

Should I Stay or Should I Go? Alternative Infrastructures in Scholarly Publishing

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For more than three-and-a-half centuries, the scholarly infrastructure—composed of commercial publishers, learned societies, libraries, and the scholars themselves—has provided the foundation functions of certification, registration, access, preservation, and reward. However, over the last two decades, the stability of this infrastructure has been disrupted by profound changes in the technological, economic, cultural, and political climate. We examine the actions of scholars in response to this infrastructure instability through the lens of Hirschman’s “exit, voice, and loyalty” framework. We describe the motivations and actions by scholars, especially those with tenure, who have chosen exit from the mainstream scholarly communication infrastructure to a proliferation of newly available alternative infrastructures. However, this option is not practical for all scholars due to the “enforced loyalty” imposed by reward systems based on metrics that are intricately tied to the traditional infrastructure. We examine the alternative of voice exercised by these scholars, combined with the threat of exit that has changed policies that are the source of dissatisfaction with the system.

Keywords: infrastructure, scholarly communication, disruption

In December 2013, Nobel prize-winning scientist Randy Schekman announced that his lab would boycott the major scientific journals *Nature*, *Cell*, and *Science*, in protest of what he considered their distorting effects on the scientific process (Sample, 2013). According to Schekman, increasingly intense pressure to publish in high-prestige journals encourages scientists to submit papers for publication prematurely, without sufficient confirmation of their results, and to focus on “trendy” areas likely to attract

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Date submitted: 2014-05-16

¹ The authors acknowledge the support of the University of Michigan MCubed program, within which this collaboration was initiated.

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attention.² In addition to publicly announcing this exit from these prestigious journals, Schekman participated in the start-up and later became editor of *eLife*, an open-access journal that provides an alternative to *Nature*, *Cell*, and *Science* (Sample, 2013).

In January 2012, Fields award-winning mathematician Timothy Gowers declared a boycott of Elsevier, the leading publisher of scholarly publications (Whitfield, 2012). The reasons for his boycott included high prices and the practice of bundling that forces libraries to subscribe to packages of journal titles in order to receive highly desired titles.³ He also opposed Elsevier's support for the Research Works Act in the United States (and similar legislation in other countries) that would forbid governments from requiring publicly funded research projects to deposit their results in public repositories.

Also in 2012, more than 64,000 people signed a petition to the Obama administration requesting that the government require free public access to scientific journals for all research publications resulting from taxpayer-funded research. This petition, an exercise of voice, led the Office of Science and Technology Policy to issue a memorandum guiding federal agencies in making the results of federally funded research publicly available via the Internet (Holdren, n.d.). Such petitions to both public and private sectors have convinced many publishers, including Elsevier, to relax restrictive policies and accept a variety of open-access models (Suber, 2012).

Scholarly Publishing as Infrastructure

These three events exemplify actions undertaken by scholars who are dissatisfied with the current state of a well-established infrastructure, *scholarly publishing*, which is foundational to the scholarly endeavor. Scholarly publishing is part of a broader range of activities, commonly referred to as *scholarly communication*, whereby scholars make their work visible. Scholars communicate via a wide variety of media, including formal refereed genres such as books, journals, and conference papers, and informal genres such as e-mail, blogs, letters, and lectures. With more and more informal interaction digitally recorded and disseminated, the formerly sharp line between publication and private communication has blurred.

² This rush to submit coexists with an ongoing frustration with the lag time between submission and final publication, which we discuss later in the article. Stated briefly, submission is tied to *registration*, which allows claims of precedence for a scholarly finding (Roosendaal & Geurts, 1997). The date of registration is independent of the actual date of publication (accessibility of the manuscript to the public).

³ The so-called Big Deal is a practice that began in the 1990s and has become an increasingly common model for library/publisher subscription deals. In this model, publishers only offer electronic access to their major titles as part of a package including lower-tier or more limited-audience publications. Although in many cases the subscription cost per title is consequently lower, the net benefits for libraries have been decidedly mixed, including a net overall gain in subscription expenditures (due to the need to subscribe to unwanted journals as part of the bundle) and cited cases of discriminatory pricing and closed-door deals (Bergstrom, Courant, McAfee, & Williams, 2014; Hahn, 2006; Nabe, 2001).

As a fundamental substrate upon which scholarly research operates, scholarly publishing can be understood as *infrastructure*—a combination of technologies, policies, human actors, and social norms (Bowker & Star, 1999) that is “ubiquitous, accessible, reliable, and transparent” (Edwards, Jackson, Bowker, & Knobel, 2007, p. 1). Like libraries, a closely related information infrastructure, the scholarly publishing infrastructure has been historically *invisible* (Borgman, 2003), seamlessly and successfully supporting knowledge work (Paisley, 1980). Recently, however, collisions between scholarly information infrastructures and the Internet have revealed deep frictions, making the invisible visible and rendering once-stable arrangements fragile.

This article posits that recent developments have destabilized scholarly publishing to the point that many individual academics are reassessing their participation in traditional journal publishing. These developments include open-access (OA) journals, such as the one in which this article appears, but they are symptomatic of more general instability in knowledge infrastructures (Edwards et al., 2013). This subject has been a topic of research for at least two decades (see Borgman, 2007, for a summary). The new contribution of this article is its development and application of a theoretical framework that characterizes scholarship’s current situation with respect to publication. This enables us to frame the empirical evidence about our situation and chart the paths forward, advancing the scholarly debate about the future of our shared work.

We develop a framework based on A. O. Hirschman’s (1970) theory of *exit*, *voice*, and *loyalty* to explain the reactions of agents (e.g., consumers) to dissatisfaction with a situation (e.g., a product). Hirschman considered that any agent’s two primary options are (a) *exit*: to abandon the product for a competing product, and (b) *voice*: to complain to the producer and appeal for improvements. In Hirschman’s analysis, the consumer’s degree of *loyalty* influences how much and how long the consumer will tolerate an imperfect or degraded product. The most loyal will continue to use it, finding workarounds for undesirable or inconvenient features, and will exercise voice before resorting to exit. In the complete theory, Hirschman proposes that the exit, voice, and loyalty trade off and interact in counterintuitive and significant ways that help explain everything from persistent but inefficient political parties to the organization of railroads in Africa. Although Hirschman is a well-known economist, his framework has been influential in economics, organizational science, political science, and communication (where it evolved into “market for loyalties” theories about the media; see Callister, 2006; Price, 1995; Price & Stremlau, 2012).

Here we use exit, voice, and loyalty to analyze and explain the current upheaval and debate in scholarly publishing. The Schekman and Gowers examples at the beginning of this introduction can be explained as instances of exit, whereas the Obama petition is one of voice. As we will demonstrate, this framework helps explain how individuals, including the readers of this article, might decide to exit, voice, or boycott aspects of scholarly publishing, as well as the nuanced influence of loyalty on these actions. We limit our scope to forms of scholarly communication mainly targeted at peers and for which scientific quality and integrity are important. These include not only refereed journals and conference papers but informal venues that have gained increasing prominence in the digital age, such as e-prints, preprints, and other non-peer-reviewed outlets. We do not consider books (monographs), a major mode of publication in

the humanities, because book publishing's unique characteristics make it worthy of a companion article (in preparation).

Hirschman's framework aligns well with the later flowering of scholarship about the characteristics of infrastructure (Edwards et al., 2007). These scholars find that infrastructure functions in ways that are distinct from consumer products or political movements. Unlike a product (e.g., an iPhone), use of infrastructure typically lacks awareness or intentionality due to the "invisibility" characteristic mentioned above. This dynamic of infrastructure exaggerates the impact of weakness or failure, because those who depend on a system do not remember they are consumers of it until it fails them. As an infrastructure, scholarly publishing therefore has features that its users are likely never to consider. As a corollary, researchers studying this infrastructure must reconstruct and elaborate what has been taken for granted.

The notion of loyalty also differs when applied to infrastructure. Rather than being intrinsic (e.g., I feel loyalty to Apple as a brand), one's loyalty to an infrastructure like scholarly publishing may be extrinsic or enforced. Furthermore, infrastructures can feature inertia and sunk costs that are far higher than some political movements or products. People who rely on embedded infrastructures (such as municipal water systems or groupings of journals sanctioned by a discipline for promotion and tenure) may view exit as totally unworkable or impossible, complicating voice and loyalty.

Seven Frictions

The contemporary infrastructure for scholarly publishing originated in 1665 with the first issue of the *Philosophical Transactions*, published by the Royal Society of London for Improving Natural Knowledge (http://en.wikipedia.org/wiki/Philosophical_Transactions_of_the_Royal_Society). The features of that first journal—peer review to ensure quality and certification and registration to establish precedence of new results (Roosendaal & Geurts, 1997; Shapin & Schaffer, 1985)—remain essential characteristics of scholarly publishing today. For three centuries, instances of this model have supported the vast majority of scientific and scholarly documentation. In fact, the progress of scholarship itself is reflected in the quantity and form of those instances, with dissemination venues (e.g., journals, conference proceedings, scholarly books) expanding and specializing in lockstep with the scholarly fields that they document. Meanwhile, scholarly publishing began to centralize and monopolize (Naughton, 2012), especially in the post-World War II scientific boom. The rise of citation indexing—especially Eugene Garfield's Institute for Scientific Information (founded in 1960), which introduced the Science Citation Index in 1964⁴—offered the first quantitative metrics of the use of not only individual articles but the journals that published them. The Institute for Scientific Information's citation counts rapidly became seen as a measure of putative scientific value (Price, 1970). Librarians used them to guide subscription decisions (abandoning rarely cited journals), and scholars used them to choose publication venues (seeking the most often cited ones). Today's journal ranking systems descend directly from these phenomena.

⁴ Now owned by Thomson Reuters.

In the latter half of the 20th century, cracks began to appear in this model of scholarly communication model. Here, we enumerate seven sources of disruption in scholarly communication. We argue that these factors led a long stable infrastructure to the present moment of crisis.

First, profit seeking by private publishers contributed to the “serials crisis.” Watching the transformation of scholarly communication, publishers saw opportunities for profit. Privately held companies such as Elsevier and Wiley began to consolidate, buying up smaller companies and their publishing portfolios and contracting to fulfill the publishing responsibilities of learned societies (Carpenter, 2013). Publishers bundled subscriptions to highly ranked journals with other, less highly ranked ones—often in combinations libraries found undesirable but unavoidable given the necessity of acquiring the major journals. This increasing monopolization arguably contributed to a spectacular rise in journal subscription prices (indexed against inflation). This coincided with an expansion in both the breadth and depth of science and a dramatic increase in the number of scholars, for whom pressure to publish was part of their career path. In turn, these phenomena produced rapid growth in the number of journal titles. Unfortunately, this all occurred during a flattening of university general-fund budgets⁵—those that fund university libraries, as opposed to research. The combination put extreme pressure on library budgets. This perfect storm of factors produced what is commonly called the serials crisis, in which libraries cancel subscriptions, leading to even higher subscription prices as journal publishers try to recover lost revenue, leading to further cancellations and so on (Panitch & Machalak, 2005).

Second, the pace of scientific work, especially in the physical and health sciences, accelerated for reasons including governmental research needs, increased funding, increased technical capacity, and increased pressure to publish in a competitive reward environment. This pace became increasingly discordant with the traditional turnaround times of scholarly publication (many months to multiple years). Scholars became increasingly frustrated with the lag time between submission and publication, which reduced the pace of scientific advance and sometimes resulted in bitter fights over priority claims to new discoveries (usually based on date of publication rather than submission). Scholars also felt frustrated that their larger volume of work was not quickly available for looming grant, promotion, and tenure decisions.

Third, science became more interdisciplinary. The increasing granularity of each publication’s focus (i.e., journals and conference proceedings targeting highly specialized subfields) (Ben-David & Zloczower, 1962) began to conflict with increasing interest in the late 20th and into the 21st century in interdisciplinary research (Wagner et al., 2011). The reasons for this interest in interdisciplinary research are many. Primary among them were the knowledge requirements needed to address pressing “grand challenge” research problems, such as climate change. In addition, as computational, statistical, and algorithmic techniques advanced into formerly nonquantitative scholarly fields (e.g., digital humanities, computational art, computational social science), the potential audience for formerly intrafield work extended beyond each field’s traditional boundaries. Scholars engaged in these cross-disciplinary activities often found it hard to find established publishing venues that targeted these broader audiences or that were willing to accept this new type of work.

⁵ See <http://www.library.illinois.edu/scholcomm/journalcosts.html>.

Fourth, scholarly publications became intellectual property for both the public good and for profit. Traditionally, publishers had demanded that authors relinquish copyright to them (Lynch, 2006). In the late 1980s, as the commercial value (to the publishers) of some research results became more evident, scholars and policy makers became increasingly aware of the problems with these transfer policies. They argued that these policies permitted publishers to extract profits from what should logically be a public good. The momentum of this opposition increased in the 1990s, blossoming into a full-blown "open access movement" (Suber, 2012) with manifestos such as the Berlin Declaration.⁶

Fifth, the rapid emergence of the personal computing and tools such as e-mail, FTP, and the World Wide Web in the 1990s offered scholars direct, unencumbered access to dissemination mechanisms.⁷ Scholars had for centuries waited for paper publication or hand-mailed their results to colleagues, but they could now, at very low cost, use the Internet to make those results accessible to the world. The publishers' monopoly on dissemination had weakened, though they retained control over other important aspects of the publishing infrastructure, such as peer review, editorial services, and the reputation effects connected with highly ranked journals.

Sixth, a so-called fourth paradigm (Hey, Tansley, & Tolle, 2009) of science emerged, based on "big data" and also called data-centric science or e-science. This trend magnified the limitations of traditional text-based publishing (whether that text is printed in ink and paper or in PDF documents). With both raw and processed data increasingly becoming part of everyday research work across fields, scholars began to ask why data sets should not be seen as primary publishable objects. Like journal articles, researchers asked, could data sets not be peer reviewed (Lawrence, Jones, Matthews, Pepler, & Callaghan, 2011; Parsons, Duerr, & Minster, 2010), stamped with standardized identifiers such as DOIs (Duerr et al., 2011), and cited in standardized formats? This would enable their producers rightfully to claim intellectual credit—and ultimately offer them for consideration in promotion and tenure.

Seventh and finally, reward mechanisms in scholarly communication contributed to a "decline effect." At the beginning of this article, we referred to Randy Schekman's boycott of major journals, in which he claimed that they distorted scientific results. Schekman's concerns about high-profile journals have been substantiated by empirical evidence that reveals a well-documented phenomenon termed the decline effect, in which "the strength of evidence for a particular finding often declines over time" (Brembs & Munafò, 2013, p. 4). The decline effect appears related to publication pressures, which can lead researchers to design studies with an increased chance of false positives. Because novel and striking results are more likely to be published (publication bias), and are also more likely to attract the attention of higher-ranked journals, the prestige of publication venues (measured by their impact factor) ironically correlates with the proportion of papers published therein that are later retracted due to error or fraud (Brembs & Munafò, 2013).

⁶ See <http://openaccess.mpg.de/286432/Berlin-Declaration>.

⁷ We distinguish between online access and open access. Virtually all scholarly publishers now support online access by the World Wide Web, but in most cases this access is behind a pay wall managed through subscriptions that are negotiated in university environments by libraries. The same online status is true for virtually all open-access publications, but there is no pay wall and attendant subscription fees.

Over the first decade and into the second decade of the 21st century, these frictions in the traditional scholarly publishing infrastructure have reached a point of crisis. Before presenting some examples of reactions by agents—scholars, universities, publishers, librarians, learned societies—to these sources of dissatisfaction (Hirschman’s term), we examine more closely the Hirschman framework.

Hirschman’s Exit, Voice, and Loyalty

Influential economist Albert O. Hirschman (1970) famously considered the situation in which an organization, firm, or nation declined in performance such that it no longer satisfied the needs of its members, customers, or citizens. Hirschman proposed that this failure was often repairable but that disciplinary assumptions strongly conditioned how different analysts expected these lapses to be fixed. He argued that those concerned with politics—political scientists—are usually too quick to consider political action as the essential route to repair. Quoting Hirschman, “It has long been an article of faith in political theory that the proper functioning of democracy requires a maximally alert, active, and vocal public” (pp. 31–32). Political scientists, in other words, have rarely seen a regime that couldn’t use more collective action. On the other hand, those concerned with products—economists—have traditionally emphasized the decision *not* to purchase a product as the only way a consumer can signal that the product is unsatisfactory or inadequate. Quoting Hirschman, “In economics it had long been thought that the more elastic demand is (that is, the more rapidly exit ensues whenever deterioration occurs), the better the functioning of the economic system” (ibid., p. 31).

Thus, the political scientist sees the citizen facing an oppressive government as someone who needs to become more involved, but the economist sees the consumer facing a suboptimal product as someone who needs to disengage. Real situations, of course, usually permit both options to some degree. Hirschman terms engagement “voice,” or the decision to agitate for change, and he names disengagement “exit,” or the decision not to purchase. His influential book proposed a theory of how these two routes to repair of a suboptimal situation interact and how individuals go about choosing between them.

The linchpin of Hirschman’s framework is the concept of “loyalty.” Hirschman asserts that instantaneous exit in the face of a problem would often be destructive. If exit alone had sway, every ailing institution, firm, or organization would quickly collapse at the first sign of trouble. Therefore, institutions and social norms may develop or cultivate cultural or economic barriers to exit (chap. 7). Such barriers may include tradition, inertia, sentimental attachment, or concern about the potential unforeseen consequences of leaving. Loyalty explains why voice is often chosen over exit, as well as why a dissatisfied customer may do nothing at all (that is, exhibit apathy).

Hirschman notes that the most useful application of his framework is likely to be found in spheres where there are elements of both politics and economics, such as instances where collectives or voluntary associations provide services to their members in an environment that is both commercial and political. It is hard to think of a more apt example than scholarly publishing, where via editorial boards, peer review, professional associations, and faculty governance, researchers nominally control and direct most elements

of the system—yet are simultaneously clients of that same system, with which many are dissatisfied and perceive to be broken. However, this framework has never before been applied to scholarly publishing.

Just as exit, voice, and loyalty apply to both political and economic situations, they also apply to infrastructural change, which traditionally incurred high costs. Many physical infrastructures, such as railroads, highways, and electrical transmission systems, are highly capital-intensive, and, although the typesetting machines and presses of paper publishing houses are less so, until recently, their capital costs (and the associated human skills) remained beyond the reach of many academic associations.⁸ In the Internet era, many of these barriers to entry rapidly diminished, especially after widespread acceptance of online-only publication without a corresponding printed journal. In the past decade or so, thanks largely to software for managing the editorial process, even many of the organizational demands of publishing—article solicitation, building lists of qualified peer reviewers, soliciting peer reviews, copy editing, and so on—have been brought within the financial and technical reach of professional associations, and even of small groups of scholars. Running an active scholarly journal is still a major commitment and still requires a budget, but it can now be done without a printing press and a highly specialized professional publishing staff. These changes have dramatically affected the relative costs of exit versus voice, arguably making loyalty less sticky and rendering exit more plausible.

A brief anecdote will cement these basic dynamics in the Hirschman framework before we turn to a broader analysis. In 1994, Margaret McLaughlin and Sheizaf Rafaeli hoped to allow scholarly authors to “exploit multiple modalities of communication and to ground their work in a matrix of related documents and sources” (McLaughlin, 1994, p. 3). They founded a new *Journal of Computer-Mediated Communication* (JCMC) as a Web page.⁹ The journal was a mainstream scholarly success despite its nontraditional format and infrastructure (or perhaps because of it), demonstrating the value of exit.

However, the later evolution of the JCMC shows that the reduced cost of creating alternative infrastructures affects movement in both directions: An alternative infrastructure that was the result of an exit choice can also relatively easily be reabsorbed back into the mainstream. In 2005, the International Communication Association did just that, naming the upstart JCMC as its fifth official association journal.¹⁰ It later produced PDFs of JCMC content that resembled printed association publications, and after several years it began assigning JCMC content page numbers (the early JCMC volumes had, in the spirit of Web-based hypertext, intentionally avoided numbering). Yet probably because of its history as a Web page, JCMC remained open access. Exit was thus a dynamic that induced change in the association’s scholarly publishing infrastructure, although this change was incremental.

⁸ The American Chemical Society is a notable exception due to several factors, including the high level of participation by industry, especially large pharmaceutical companies (Velden & Lagoze, 2009).

⁹ An interesting twist here in light of the notion of alternative infrastructures is that they also provided parallel plain text distribution on Gopher in case the World Wide Web (then still an alternative infrastructure) did not prevail as a mainstream publishing technology

¹⁰ See <http://ella.slis.indiana.edu/~herring/jcmc.message.html>.

At the time of JCMC's blessing by a scholarly association, the associations in the communication field remained tepid about experimentation with new forms of scholarly publishing, advocating for a wait-and-see approach (Haley, 2005). But in the years since the JCMC black sheep was returned to the fold, it has begun to dominate the association's journal portfolio. In 2010, JCMC's five-year impact factor, a common measure of scholarly value, was first computed by Thomson Reuters.¹¹ In 2011 and 2012, JCMC, the association's only open-access journal, earned the highest five-year impact factor of any journal in the discipline of communication, undoubtedly changing opinions about open access as a publishing strategy (for additional context, see Poulin & Tomaszewski, 2014). Returning to Hirschman, the case study of JCMC clearly demonstrates how an initiative that starts as an exit—offering a new interactive venue for scholarly publication—can also act as a voice—demonstrating the value of open access. In the remainder of this article, we analyze exit, voice, and loyalty responses by scholars as they navigate the scholarly publishing infrastructure in the digital age.

Loyalty to the Existing System

Loyalty is a critical feature of scholarly publishing because of the barriers to exit that most scholars face. As noted earlier, the notion of loyalty here differs from the “feeling of affinity” Hirschman ascribes to a user of a product or member of a political party. Loyalty to the scholarly publishing infrastructure is both enforced and self-reinforced by the role that the scholarly publisher plays in the career path of scholars. Consider the intimate binding of scholarly publishing to essential elements of scholarship as enumerated by Roosendaal and Geurts (1997):

1. *Registration* allows claims of precedence for a scholarly finding.
2. *Certification* establishes the validity of a registered scholarly claim.
3. *Awareness* allows actors in the scholarly system to remain aware of new claims and findings.
4. *Archiving* preserves the scholarly record over time.
5. *Rewarding* recompenses actors for their performance in the communication system based on metrics derived from that system.

The last of these, rewarding, is particularly notable here, because the mantra of “publish or perish” is so strong an influence on scholarly behavior. Increasingly across academia, avoiding perish (the flip side of reward) entails allegiance to reified, and arguably deeply flawed, metrics such as *h* index and journal impact factor (Cope & Kalantzis, 2009; Eisen, Maccallum, & Neylon, 2013; Eyre-Walker & Stoletzki, 2013); these metrics are intimately linked with the existing scholarly publishing infrastructure. That is, publish not only in quantity but in quality—where the latter is calculated using quantitative proxies such as number of publications, citations of one's work by others, and relative ranking of journals' putative capacity to promote further citation of one's work.

¹¹ As stated elsewhere in this article, impact factor and other mainstream measures have notable flaws. But our point here is implied worth rather than actual worth, and it is indeed true that impact factor correlates with reputation.

These metrics effectively *enforce* loyalty to the existing infrastructure, from which they are directly calculated. Virtually all junior scholars know that they risk their careers if they choose to buck the system (i.e., disseminate their results in alternative venues) (Madrigal, 2012). After tenure, scholars have the freedom to make more nuanced choices about publication venues. For example, they may choose an open-access journal because of the evidence that such journals are more highly cited than the toll access venues (Eysenbach, 2006). However, promotion and tenure committees are notoriously conservative and tend to judge the next generation of scholars using established criteria and metrics, sustaining a self-perpetuating cycle (Peek & Newby, 1996). This self-enforcement has produced the perception within the academy that quality scholarship surfaces only in high-ranking journals—despite growing evidence that journal impact factor is *negatively* correlated with scientific quality (Brembs & Munafò, 2013).

Stay and Complain, or Run to the Exits? The Question of Open-Access Publishing

We now examine the *exit* and *voice* facets of Hirschman's framework. One coherent context for investigating these two choices has emerged from the *open-access movement* (Suber, 2012), which over the last two decades has united scholars worldwide in declarations¹² and initiatives promoting a revised or reborn scholarly publishing infrastructure unencumbered by subscriptions, license restrictions, and self-justifying metrics. Simultaneously and related, an *alt-metrics movement* has arisen (Priem, Piwowar, & Hemminger, 2012), aiming to develop quality measures that are independent of the existing system (and to recognize new possibilities of the Internet context, such as the ability to count downloads and leverage crowdsourcing). A core concept of the open access movement is the distinction between "green" and "gold" OA models (Suber, 2012). An examination of both reveals how they enable and influence exit and voice decisions.

The former model, green, is also known as "self-archiving." It entails the deposit by the author of a scholarly paper in an open-access repository, which may occur in conjunction with formal submission to an established journal if the respective journal allows it. Until recently, many journals prohibited deposit in OA repositories, and leading publications such as *Nature* continue to refuse to publish articles that have appeared on an OA server. These embargo policies are an artifact of the so-called Ingelfinger Rule, which states that scholars should not publish the same article in multiple venues (Jacobsmeier, 2012). However, publisher prohibition of self-archiving has begun to break down due to pressure from the OA movement and scholars worldwide—an example of the power of voice and the threat of exit. Green OA (self-archiving) may also be completely independent of publishers (i.e., the author may completely forgo—exit from—"formal" publication). Clearly this option is more available to senior scholars with tenure, whose "enforced loyalty" is less of an issue than for junior scholars and graduate students.

Clearly, green open access provides a vehicle for Hirschman's exit alternative, enabling scholars to forego traditional publishing venues and essentially self-publish in a new emerging infrastructure. The technical basis for this infrastructure is the availability of turnkey open-source repository software (e.g., DSpace,¹³ Fedora,¹⁴ ePrints¹⁵) and the deployment of this software in both institutional repositories,

¹² See http://oad.simmons.edu/oadwiki/Declarations_in_support_of_OA.

¹³ See <http://www.dspace.org>.

usually run by academic research libraries (Crow, 2002), and discipline-focused repositories run by learned societies or other members of a discipline's community.¹⁶ Examples of institutional repositories include the University of Michigan's Deep Blue¹⁷ and the University of Pennsylvania's ScholarlyCommons.¹⁸ The arXiv,¹⁹ described in more detail later, is often featured as a prime example of a discipline-oriented repository.

Green OA repositories, although useful, provide only a substrate for an alternative infrastructure to the established scholarly publishing system. When deployed as individual instances, they effectively scatter content over many locations, making it difficult for scholars to find what they need. To address this problem, metadata describing the contents of these repositories have increasingly been *federated* in a "system of systems," following an evolutionary pattern typical of infrastructure (Edwards et al., 2007). Conceptually, this resembles the way that search engines like Google provide access to many Web servers that Google itself does not own. The technical foundations of federated access are protocols such as the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) that facilitate cross-repository searching and access (Lagoze & Van de Sompel, 2003). Recent technical advances such as resourceSync (Sompel, Nelson, Klein, & Sanderson, 2013) offer the possibility of expanding this metadata-based federation into full-text federation.

The second shortcoming of green repositories is the absence of selectivity and other quality control mechanisms. By and large, the green open-access repositories have little to no peer review. However, an ecology of value-added services has evolved over the repository/OAI-PMH fabric. Notable among these is the notion of an "overlay journal" that provides journal functionality (selection, peer review, curation, table of contents, alerting system) across papers distributed over multiple institutional or disciplinary repositories (Brown, 2010). Several examples of overlay journals exist, such as the *Journal of Nonlinear Mathematical Physics*.²⁰ The experimental communication journal *Vectors*²¹ partially functions as an overlay journal, because, although it does publish and host research in the traditional way, it will also peer-review scholarly work hosted elsewhere, on any Web server. If a work that already exists on the Web is accepted for publication, *Vectors* does not copy the work; final "publication" consists only of linking to the original server from an official table of contents. The combination of these components—institutional and disciplinary repositories, federating protocols, value-added tools—certainly qualify as an *alternative infrastructure* that facilitates the exit alternative.

We now turn our attention to gold open access, which can manifest as either exit or voice. As mentioned earlier, gold open-access journals forego subscription fees and access restrictions. In addition,

¹⁴ See <http://www.fedora-commons.org>.

¹⁵ See <http://www.eprints.org>.

¹⁶ See http://oad.simmons.edu/oadwiki/Disciplinary_repositories.

¹⁷ See <http://deepblue.lib.umich.edu>.

¹⁸ See <http://repository.upenn.edu>.

¹⁹ See <http://arxiv.org>.

²⁰ See <http://www.worldscientific.com/worldscinet/jnmp>.

²¹ See <http://vectors.usc.edu>.

authors do not reassign their copyright to the publisher. Because access is free, readers may freely copy the contents of the journal. There are only a few restrictions, most notably attribution to the original author. These conditions are generally stated in a Creative Commons license.²² The journal as an organization still undertakes traditional journal functions such as peer review. The article you are now reading is published in the *International Journal of Communication* (IJoC), a gold OA journal. It is one instance of an accelerating movement toward OA in communication studies and other social sciences (Poulin & Tomaszewski, 2014; SPARC Europe, 2014).

Lacking revenue from subscription charges, gold open-access journals adopt various financial sustainability models. (As noted earlier, online publication is cheap, but it isn't free; journals still need support staff, server space, and website managers, who must be paid.) One common model (not used by IJoC) involves article processing charges, also known as "page charges." These can range from hundreds to thousands of dollars. The charges may be covered by the author's institution, funder, or by the author. Typically, these charges are on the order of \$3,000 to \$5,000.

The earliest open-access journals emerged in the late 1980s and the early 1990s as efforts by OA advocates to offer an exit alternative to scholars frustrated by the dominant scholarly communication infrastructure. Three well-known pioneers, all still in existence, are *Psycoloquy*,²³ *Postmodern Culture*,²⁴ and the *Electronic Journal of Communication*.²⁵ Currently, the *Directory of Open Access Journals*²⁶ lists more than 10,000 journals, over 6,000 of them searchable at the article level, publishing almost 2 million articles in 138 countries. Some of these are relatively traditional in form, but others, such as PLOS ONE,²⁷ offer innovations such as alternative metrics. The OA trend was strengthened by research universities that banded together to create initiatives such as the Public Knowledge Project, an effort that developed the free software package Open Journal Systems²⁸ to reduce the technical costs of setting up these OA journals.

Although the vast majority of early OA journals were promoted as alternatives (exits in Hirschman's terms) from traditional so-called toll-access journals, there is increasing momentum in the open-access movement to convert toll-access journals to open-access journals.²⁹ We see here the execution of exit by a set of agents (the "exiters") having a voice effect on the "exited" agent. Arguably, the proliferation of OA journals and their popularity among scholars who chose to exit to them exerted voice pressure on publishers to adopt this model.

²² See <http://creativecommons.org>.

²³ See <http://www.cogsci.ecs.soton.ac.uk/cgi/psyc/newpsy>.

²⁴ See <http://pmc.iath.virginia.edu/contents.all.html>.

²⁵ See <http://www.cios.org/www/ejcmmain.htm>.

²⁶ See <http://doaj.org>.

²⁷ See <http://www.plosone.org>.

²⁸ See <http://pkp.sfu.ca/ojs>.

²⁹ See http://oad.simmons.edu/oadwiki/Journals_that_converted_from_TA_to_OA.

Another important example of the power of voice to modify the practices of traditional publishers is the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3).³⁰ This is an international initiative in which scholars and libraries work with established publishers to convert existing toll-access journals to open access. To date they have converted key journals from publishers, including Elsevier. The goal is to accomplish this without imposing costs on individual authors. Therefore, SCOAP3 provides a central payment system for participating organizations to cover the article processing charges at the institutional level. Here, voice has effectively turned the subscription system on its head. Rather than pay onerous subscription charges, forfeiting rights, and supporting limited access to their research results, the institutions have jointly convinced publishers (who are under the threat of exit) to accept a new financial model in exchange for providing open access while maintaining the prestige and reward systems of the existing infrastructure.

Unfortunately, the gold OA model is not without problems. In some cases, the economic model driven by article processing charges has resulted in the proliferation of poor quality and, in some cases, essentially worthless, even fake "peer-reviewed" journals, with the main goal of producing profit for the journal creator. Nicknamed "predatory publishing," this practice ensnares junior scholars at lower-tier institutions or in the developing world who are enthusiastic about the opportunity to flesh out their CVs (Beall, 2012) but who lack the experience or guidance to understand the complicated publishing domain. It remains to be seen how or whether this market will shake out to produce a model that mitigates this problem and assures sustainability and quality.

The arXiv: A General Exit Vehicle or an Example of Particular Community Practice?

The arXiv is an e-print archive started at Los Alamos National Laboratory and now managed by the Cornell University Library. Started in 1991 as a service to the high-energy physics community, the arXiv spread not only to other fields of physics but to mathematics, computer science, and statistics. The arXiv did not start out as an exercise of either voice or exit (Ginsparg, 1994). In fact, the roots of the arXiv are surprisingly traditional; it originated as an FTP replacement for a long-standing tradition of paper preprint exchange in the physics community. Soon after CERN introduced the World Wide Web in 1993, the arXiv moved to that platform. It quickly became the most up-to-date publication venue and the default communication infrastructure for various physics fields, later expanding into other fields in which it has also become popular (Ginsparg, 2011). Despite the fact that it was not an overt expression of voice or exit, the arXiv evolved into the late 1990s as the poster child of a broad "self-archiving" movement (Harnad, 1995, 1999) that, with the support of institutional repositories and a federation architecture (described earlier), presented the threat of exit from established publication venues.

That threat was a voice that was loudly heard by the American Physical Society, which adapted its publishing guidelines that restricted self-archiving to recognize that the default registration and certification infrastructure was now the arXiv (Jacobsmeier, 2012). Furthermore, it has evolved as the default dissemination mechanism; even in cases where the submission is matched by a journal submission, the arXiv copy frequently serves as the authoritative copy because of its support for revisions.

³⁰ See <http://scoap3.org/what-is-scoap3>.

Consequently, publication in the arXiv and citation of arXiv publications became accepted components of the reward system in some fields of physics. It is now common practice among some physicists and mathematicians to consider the arXiv version of a paper as the official, up-to-date revision and the citable version. Since then, it has not been uncommon for highly influential papers to appear *only* in the arXiv. The blurred line between traditional journals published by the American Physical Society and the arXiv illustrates the quick transitions between exit and voice decisions when new infrastructure is relatively cheap.³¹ In this case, the threat of a de facto exit also evoked a distinctive voice; together, these resolved to a synergistic relationship between traditional and alternative infrastructure.

Open-access advocates naïvely saw the arXiv as just the tip of the iceberg. They inferred that the technical affordances of the Web would naturally spawn massive and generalized exit from the existing scholarly publishing infrastructure (Harnad, 1995). These advocates failed to recognize the power of enforced loyalty in various scholarly fields and the idiosyncratic nature of that loyalty in high-energy physics (Kling & McKim, 2000). In that domain, the arXiv actually represented a continuation of established, field-specific communication cultures. Much to their dismay, attempts to replicate the arXiv as a generic solution that would apply across fields produced decidedly nonrevolutionary results. Although a hybrid model integrating e-prints with traditional publishing mechanisms did develop in such fields as biomedicine,³² in chemistry, the e-print model completely collapsed under extraordinary pressure from a highly oppositional American Chemical Society. When the American Chemical Society blocked e-print efforts, there was little opposition from chemistry's scholarly community, for whom, unlike the physicists, sharing was not a culturally embedded practice (Town, 2002). Thus, any assessment of the power of exit and voice in changing the scholarly publication infrastructure must account for the fact that communication practices among scholars are highly field specific (Cronin, 2003; Fry & Talja, 2007; Hine, 2008; Kling & McKim, 2000; Nentwich, 2005; Velden, 2011; Walsh & Bayma, 2007). Scholarly publishing mechanisms are deeply interdependent with historically embedded communication cultures, collaboration patterns, and attitudes toward openness (sharing) and closure that mitigate the power of exit and voice, strengthening existing infrastructures with strongly enforced institutional loyalty.

Conclusion

This article describes several examples of exit, voice, and loyalty in response to the scholarly publishing infrastructure that, over three and a half centuries has expanded and monopolized. In recent decades, this infrastructure became increasingly dissatisfying to its primary producers and users, the scholars themselves. The option of exit, although feasible in the era of Internet self-publishing, remains complicated by enforced loyalty to a well-established scholarly reward system that depends upon, and reinforces, the dominant infrastructure. Nevertheless, alternative infrastructures such as arXiv and PLOS ONE have emerged, providing an exit option to those scholars whose careers enable it or whose scholarly

³¹ Paul Ginsparg, the inventor of the archive, started the archive with a self-authored Perl script on a "server" installed under his desk. Now managed by the Cornell University library, maintenance of the arXiv is certainly not free, but the costs are low compared to formal publications (Ginsparg, 2011). In 2010, it cost arXiv \$6 per article (http://arxiv.org/help/support/2010_budget).

³² See <http://www.nih.gov/about/director/pubmedcentral/ebiomedarch.htm>.

cultures condone it. Simultaneously, dissatisfaction with the existing infrastructure has led to a strong exercise of the voice option. Publishers have begun to respond, especially after additional pressure from funding institutions such as the Wellcome Trust,³³ the National Institutes of Health,³⁴ and the Research Councils UK,³⁵ which increasingly mandate open access to funded results. An increasing number of publishers, including Elsevier, have converted a nontrivial portfolio of journals to the gold model, and increasingly permit simultaneous publication in green repositories. One could reasonably argue that the combination of research institutions' promotion of OA with increasingly easy exit to an alternative infrastructure has increased the power of voice, persuading even the largest publishers to reconsider their positions.

We close with some thoughts about the tension between the need for change in the scholarly publishing infrastructure versus the need for some measure of stability, or at least evolution, rather than revolution. Because of the value of tradition, academic journal systems can sometimes feel monopolistic, even if they are not technically so. For example, in some fields (as in business schools), a job ad may state that applicants must have published in one of the primary three association-sponsored journals in order to be considered. But this quasi-monopoly should not be blithely judged to be detrimental. One of the reasons Hirschman's theory is so valuable is that it produces counterintuitive conclusions in some situations. One of these is that *monopoly* and barriers to exit may have beneficial aspects that are usually overlooked. If perfect, barrier-free exit is always the first resort, any enterprise with problems would collapse before its problems could be addressed. Voice, the mechanism that improves existing systems, must be given time to work. Similarly, some systems are too elaborate or too valuable to actually destroy in a Schumpeterian fashion (Reisman, 2004). Exit as an option will attract the people who care most about change—but the people who care most are also most likely to have the best ideas for improvement. Those exiting constitute a brain drain that makes the prospects for voice much worse. Thus, exits that some people view as beneficial can have harmful effects on larger scales. The practices embodied in traditional academic journals represent a valuable legacy worth preserving in some recognizable form. Thus, a massive exit to open access would not necessarily be beneficial. In the end, the delicate balance we have described between voice and exit, and the resulting evolutionary change, may be the best outcome.

³³ See <http://www.wellcome.ac.uk/about-us/policy/spotlight-issues/Open-access/index.htm>.

³⁴ See <https://publicaccess.nih.gov>.

³⁵ See <http://www.rcuk.ac.uk/RCUK-prod/assets/documents/documents/RCUKOpenAccessPolicy.pdf>.

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