs. In our analyses, the two largest megajournals (*PLOS ONE*, *Scientific Reports*) will be compared and contrasted with conventional generalist journals (*Nature*, *PNAS*, *Science*) and two quasi-megajournals that partially adhere to typical megajournal criteria (*Nature Communications*, *PeerJ*).

Publication counts for these journals were retrieved from Clarivate Analytics' Web of Science (WoS). The built-in classification of this database—as well as of other citation indexes—is made at the journal level and is therefore of limited use to measure the relative importance of disciplines within each of the multidisciplinary journals analyzed. Therefore, to assign a discipline and specialty to each paper published in the seven journals analyzed, we used each article's set of cited references, to which we assigned a discipline and specialty based on the journal classification used created for the National Science Foundation (Hamilton, 2003). Each article's discipline and specialty was defined as the field that accounted for the largest share of cited references in the article. In rare cases of ties, the article was randomly assigned to one of the tied specialties. Given most papers published in megajournals are in scientific and medical disciplines, which have a higher percentage references made to source items (Sugimoto & Larivière, 2018), the vast proportion of references cited by the papers under study could be assigned a discipline and specialty. More specifically, 93.5% of all references cited by those megajournals (23,935,542) were to other WoS papers.

Citation rates for each article were compiled using an open citation window (i.e., from publication year until the end of 2017). Following standard practice, citation rates were normalized by publication year and specialty (Waltman et al., 2011), which allows us to compare the mean impact of articles from different domains and publication years. When mean normalized citation rates are above one, it means that articles have a higher impact than average; when it is below one, it means the opposite. In total, the articles in our dataset cover 30,159,925 articles and reviews published between 2000 and 2017; 383,306 of which are published in the seven megajournals analyzed.

Table 1. Characteristics of Scientific Journals and Publishers Analyzed

	Founded	APC ($USD)	Acceptance Rate	Publisher	OA/Subscription	Journal Impact Factor (2017)	Published Articles (2017)
Nature	1869	N/A	<10%[2]	Nature Publishing Group/Holtzbrinck Publishing Group	Subscription	41.577	802
Science	1880	N/A	<10%[3]	American Association for the Advancement of Science	Subscription	41.058	702
***Proceedings of the National Academy of Sciences* (PNAS)**	1915	$1700 ($3150 immediate OA)	16-19% (direct submissions)[3]	National Academy of Sciences	Subscription/6-month delayed Open Access	9.504	3260
PLOS ONE	2006	$1595	~50%[4]	Public Library of Science	Open Access	2.766	19920
Nature Communications	2010	$5200	8%[5]	Nature Publishing Group/Holtzbrinck Publishing Group	Open Access	12.353	4304
Scientific Reports	2011	$1760	55%[6]	Nature Publishing Group/Holtzbrinck Publishing Group	Open Access	4.122	24806
PeerJ	2012	$1095[7]	58%[8]	PeerJ Inc.	Open Access	2.118	1346

[2] https://www.nature.com/news/open-access-journal-elife-gets-25-million-boost-1.20005

[3] http://www.pnas.org/content/113/14/3702 *PNAS* also accepts Contributed Submissions from NAS members. In 2013, 98% of Contributed submissions were published: https://www.nature.com/news/scientific-publishing-the-inside-track-1.15424

[4] https://retractionwatch.com/2017/03/15/plos-one-faced-decline-submissions-new-editor-speaks/

[5] https://medium.com/@journalsfriend/nature-communications-should-you-publish-here-c4e384f8608d

[6] https://peerj.com/articles/981/#results

[7] *PeerJ* also offers lifetime memberships from $399-$499(USD) offering one, two or five annual publications, contingent on all authors of an accepted article also being *PeerJ* members.

[8] https://peerj.com/blog/post/115284878470/what-are-my-chances-of-being-accepted-at-peerj/

Table 2. Journal Overlap with Main Megajournal Characteristics

	Large Publishing Volume	**Soundness-only Peer Review**	**Multiple subject areas**	**Full Open Access via APCs**
MEGAJOURNALS				
PLOS ONE	Yes	Yes	Yes	Yes
Scientific Reports	Yes	Yes	Yes	Yes
CONVENTIONAL GENERALIST JOURNALS				
Nature	No	No	Yes	No
Proceedings of the National Academy of Sciences (PNAS)	No	No	Yes	No – Hybrid OA option with extra APC to forego standard 6-month embargo.
Science	No	No	Yes	No
QUASI-MEGAJOURNALS				
Nature Communications	No – but growing	No	Yes	Yes
PeerJ	No – but growing	Yes	Yes – currently limited coverage outside life sciences	Yes

RESULTS

As shown in Figure 1, *Scientific Reports* has displaced early entrant *PLOS ONE* as the most prolific megajournal. The recent decline in *PLOS ONE* publications is at least partially strategic, as the journal has recently reduced its acceptance rate. Total publications in *PLOS ONE* declined 22% from 2015 to 2016, but submissions were only down 9% (Davis, 2017; McCook, 2017). The decline in submissions at *PLOS ONE* has also likely been influenced by the emergence of alternative publication outlets in the growing OA/megajournal market, such as *Scientific Reports*. The number of publications by the traditional journals have stayed fairly constant since 2000, although there has been a gradual increase in *PNAS* publications. The recent entrants in our sample – *Nature Communications* and *PeerJ* – are exhibiting signs of growth but are currently much smaller than *PLOS ONE* and *Scientific Reports*.

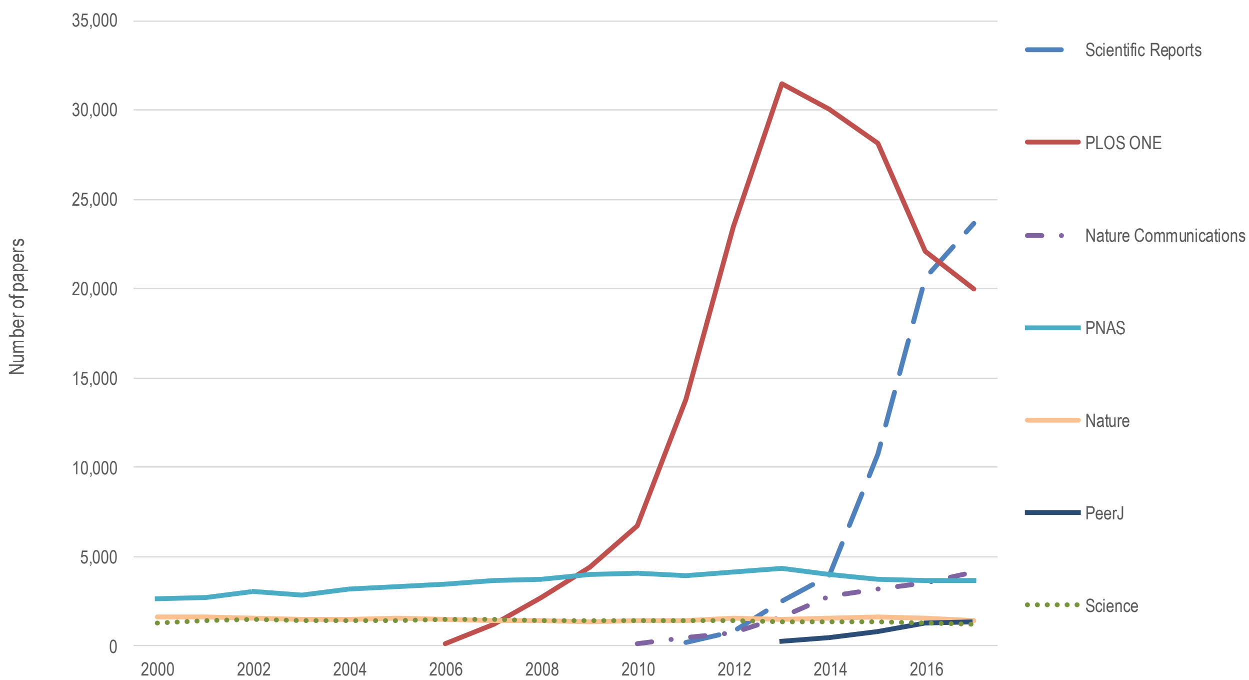

Figure 1. Number of papers published annually, by journal, 2000-2017

Table 3 presents the percentage of each journal's articles that are published in each of the disciplines (left panel), and the percentage of each discipline's articles that are published in each of those journals. Among the established journals, *Nature* and *Science* are mostly similar in their disciplinary composition, although *Science* publishes more slightly more Chemistry and less Biomedical Research and Clinical Medicine than *Nature*. *PNAS* is differentiated from *Nature* and *Science*, more prominently featuring Biomedical Research and Clinical Medicine, with small proportions of Earth and Space and Physics articles. *Nature Communications* resembles *Nature* and *Science* in disciplinary composition, although Physics and Engineering feature more prominently than in *Nature* or *Science*. In contrast, Earth and Space articles are not nearly as common in *Nature Communications* as in *Nature* or *Science*, instead resembling the other journals in our sample. *PeerJ* has a particularly unique – and nascent – niche as a journal, focusing strongly on Biology, Biomedical and Clinical Medicine. The two large, established megajournals – *PLOS ONE* and *Scientific Reports* – exhibit numerous differences in disciplinary composition. Medicine, Biomedical and Biology are more prominent in *PLOS ONE* than *Scientific Reports*. While *PLOS ONE* shares a strong focus on life sciences with *PNAS*, *PLOS ONE* inverts the relative distribution of Biomedical Research and Clinical Medicine with *PNAS*. *PNAS* is more focused on Biomedical Research, while *PLOS ONE* has a stronger focus on Clinical Medicine. Those three life science categories alone account for 90.2% of *PLOS ONE*'s published output, while accounting for 65.0% of *Scientific Reports*. In turn, while the life sciences appear to be the biggest adopter of megajournals in general, this niche is more dominant in *PLOS ONE* than *Scientific Reports*. Although life sciences are also prominent in *Scientific Reports*, the journal also publishes a strong minority of articles from the physical sciences, particularly Engineering and Physics.

Table 3. Percentage of papers published in each journal, by discipline (left panel) and percentage of papers published in each discipline, by journal (right panel), 2000-2017

Discipline	Percentage of each journal's number of papers							Percentage of each discipline's number of papers						
	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS One	Scientific Reports	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS One	Scientific Reports
Arts	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Biology	7.1%	6.2%	8.9%	3.7%	31.9%	10.4%	7.7%	0.1%	0.2%	0.1%	0.0%	0.1%	1.0%	0.2%
Biomedical Research	37.0%	51.9%	31.8%	35.0%	28.8%	31.3%	26.9%	0.3%	1.1%	0.3%	0.2%	0.0%	2.0%	0.6%
Chemistry	3.6%	3.0%	6.2%	9.3%	0.6%	0.5%	5.3%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%
Clinical Medicine	17.7%	26.2%	15.4%	17.0%	23.5%	48.5%	30.4%	0.0%	0.2%	0.0%	0.0%	0.0%	0.9%	0.2%
Earth and Space	17.7%	3.8%	17.3%	5.5%	6.0%	1.5%	4.2%	0.4%	0.2%	0.3%	0.1%	0.0%	0.2%	0.2%
Engineering and Technology	2.0%	1.1%	3.2%	9.8%	0.6%	1.2%	9.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%
Health	0.3%	0.1%	0.4%	0.0%	1.3%	1.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%
Humanities	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mathematics	0.2%	0.6%	0.1%	0.0%	0.4%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Physics	11.5%	3.8%	10.9%	19.0%	0.3%	0.9%	14.3%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.4%
Professional Fields	0.4%	0.2%	1.0%	0.0%	0.8%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Psychology	1.0%	1.4%	1.8%	0.3%	5.1%	2.6%	0.9%	0.0%	0.1%	0.1%	0.0%	0.0%	0.8%	0.1%
Social Sciences	1.6%	1.8%	2.9%	0.3%	0.7%	0.9%	0.3%	0.0%	0.1%	0.1%	0.0%	0.0%	0.2%	0.0%

Table 4 reports ratios expressing the relative specialization of each journal, in each discipline. For example, if a journal publishes 4% of its articles in a given discipline, and that discipline accounts for 2% of articles across all fields, the specialization of that journal in that discipline would be 2.0, which means that the journal publishes twice as many articles in that discipline as it would be expected. High-status 'generalist' journals assume varying levels of specialization in different disciplines. *Nature* and *Science* are relatively specialized in Biomedical Research and Earth and Space, and to a lesser extent, Physics.

PNAS is similar to *Nature* and *Science*, but is even more specialized. There is only one discipline in which *PNAS* is relatively specialized (Biomedical Research) and one in which it publishes as much as expected (Biology). In all other disciplines, *PNAS* is relatively less active than expected. Like traditional generalist journals, megajournals and quasi-megajournals are heavily specialized in the life sciences. However, megajournals and quasi-megajournals also attracted specific research communities, such as Physics in the case of *Nature Communications* and *Scientific Reports*, and Psychology in the case of *PLOS One* and *PeerJ*. The strong affinity between *Nature Communications* and *Scientific Reports* may be due to the fact that both journals are owned by Springer-Nature, and that in the case of a rejection from *Nature Communications*—which has a higher Impact Factor (and APCs)—papers can be directly 'cascaded' to *Scientific Reports*. On the whole, all journals analyzed are heavily focusing on Biomedical Research. Although the relative lack of specialization in social sciences and humanities was expected, it was surprising that none of the journals analyzed—traditional generalist journals, megajournals, and quasi megajournals— specialized in mathematics. In turn, the mathematics community may still prefer to publish in their disciplinary journals.

Table 4. Relative specialization of each journal, by discipline, 2000-2017

Discipline	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS One	Scientific Reports
Arts	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Biology	1.1	1.0	1.4	0.6	5.0	1.6	1.2
Biomedical Research	3.8	5.3	3.3	3.6	2.9	3.2	2.8
Chemistry	0.4	0.4	0.7	1.1	0.1	0.1	0.6
Clinical Medicine	0.5	0.8	0.5	0.5	0.7	1.4	0.9
Earth and Space	4.1	0.9	4.0	1.3	1.4	0.3	1.0
Engineering and Technology	0.2	0.1	0.3	0.9	0.1	0.1	0.9
Health	0.1	0.0	0.2	0.0	0.6	0.5	0.0
Humanities	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mathematics	0.1	0.2	0.1	0.0	0.2	0.1	0.1
Physics	1.6	0.5	1.5	2.6	0.0	0.1	2.0
Professional Fields	0.1	0.1	0.4	0.0	0.3	0.2	0.0
Psychology	0.5	0.7	0.9	0.1	2.5	1.3	0.5
Social Sciences	0.4	0.5	0.8	0.1	0.2	0.3	0.1

Similar trends are observed at the level of specialties. Figure 2 (and Appendix) present the percentage of papers from each journal that are published in each specialty, for specialties that account for at least 1% of papers published in each journal. Specialties from the Clinical Medicine and Biomedical Research (Biochemistry & Molecular Biology, Genetics & Heredity, etc.), as well as Ecology and Botany (at the middle of Figure 2) are covered by all journals, while other specialties are more likely to be published in specific journals or groups of journals. *Science* and *Nature* roughly cover the same specialties, while *Scientific Reports*, *PNAS* and to a lesser extent, *Nature Communications* also exhibit similar disciplinary niches. *PLOS One* and

PeerJ are slightly isolated from the other groups of journals. *PLOS ONE* exhibited a greater emphasis on medical specialties that are less-covered in *PLOS ONE*, while *PeerJ* exhibited a disproportionate focus on Biology.

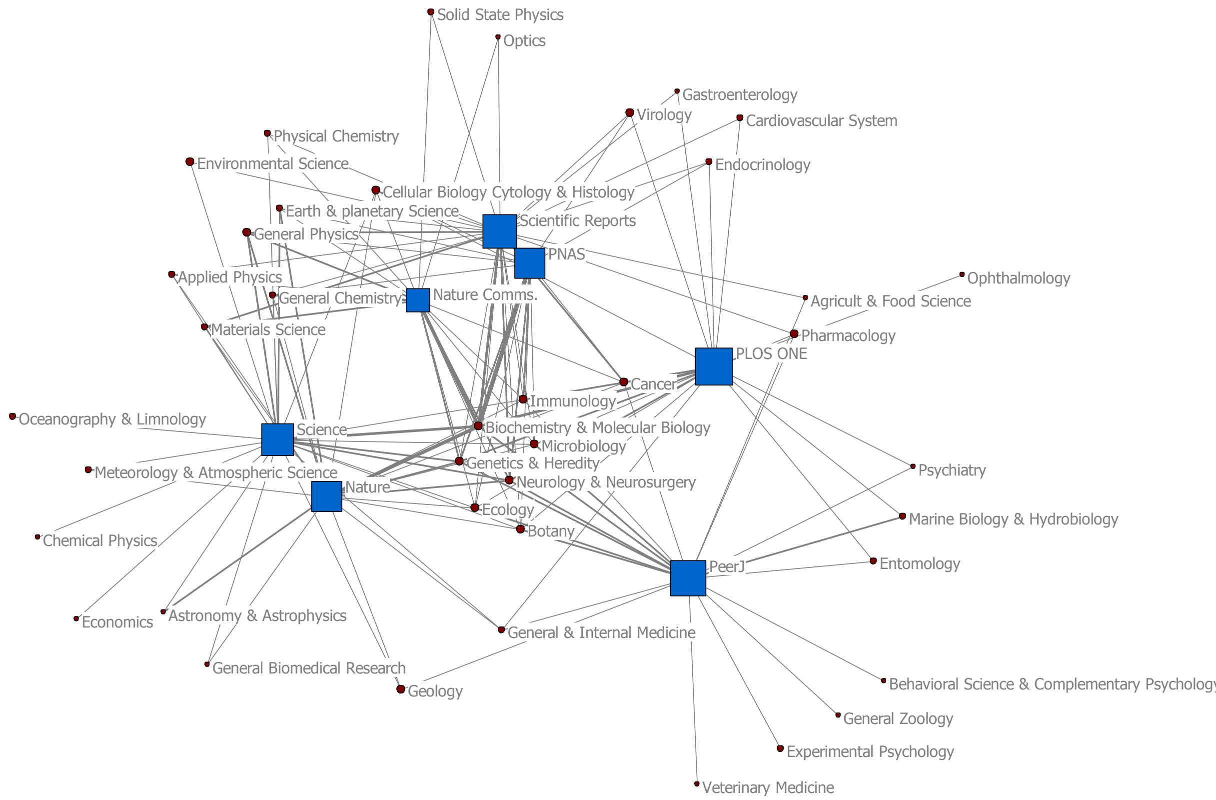

Figure 2. Relationships between journals (blue squares) and specialties (red circles). Only specialties that account for 1% or more of papers published in each journal are shown. Size of the nodes indicate degree centrality of journals/specialties; size of edges indicate relationship strength.

A broad, overarching finding that can be surmised from Tables 3 and 4 is that there is considerable differentiation within the megajournal category, particularly when compared to other large generalist journals. While megajournals are differentiated from established traditional journals, they also differentiate from each other. As shown, the two most prominent megajournals, *PLOS ONE* and *Scientific Reports*, show distinctive concentrations and niches. Given its strong concentration in the life sciences and relative lack of coverage in Chemistry, Physics and Engineering, *PeerJ* could perhaps be classified as a nascent or aspirational megajournal. In January 2019, *PeerJ* has announced that it will expand into the field of chemistry with the introduction of five new chemistry journals (PeerJ Community, 2018). This suggests a business model – like *PLOS ONE* – where megajournals function as an 'anchor' for publishers, establishing a brand to support other more specialized journals. By supplementing megajournals with more specialized alternatives, this differentiation allows publishers to target multiple markets (e.g., generalist and specialist at various APC levels) simultaneously.

Specific Journal Niches and Growth Trajectories

PLOS ONE

Figure 3 shows that *PLOS ONE* is dominated by research in the life sciences, specifically Clinical Medicine, Biomedical Research and Biology. Over time, the proportion of articles in Biomedical Research has declined, although this has been offset by increases in Clinical Medicine and Biology. Currently, a single discipline – Clinical Medicine – accounts for over half of *PLOS ONE*'s total publications. There are also proportionally small auxiliary niches for other disciplines in *PLOS ONE*, which have slowly increased over time. However, as of 2017, apart from the three largest life science disciplines, no other single discipline comprises more than 3% of *PLOS ONE*'s published output.

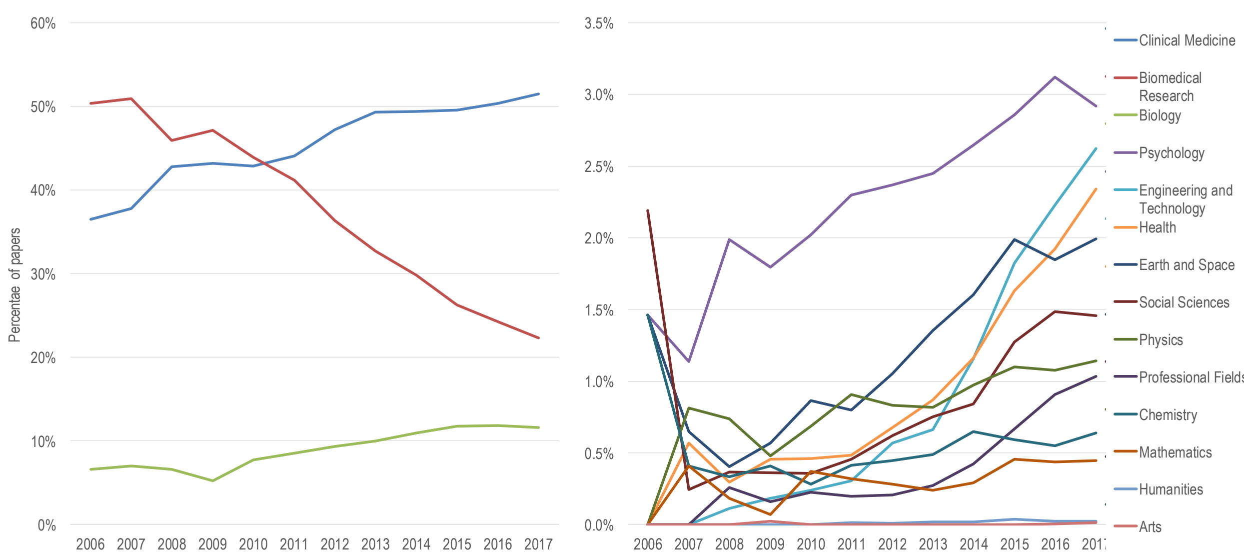

Figure 3. Percentage of papers published in *PLOS ONE*, by discipline

Scientific Reports

Figure 4 reports the proportional distribution of articles published in *Scientific Reports* over its history. *Scientific Reports* exhibits more disciplinary heterogeneity than *PLOS ONE*. Similar to *PLOS ONE*, Clinical Medicine and Biomedical Research are the most commonly published disciplines in *Scientific Reports*. A major difference between *Scientific Reports* and *PLOS ONE* is the prominent auxiliary niche Physics occupies in *Scientific Reports*, while being relatively absent in *PLOS ONE*. In 2012, Physics was the most frequently published discipline in *Scientific Reports*, although this proportion has declined since then. A smaller but significant niche in Engineering and Technology exhibits a similar trend, suggesting that both theoretical and applied physicists have found a niche in *Scientific Reports*. Biology has a similar small niche, hovering between 5-10% over the history of *Scientific Reports*, which is slightly below its proportional level of prominence in *PLOS ONE*. The recent growth of *Scientific Reports* is largely driven by Clinical Medicine and Biomedical Research. Over time, *Scientific Reports* increasingly resembled *PLOS ONE* with its relative dominance of the life sciences. However, smaller niches in fields like Physics, Engineering and Technology, and Chemistry continue to persist in *Scientific Reports*. Even if the absolute number of articles published in those fields have recently leveled off, there is yet to be evidence of significant decline or retrenchment in published output in those fields.

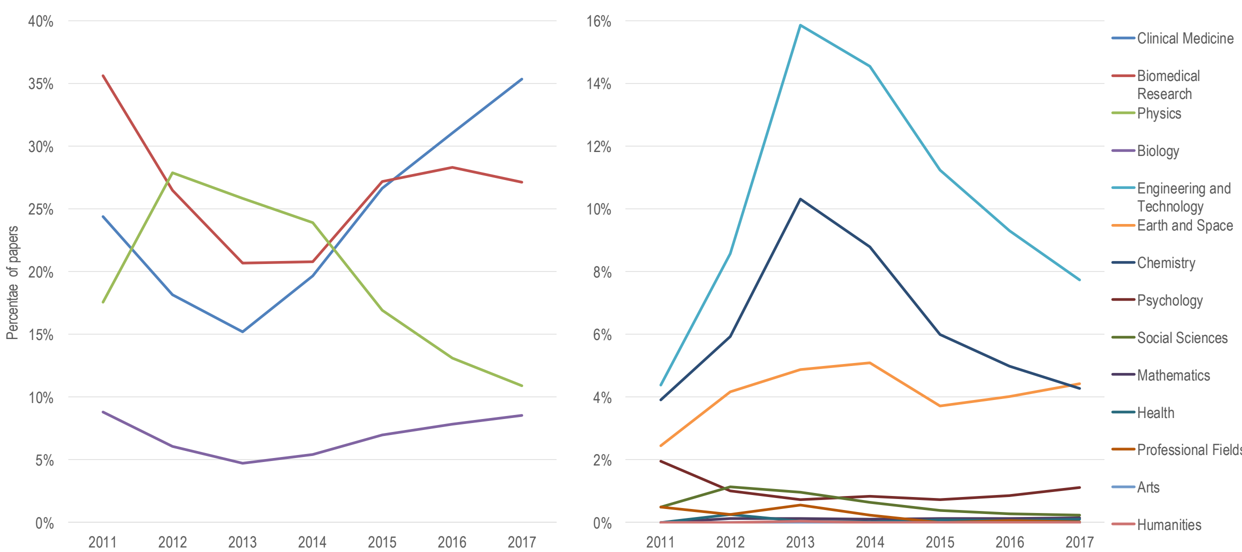

Figure 4. Percentage of papers published in *Scientific Reports*, by discipline

Citation Impact

Table 5 reports average citation rates of articles published in various disciplines and journals. There is considerable heterogeneity in citation rates by both journals and disciplines. The status hierarchy in academic publishing is apparent, with *Nature* and *Science* receiving substantially more citations than other journals, followed by *PNAS* and *Nature Communications*. There is clear demarcation in citation impact between megajournals, conventional generalist journals and quasi-megajournals. The relatively stronger citation performance of *Nature Communications* vis-à-vis other megajournals suggest returns to the selectivity and exclusivity of the journal, and also perhaps enables its relatively high Article Processing Charges. Within each journal, the variation in citation rates across varying disciplines suggests heterogeneity in the academic strength and impact of individual journals (see Leydesdorff & Shin, 2011). Comparing the two largest megajournals – *PLOS ONE* and *Scientific Reports* – *PLOS ONE* currently shows small citation advantages in the highly-populated Biomedical Research and Clinical Medicine fields.

Table 5. Field-normalized citation rates of papers published in the various journals

Discipline	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS One	Scientific Reports
Arts					0.0	1.5	
Biology	9.1	3.9	8.1	2.8	0.6	1.1	0.9
Biomedical Research	8.4	2.1	6.8	1.7	0.6	0.7	0.6
Chemistry	10.9	2.3	9.0	2.9	0.1	0.7	1.0
Clinical Medicine	11.2	2.7	8.6	2.1	0.3	0.9	0.6
Earth and Space	5.4	3.3	6.1	1.6	0.7	1.0	0.9
Engineering and Technology	17.8	4.0	18.7	4.3	2.0	0.8	1.3
Health	18.4	7.9	12.2		0.5	1.1	1.2
Humanities	0.0	9.6	8.7			4.0	
Mathematics	40.6	2.9	33.7	1.4	0.6	1.4	4.3
Physics	13.0	3.6	11.8	4.1	0.9	1.0	1.6
Professional Fields	1.5	4.1	7.7		0.7	1.3	2.0
Psychology	4.7	2.7	5.3	1.7	0.6	0.8	0.8
Social Sciences	12.3	5.0	9.9	6.0	0.4	1.3	2.0
All Disciplines	9.1	2.6	8.3	2.7	0.5	0.8	0.9

DISCUSSION

Our results show that the examined generalist journals – whether a megajournal, conventional journal or quasi-megajournal – all exhibited unique niches in terms of publishing outcomes and disciplinary composition. Generalist journals may be eclectic in theory and mission, but are less so in practice, despite their generalist orientation and peer review philosophies. While *Nature* and *Science* were relatively similar, the remainder of our journals exhibited considerable heterogeneity. Generalist journals – and more specifically, megajournals – share institutional forms and logics. Despite the commonalities between megajournals, publishing niches and outcomes varied considerably, contributing to the diverse, competitive ecology of contemporary academic communication.

Megajournals are particularly popular in the life sciences (Biology, Medicine and Biomedical Research). This raises the question of why the life sciences have been relatively receptive to publishing in megajournals. Björk and Solomon (2012) also argued that in biomedical and healthcare fields, researchers are more likely to be supported by grants that mandate and/or enable Open Access through earmarked funds (e.g., mandates from the Wellcome Trust or National Institute of Health). Particularly in fields without strong pre-print cultures, OA journals offer the only reputable alterative to get publicly-accessible peer-reviewed work published quickly.

Nature Communications stands out as a new generalist alternative with a unique OA niche with high selectivity and cost. In its short history, *Nature Communications* has already developed citation impact above other 'conventional' megajournals, although it is not at the level of *PNAS*. This could be due to journal selectivity, self-selection of authors and/or leveraging the resources of the *Nature* brand. However, whether individual scientists – or scientific benefactors in general – receive good value for the relatively high APCs at *Nature Communications* is an open question.

Whether purposely or not, the generalist journals analyzed exhibited at least some degree of specialism. This differentiation and specialization could be driven as much by the submissions and preferences of scholars, as it is deliberate strategic choices or marketing on the part of journals or publishers. Differences in journal disciplinary composition could be strategic, path-dependent (imprinting) and/or simply random. A strategic benefit of product differentiation is that it reduces competition (Shaked & Sutton, 1982). Differentiation can also exploit benefits from less-crowded niches and gains from specialization (Hannan & Freeman, 1977). Randomness and historical path-dependence alone are also possible explanations for niche differences between journals. Social differentiation can occur even in the absence of initial differences (Mark, 1998). Thus, it is unsurprising that our results show differences both between and within the legacy print journals (*Nature*, *PNAS*, *Science*) and the newer OA journals (*Nature Communications*, *PeerJ*, *PLOS ONE*, *Scientific Reports*), given the historical and institutional differences between the publications.

Nascent institutions are particularly susceptible to influence by people, laws, populations and social relationships prevalent in the environment at the time of founding. This phenomenon is known as *imprinting* (Stinchcombe, 1965: 142). Although founding periods are far more recent for the megajournals than *Nature*, *Science* and *PNAS*, the notion that institutions develop unique niches and cultures over time is applicable to both new and old scientific journals. For example, Baldwin (2015) chronicled the unique historical trajectory of the journal *Nature* since its inception in 1869. In turn, scientific journals can acquire identities, reputations and niches in a path-dependent process, where initial founding conditions influence the historical trajectory of journals, as well as their intellectual and professional communities. Carley (1991) posited that repeated interaction leads to shared knowledge, which begets future interactions, fact complexity and group distinctiveness. This is applicable to all academic journals – whether generalist or specialist, upmarket or downmarket – which develop unique histories, conversations and identities through their published corpora over time. Our analyses suggest that *PLOS One* was imprinted as a life sciences-dominant journal and *Scientific Reports* was imprinted as a physics-dominant journal. However, since these foundational periods, both journals exhibited differentiation and development in their disciplinary composition.

Abbott (2001) posited that science is in a continual state of differentiation and synthesis, developing in a fractal-like pattern. In general, growth begets increased heterogeneity and differentiation in social systems (Blau, 1970). Over time, scholars and their institutions continually evolve and differentiate within their existing niches. Fractalization is apparent in our results. For example, while social sciences are roughly half as likely to publish in *Nature* than *Science*, there still is a smaller, viable niche in *Nature* for such work. Likewise, the prominence of biomedical research in *Nature* and *PNAS* does not forestall a smaller niche for such research in *Science*.

Fractalization processes and niche differentiation may influence the future of megajournals. Publishers often offer differentiated publishing options by specific topics (e.g., *PLOS Medicine*, *PLOS Neglected Tropical Diseases*, *PLOS Pathogens*), status, selectivity and cost (e.g., *Nature Communications*, *Communications Chemistry*, *Communications Physics*). Megajournals can play a key part of publisher business models and affect niches of other journals. For example, Butler (2008) argued that PLOS employs a *haute couture* strategy, where bulk publication in *PLOS ONE* subsidizes its more-selective flagship journals. This subsidy could help PLOS compete on price versus other high-end APC-based journals. However, Ellers et al. (2017) argued that this business model entails regressive redistribution of funds from less-wealthy to more-wealthy scholars and institutions, given the different demographics of scholars who publish in *PLOS ONE* vis-à-vis PLOS's more specialized, upscale imprints. Further, as illustrated in Figure 1, given recent declines in submissions, publications and revenue at *PLOS ONE*, this business model of subsidizing upscale publications may be unsustainable long-term (also see Davis, 2017).

When innovations – such as megajournals or Open Access publishing – lack categorical legitimacy, actors rely on proximately peer-oriented heuristics such as information cascades to inform adoption decisions. As more people adopt the innovation – in this case, publishing in megajournals – categorical legitimacy develops (Rossman, 2014). Categorization can underpin legitimacy in social systems (Zuckerman, 1999). In turn, the 'megajournal' may have developed into a legitimate category of its own in contemporary science. Solomon (2014) found that the audience of a journal was (after perceived journal quality) the most important factor influencing scientists to submit an article to a megajournal. Consequently, building distinct journal identities and communities is a unique challenge for interdisciplinary megajournals.

CONCLUSION

Our analyses show that there is considerable variation in the disciplinary niches between and within megajournals, generalist conventional journals and quasi-megajournals. Megajournals have established a small, but legitimate – and increasingly prominent – niche in contemporary science, offering relatively fast peer review and time to publication. The interdisciplinary scope of megajournals is also distinctive, although our results show that even megajournals have degrees of specialization. Scientific disciplines vary in their propensity to publish in megajournals, as well as the specific megajournals they prefer. The megajournal has been a successful recent innovation in scientific communication. However, this diffusion has occurred more rapidly in some scientific fields more than others.

Megajournals have offered new dissemination and creative opportunities to academics, altering incentives and reward structures in science. Numerous potential future trajectories exist for megajournals and the broader ecology of scientific publishing. Through institutional strategy, randomness and/or historical path-dependent evolution, megajournals will likely continue to develop and change over time. For now, the broad interdisciplinary model of megajournals has successfully diffused, established legitimacy and prominence in some fields more than others. Where future areas of growth exist for the megajournal model of academic communication is an open question.

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APPENDIX: Proportion of papers published in each of the journals, by specialty, 2000-2017

Specialty	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS ONE	Scientific Reports
Biochemistry & Molecular Biology	22.66%	35.94%	18.06%	23.71%	8.78%	15.51%	15.40%
Neurology & Neurosurgery	7.03%	11.24%	6.87%	6.77%	4.55%	10.06%	7.80%
Genetics & Heredity	6.24%	5.76%	5.62%	4.91%	9.09%	5.22%	3.55%
General Physics	8.26%	2.49%	7.11%	13.23%	0.14%	0.64%	7.16%
Immunology	3.41%	6.58%	3.55%	4.11%	1.40%	7.59%	3.72%
Ecology	2.96%	2.18%	4.00%	1.46%	10.68%	3.22%	1.56%
Microbiology	1.80%	3.46%	2.05%	1.92%	6.50%	4.47%	3.37%
Cancer	1.84%	2.72%	0.81%	2.87%	1.97%	6.67%	5.20%
Materials Science	1.25%	0.74%	1.94%	9.10%	0.10%	0.25%	7.78%
Earth & planetary Science	7.53%	1.27%	8.01%	2.61%	0.12%	0.13%	1.08%
General Chemistry	2.29%	1.78%	3.95%	6.44%	0.36%	0.15%	2.15%
Botany	1.34%	2.22%	1.79%	1.23%	4.55%	2.68%	2.72%
Marine Biology & Hydrobiology	0.61%	0.48%	0.83%	0.30%	8.01%	1.61%	0.87%
Cellular Biology Cytology & Histology	2.02%	2.08%	2.01%	2.39%	0.55%	1.45%	1.41%
General & Internal Medicine	1.85%	0.50%	1.54%	0.18%	2.29%	3.26%	0.74%
Geology	1.89%	0.53%	1.58%	0.87%	4.23%	0.35%	0.60%
Astronomy & Astrophysics	4.83%	0.19%	3.31%	0.31%	0.00%	0.00%	0.06%
Virology	0.78%	2.07%	0.99%	0.72%	0.67%	1.84%	1.23%
Physical Chemistry	0.93%	0.83%	1.68%	2.37%	0.10%	0.15%	2.09%
Pharmacology	0.65%	0.87%	0.51%	0.52%	1.59%	1.82%	1.98%
Applied Physics	1.15%	0.19%	1.15%	1.97%	0.00%	0.04%	3.07%
Cardiovascular System	0.35%	0.79%	0.20%	0.68%	0.89%	2.77%	1.75%
Endocrinology	0.34%	1.05%	0.28%	0.40%	0.96%	2.34%	1.42%
Meteorology & Atmospheric Science	1.68%	0.86%	2.09%	0.88%	0.05%	0.10%	0.73%
Environmental Science	0.88%	0.61%	1.29%	0.37%	0.82%	0.64%	1.41%
Entomology	0.25%	0.51%	0.37%	0.20%	2.69%	1.04%	0.93%
Solid State Physics	0.74%	0.19%	0.77%	1.80%	0.00%	0.00%	1.31%
Optics	0.35%	0.19%	0.40%	1.37%	0.05%	0.10%	2.34%
General Biomedical Research	1.59%	0.52%	1.47%	0.29%	0.41%	0.24%	0.23%
Behavioral Science & Complementary Psychology	0.41%	0.35%	0.41%	0.22%	2.24%	0.66%	0.38%
Oceanography & Limnology	0.84%	0.30%	1.05%	0.51%	0.77%	0.26%	0.34%
Experimental Psychology	0.32%	0.52%	0.57%	0.05%	1.25%	0.90%	0.35%
Gastroenterology	0.18%	0.20%	0.11%	0.22%	0.48%	1.52%	1.17%
Agricult & Food Science	0.30%	0.15%	0.32%	0.15%	1.11%	0.78%	1.03%
General Zoology	0.54%	0.14%	0.35%	0.07%	2.26%	0.27%	0.13%
Psychiatry	0.29%	0.21%	0.19%	0.04%	1.35%	1.12%	0.43%
Physiology	0.52%	0.66%	0.35%	0.23%	0.60%	0.83%	0.35%
Economics	0.48%	0.66%	1.30%	0.13%	0.14%	0.36%	0.15%
Anthropology and Archaeology	0.67%	0.82%	0.83%	0.13%	0.29%	0.26%	0.13%
Embryology	0.81%	0.64%	0.61%	0.41%	0.02%	0.27%	0.14%
Hematology	0.36%	0.59%	0.16%	0.46%	0.12%	0.76%	0.39%
Miscellaneous Biology	0.49%	0.28%	0.52%	0.16%	0.87%	0.27%	0.17%
Ophthalmology	0.07%	0.21%	0.02%	0.06%	0.24%	1.11%	0.88%
Chemical Physics	0.34%	0.51%	1.12%	0.41%	0.00%	0.03%	0.20%
Radiology & Nuclear Medicine	0.09%	0.21%	0.07%	0.10%	0.36%	0.95%	0.74%
Veterinary Medicine	0.15%	0.04%	0.09%	0.01%	1.18%	0.69%	0.17%
General Biology	0.42%	0.18%	0.44%	0.15%	0.58%	0.13%	0.11%
Parasitology	0.18%	0.23%	0.21%	0.14%	0.65%	0.33%	0.15%

Specialty	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS ONE	Scientific Reports
Computers	0.17%	0.13%	0.32%	0.03%	0.41%	0.56%	0.22%
Social Psychology	0.08%	0.26%	0.37%	0.01%	0.51%	0.40%	0.07%
Respiratory System	0.04%	0.07%	0.04%	0.03%	0.29%	0.94%	0.28%
Orthopedics	0.03%	0.02%	0.00%	0.04%	0.75%	0.49%	0.30%
Metals & Metallurgy	0.15%	0.04%	0.33%	0.44%	0.00%	0.01%	0.66%
Miscellaneous Zoology	0.16%	0.05%	0.19%	0.02%	0.99%	0.17%	0.05%
Tropical Medicine	0.12%	0.12%	0.16%	0.09%	0.31%	0.64%	0.16%
Environmental & Occupational Health	0.19%	0.06%	0.27%	0.01%	0.24%	0.61%	0.20%
Dentistry	0.01%	0.01%	0.02%	0.02%	0.65%	0.41%	0.38%
Nephrology	0.01%	0.07%	0.02%	0.04%	0.14%	0.72%	0.48%
Public Health	0.12%	0.05%	0.20%	0.01%	0.36%	0.69%	0.05%
Arthritis & Rheumatology	0.01%	0.09%	0.03%	0.11%	0.29%	0.53%	0.39%
Nutrition & Dietetic	0.09%	0.05%	0.07%	0.02%	0.38%	0.53%	0.20%
Analytical Chemistry	0.12%	0.16%	0.10%	0.07%	0.10%	0.14%	0.64%
Biomedical Engineering	0.08%	0.06%	0.09%	0.07%	0.31%	0.25%	0.45%
Miscellaneous Clinical Medicine	0.06%	0.01%	0.06%	0.00%	0.84%	0.26%	0.05%
Fertility	0.16%	0.17%	0.12%	0.06%	0.14%	0.36%	0.26%
Pediatrics	0.07%	0.04%	0.05%	0.01%	0.46%	0.44%	0.15%
Surgery	0.03%	0.03%	0.02%	0.02%	0.31%	0.50%	0.31%
Developmental & Child Psychology	0.05%	0.15%	0.21%	0.01%	0.29%	0.30%	0.09%
Polymers	0.10%	0.07%	0.29%	0.27%	0.02%	0.04%	0.28%
Electrical Engineering & Electronics	0.14%	0.04%	0.18%	0.08%	0.07%	0.17%	0.40%
Biophysics	0.09%	0.36%	0.10%	0.11%	0.12%	0.14%	0.13%
Obstetrics & Gynecology	0.03%	0.04%	0.02%	0.00%	0.31%	0.45%	0.18%
Probability & Statistics	0.07%	0.20%	0.07%	0.02%	0.34%	0.25%	0.08%
Dermatology & Venerial Disease	0.06%	0.05%	0.03%	0.05%	0.26%	0.29%	0.18%
Urology	0.02%	0.04%	0.01%	0.01%	0.31%	0.28%	0.22%
Education	0.04%	0.04%	0.43%	0.00%	0.19%	0.09%	0.00%
Information Science & Library Science	0.08%	0.03%	0.09%	0.00%	0.43%	0.14%	0.03%
Health Policy & Services	0.10%	0.01%	0.11%	0.00%	0.31%	0.24%	0.00%
Anatomy & Morphology	0.07%	0.01%	0.05%	0.01%	0.53%	0.04%	0.03%
Miscellaneous Biomedical Research	0.06%	0.05%	0.08%	0.03%	0.14%	0.15%	0.21%
Nuclear & Particle Physics	0.44%	0.01%	0.17%	0.06%	0.00%	0.01%	0.03%
Management	0.15%	0.08%	0.16%	0.01%	0.07%	0.20%	0.03%
Clinical Psychology	0.03%	0.01%	0.03%	0.00%	0.43%	0.16%	0.02%
Fluids & Plasmas	0.12%	0.12%	0.12%	0.16%	0.00%	0.02%	0.12%
Organic Chemistry	0.09%	0.12%	0.13%	0.09%	0.00%	0.03%	0.15%
Dairy & Animal Science	0.04%	0.02%	0.04%	0.00%	0.19%	0.20%	0.11%
Otorhinolaryngology	0.02%	0.05%	0.02%	0.01%	0.12%	0.23%	0.14%
Miscellaneous Psychology	0.05%	0.04%	0.11%	0.00%	0.22%	0.10%	0.00%
Addictive Diseases	0.02%	0.02%	0.01%	0.00%	0.26%	0.16%	0.03%
Miscellaneous Engineering & Technology	0.07%	0.05%	0.14%	0.04%	0.02%	0.07%	0.12%
Acoustics	0.05%	0.09%	0.03%	0.02%	0.12%	0.11%	0.09%
Sociology	0.06%	0.10%	0.10%	0.01%	0.10%	0.09%	0.02%
Chemical Engineering	0.09%	0.03%	0.10%	0.02%	0.00%	0.03%	0.18%
Pathology	0.07%	0.04%	0.02%	0.02%	0.12%	0.10%	0.07%
Geriatrics	0.09%	0.04%	0.05%	0.02%	0.07%	0.13%	0.04%
Mechanical Engineering	0.06%	0.04%	0.08%	0.04%	0.00%	0.07%	0.15%

Specialty	Nature	PNAS	Science	Nature Comms.	PeerJ	PLOS ONE	Scientific Reports
Miscellaneous Social Sciences	0.07%	0.03%	0.10%	0.01%	0.14%	0.05%	0.01%
General Mathematics	0.09%	0.27%	0.03%	0.01%	0.00%	0.01%	0.01%
Anesthesiology	0.01%	0.01%	0.01%	0.00%	0.14%	0.13%	0.07%
General Psychology	0.04%	0.02%	0.09%	0.00%	0.19%	0.02%	0.00%
Law	0.07%	0.02%	0.24%	0.00%	0.00%	0.01%	0.00%
Allergy	0.01%	0.01%	0.00%	0.02%	0.02%	0.16%	0.08%
Nursing	0.00%	0.00%	0.00%	0.00%	0.24%	0.06%	0.00%
Demography	0.06%	0.04%	0.10%	0.00%	0.05%	0.06%	0.00%
Applied Mathematics	0.04%	0.08%	0.04%	0.00%	0.02%	0.08%	0.04%
Social Sciences, Biomedical	0.04%	0.01%	0.03%	0.00%	0.12%	0.10%	0.00%
Political Science and Public Administration	0.04%	0.04%	0.15%	0.00%	0.00%	0.03%	0.00%
Rehabilitation	0.01%	0.00%	0.01%	0.00%	0.14%	0.07%	0.01%
Science studies	0.07%	0.01%	0.12%	0.00%	0.00%	0.01%	0.00%
Nuclear Technology	0.03%	0.00%	0.05%	0.02%	0.00%	0.01%	0.09%
Microscopy	0.03%	0.01%	0.05%	0.05%	0.00%	0.01%	0.04%
Inorganic & Nuclear Chemistry	0.02%	0.03%	0.06%	0.04%	0.00%	0.00%	0.03%
Geography	0.03%	0.05%	0.03%	0.01%	0.00%	0.04%	0.01%
International Relations	0.03%	0.03%	0.09%	0.00%	0.00%	0.01%	0.00%
Speech-Language Pathology and Audiology	0.00%	0.00%	0.02%	0.00%	0.10%	0.03%	0.00%
Geriatrics & Gerontology	0.03%	0.01%	0.04%	0.01%	0.02%	0.03%	0.01%
General Social Sciences	0.05%	0.01%	0.06%	0.00%	0.00%	0.01%	0.00%
Communication	0.01%	0.02%	0.04%	0.00%	0.02%	0.02%	0.00%
Human Factors	0.01%	0.00%	0.01%	0.01%	0.02%	0.05%	0.00%
Language & Linguistics	0.02%	0.02%	0.02%	0.00%	0.00%	0.02%	0.00%
Civil Engineering	0.01%	0.00%	0.02%	0.01%	0.00%	0.03%	0.00%
Criminology	0.01%	0.01%	0.01%	0.00%	0.02%	0.02%	0.00%
Miscellaneous Professional Field	0.01%	0.00%	0.00%	0.00%	0.02%	0.02%	0.01%
Aerospace Technology	0.02%	0.00%	0.01%	0.00%	0.00%	0.01%	0.01%
History	0.01%	0.01%	0.03%	0.00%	0.00%	0.00%	0.00%
Philosophy	0.01%	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%
Performing Arts	0.00%	0.00%	0.02%	0.00%	0.02%	0.00%	0.00%
Operations Research	0.01%	0.01%	0.00%	0.00%	0.00%	0.02%	0.00%
Social Work	0.00%	0.00%	0.01%	0.00%	0.02%	0.01%	0.00%
Pharmacy	0.00%	0.00%	0.00%	0.00%	0.02%	0.02%	0.00%
Applied Chemistry	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%
Planning & Urban Studies	0.01%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
Miscellaneous Physics	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%
Area Studies	0.01%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%
Fine Arts & Architecture	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Industrial Engineering	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Miscellaneous Humanities	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Miscellaneous Mathematics	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
Literature	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
General Engineering	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Religion	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Psychoanalysis	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Social Studies of Medicine	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%