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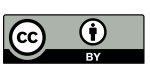

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COMMENTARY

The Changing Landscape of Open Access Publishing: Can Open Access Publishing Make the Scholarly World More Equitable and Productive?

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ABSTRACT

Almost 50% of scholarly articles are now open access in some form. This greatly benefits scholars at most institutions and is especially helpful to independent scholars and those without access to libraries. It also furthers the long-standing idea of knowledge as a public good. The changing dynamics of open access (OA) threaten this positive development by solidifying the pay-to-publish OA model which further marginalizes peripheral scholars and incentivizes the development of sub-standard and predatory journals. Causal loop diagrams (CLDs) are used to illustrate these interactions.

THE RISE OF OPEN ACCESS PUBLISHING

The Generation of Academic Knowledge

Much scholarly work is built on knowledge discovered or created by previous scholars. The details of that previous work are communicated via scholarly publications. Although the form of these has changed over the years, the most common form now is via journal articles and books. Access to this accumulated knowledge is an issue of vital importance to scholars

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around the world because, until recently, much of it was not available to most of them. Although open access (OA) publishing has made accumulated knowledge more available, scholars must also be able to publish their own findings so that others can benefit (Figure 1). This article examines how the evolving open access movement is changing the dynamics of scholarly publishing in a way that both helps, but also hinders, peripheral scholars. Causal loop diagrams are used to illustrate factors that cause, and reinforce, these trends, sometimes making them difficult to alter.

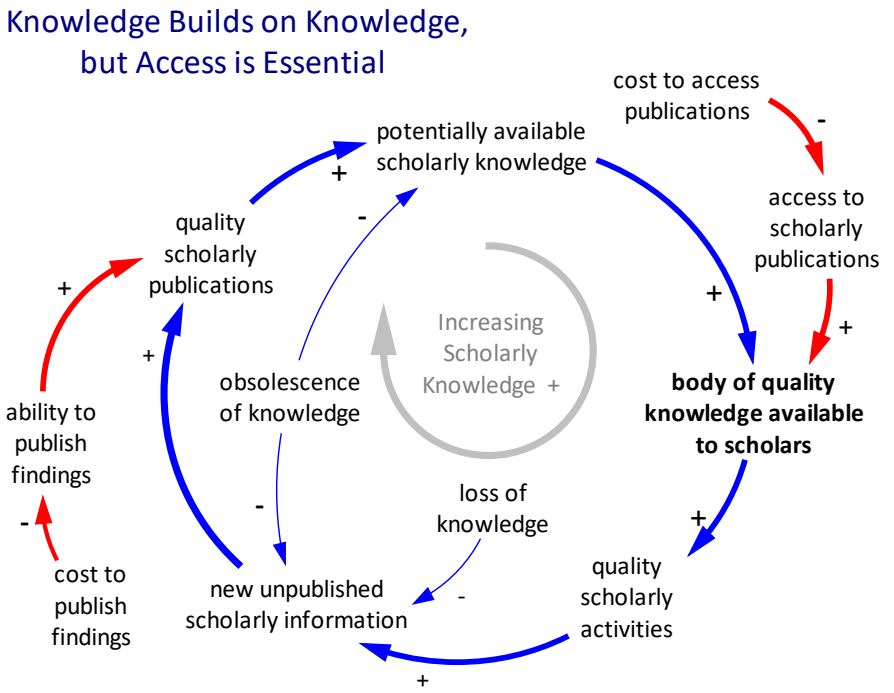

Figure 1. Creation of knowledge is a positive feedback whereby new knowledge is dependent on previous scholarly works. Such scholarly progress is dependent on the actual availability of scholarly publications, which is to a large extent dependent on funding (red arrows). [*Note:* Detailed descriptions for all figures that describe the visual relationships depicted are provided starting on page 15]

A Note on Reading Causal Loop Diagrams. Causal loop diagrams are diagrammatic representations of links among elements in a system: in this case the system of interlinked factors that affect open access publishing. Typically, elements in a causal loop diagram are connected with unidirectional arrows which link a cause to an effect. These arrows, or causal links, indicate how a change in the causal variable might affect change in the second variable. These causal links are generally thought of as causing either: 1. Change in the same

direction - indicated with a plus sign, or 2. Change in the opposite direction - indicated with a minus sign. In using these diagrams we are usually thinking about how the system has changed, or will change, over time.

For example, in Figure 1, there is a link between *cost to access publications* and *access to scholarly publications*. In this case the causal link shows an opposite effect meaning, for example, if *cost to access publications* increases then *access to scholarly publications* will decrease. Or, alternatively, if *cost to access publications* decreases then *access to scholarly publication*s will increase (other things being equal).

It is important to remember that these diagrams, if drawn correctly, allow the starting point of any inquiry to assume the first element can increase or decrease. Thus, in this example *cost to access publications* as a starting point could increase or could decrease. In this way a detailed diagram can be drawn showing causal links so that the viewer can think about what would happen in either case. (In the example below I will typically use the direction I think will actually happen… usually "increase", rather than try to describe what would happen if a term increased or decreased.)

Importantly, links of several variables in one of these diagrammatic models can form loops typically called feedback loops. Depending on the causality among elements in a loop, a loop can be a positive feedback loop or a negative feedback loop. A positive feedback loop indicates reinforcing behavior, often described as vicious or virtuous cycles. A negative feedback loop typically creates balancing behavior whereby an increase in the initial variable will ultimately be dampened, or counteracted, by the behavior of the feedback loop.

Note that there typically is no single starting point in a feedback loop although a viewer may feel one element is the focal point.

It is important to remember that there is no quantitative calculation in causal loop diagrams: they are images of mental models that depict beliefs about how a system behaves. In these following examples the diagrams are designed to examine how various elements in the open access publishing system affect one another. Keep in mind that when the description herein says that "if a cause increases then..." we could optionally be saying "if that cause decreases...". After each statement the phrase "other things being equal" is assumed. Note that any element in a diagram can have more than one item affecting it and also, in turn, can affect more than one other item.

The Move Toward Open Access

The development of the internet and related technologies changed the journal format by creating the opportunity for online publishing. Traditional print journal publishers rapidly moved to this new format, but at first access to journals remained restricted by high subscription (pay-to-view)[1] fees. That situation continued to restrict journal readership to scholars having access to good libraries. Even as online journals flourished, the pay-to-view approach continued to lock out most academics around the world, preventing them from reading recent research findings thus limiting their ability to improve their own research efforts. This limitation principally affected academics at small institutions (in many countries) and independent scholars[2] with no academic affiliation. Such restrictions on journal readership limited the use of published research findings, the citation of that work, and, generally, the spread of knowledge. These restrictions ultimately helped to reinforce the development of the OA movement.

Ultimately the rising price of journal subscriptions reached the point that even large academic institutions rebelled and considered a new alternative: open access publishing (e.g. see Chapter 2 in Suber, 2012). Basically, the cost of maintaining academic libraries had become unsustainable and contributed to this first revolution in OA publishing.

In the early 2000s OA was still a relatively new, but rapidly growing, phenomenon within academic publishing circles. Open access strove to make published works available to a wider readership by removing the cost of access to journal articles… by making articles free to read. Examples of respected *early OA journals*[3] are *Ecology and Society*, online since 1997[4], and the seven journals published by the *Public Library of Science* (PLOS)[5], online since 2003, among others. These and other pioneering OA journals helped establish the *credibility of OA as a platform* (Figure 2 pink arrows).

[1] Subscription (pay-to-view) publications are sometime referred to as toll access or TA.

[2] The term "academic nomad" is sometimes used but that usually refers to people who move among temporary academic positions, including those who must move for political reasons (Vatansever, 2018). The term "peripheral scholar" is used but that could be interpreted as "not important" which is not what is meant here. See, for example, comments by B.C. Björk (2017) about specialists working outside academia.

[3] Words or phrases in italics also appear in the figures.

[4] http://www.ecologyandsociety.org/ Originally published under the title *Conservation Ecology*.

[5] https://www.plos.org/

Although the rapid expansion of OA was new, *early OA archives* had existed for some time, a fact that helped establish the credibility of OA as a platform (Figure 2 pink arrows). ArXiv[6], still in use today, first went online in 1991, to improve communication within certain fields of mathematics and physics (Ginsparg, 1994). Other early OA archives are PubMed Central[7] and Project Euclid[8]. In reality, using the internet to exchange information in formalized serial format started even earlier (e.g. see Bailey, 1990, 1991).[9]

Laakso et al. (2011) provide a detailed review of the growth of OA publishing from 1993 to 2009. They found that annual growth in OA journals from 2000 to 2009 was 18% and annual growth in the number of OA articles during the same period was 30%. Nevertheless, by 2009 OA articles still made up only 7.7% of peer-reviewed articles.

University libraries, fighting ever-rising subscription costs, were early promoters of OA. As the OA movement grew *funding agency support for OA* also grew, and reports of funded research were made accessible to other researchers and the public (Figure 2). For example, since 2008, agencies of the U.S. government require research findings to be available on OA platforms (Varmus, 2008). More recently, since September 2018, a major OA campaign, Plan S, has been underway, backed by an influential international consortium of research funders[10] (Rabesandratana, 2018; Schiltz, 2018). Such widespread *funding agency support for OA* further reinforced the *credibility of OA as a platform* and, as of 2018 more than half of all published academic articles were freely available through some form of OA (Science-Metrix Inc., 2018).

Other *active promotion of OA* also occurs through private organizations further reinforcing the use of OA journals (Figure 2). For example, SPARC (http://sparc.arl.org/about), "an international alliance of academic and research libraries" works to create a more open system of scholarly communication. The Directory of Open Access Journals DOAJ (https://doaj.org/), and the Open Access Scholarly Publishers Association OASPA (http://oaspa.org/) strive to steer authors toward suitable OA outlets for their publications and also help authors avoid *predatory journals* (see below).

[6] http://arXiv.org

[7] http://www.ncbi.nlm.nih.gov/pmc/. An archive of scholarly articles in biomedical and life sciences.

[8] https://projecteuclid.org/.

[9] The open access directory (http://oad.simmons.edu/oadwiki/Main_Page) provides additional information about early OA and online journals.

[10] See: Plan S Website at https://www.coalition-s.org.

Benefits of Open Access

The benefits of OA publishing, in terms of increased visibility of research findings, has been documented for some years (Antelman, 2004), as has evidence for increased citation of open access articles (Eysenbach, 2006). More recent studies confirm these findings (Breugelmans et al., 2018; Piwowar et al., 2018; Science-Metrix Inc., 2018). Although Davis (2010) found only a slight increase in citation of OA articles, he found a 100% plus increase in downloads of OA, compared to non-OA, articles. He hypothesized that writers of academic articles typically worked at institutions with access to pay-to-view journals while a large proportion of readers did not, suggesting that OA publishing helps extend the reach of academic communication to a larger, and new, readership (Figure 2).

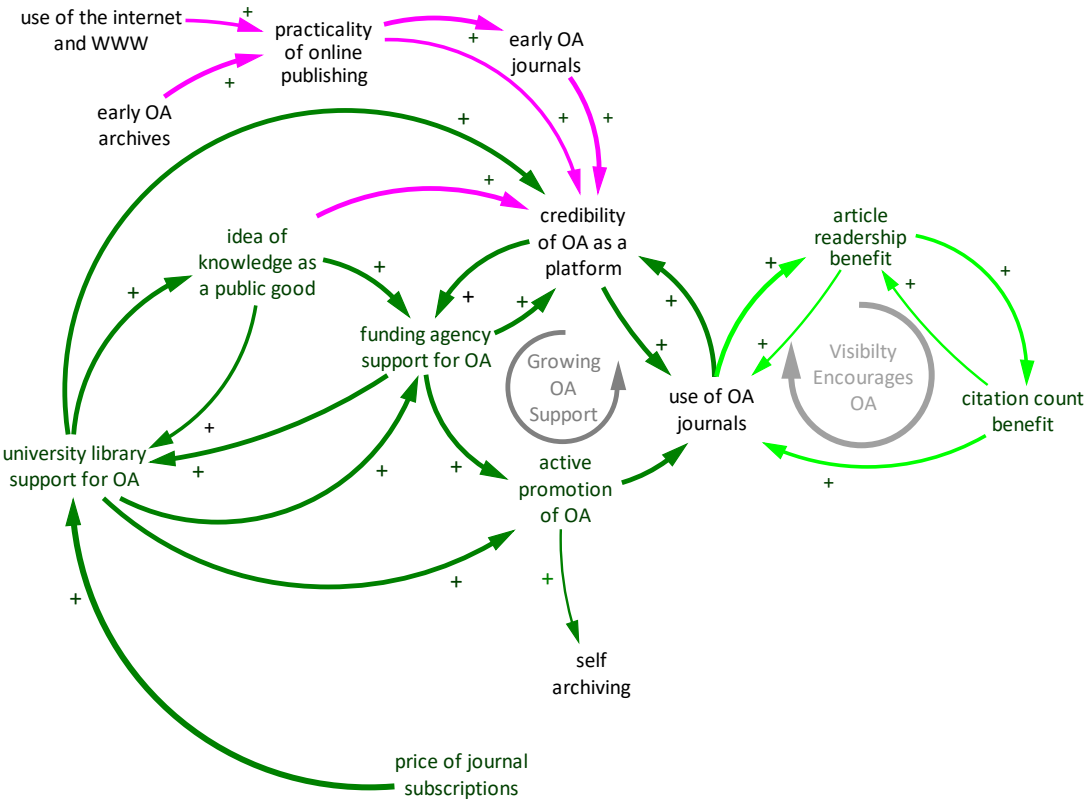

Figure 2. Several factors reinforce the growth of the OA movement. As journal prices rise, libraries rebel, and funding agencies support increased OA, reinforcing the idea of knowledge as a public good (dark green). As use of OA grows, authors realize that OA provides improved article readership, further reinforcing the growth of OA (light green). Early influences on online scholarly communication are shown in pink.

The wider availability of scholarly articles via OA also helps remove certain non-financial barriers faced by 'peripheral' scholars such as the likelihood that they have current references, the assumption that they will adhere to a particular writing style, and an expectation that they follow internationally accepted framing of discussion (Canagarajah, 1996, 2010). Access to a wide range of journals allows authors, reviewers, and editors to develop an improved understanding of different academic traditions.

There are many disagreements as to the form that OA should take. For example, an unintended consequence of self-archiving, including the use of institutional and commercial archives, sometimes called green OA, is that it does not reinforce the use of OA journals. Rather it permits the continued use of subscription-based journals even though it may slightly lower numbers of subscriptions (Figure 3). It is conceivable that green OA might also limit growth of other forms of OA (Brainard, 2019a) thus providing a disincentive in moving toward a fully OA world. There are also reasonable concerns about long-term storage of green OA archive sites (Björk, Laakso, Welling, & Paetau, 2014), prompting Essl, Courchamp, Dullinger, Jeschke, and Schindler (2020) to term the approach anarchistic OA.

Ultimately the *idea of knowledge as a public good* is a fundamental and early basis for the OA movement (Figure 2). In the phrase of Bollier (2010): "Academic knowledge should be regarded as the inalienable resource of a commons." The governance of this knowledge commons has been undergoing significant change (Beerkens, 2018; Hellström, 2003; Stiglitz, 1999). Important parts of that change involve how OA knowledge is created and how peripheral scholars will participate in that knowledge creation.

Big publishers' response: consolidation of the pay-to-publish OA model

Importantly, a main driving force behind the rise of the OA movement was the mounting *price of journal subscriptions*, which threatened the sustainability of academic libraries (e.g. Buranyi, 2017; earlier commentary in Sosteric, 1996). Because of libraries moving to support open access initiatives, the income stream to publishers looked precarious. To make up for the real, potential, and imagined loss of subscription revenue, and to better compete with pure OA publishers, many traditional publishers created a system to allow authors to publish OA articles within existing pay-to-view journals. This was accomplished through a system of article processing charges (APCs), which an author can pay to make an article OA.[11] Most pure OA journal publishers also use the APC approach to fund their operations but, in those cases, all articles are OA… there are no subscription charges. This hybrid ap-

[11] A pay to view (subscription) journal that includes OA articles paid for with APCs is referred to as a hybrid OA journal.

proach coupled with pure OA is creating a system where the APC is the de facto standard within the OA landscape (Figure 3). In fact, most major academic institutions have created specific funding mechanisms to help their authors pay APCs thereby reinforcing the use of the APC model. Although APCs can be as low as a few hundred dollars, most range in the thousands, and some are well above $5,000 per article published. This appears to have more than compensated publishers for possible loss of subscription revenue and major publishing houses have been accused of double dipping: charging for both subscriptions and for APCs (Pinfield, Salter, & Bath, 2016).

One ideal of the open access movement has been equal access to scholarly knowledge, but the increasing use of APCs has placed significant financial barriers in the path of independent scholars, those at smaller institutions, and academics in much of the developing world who would like, or need, to publish their work (Gadagkar, 2008; Peterson, Emmett, & Greenberg, 2013). Consequently, the growing dominance of the pay-to-publish model has given rise to sub-standard, predatory, and fake journals (Figure 3).

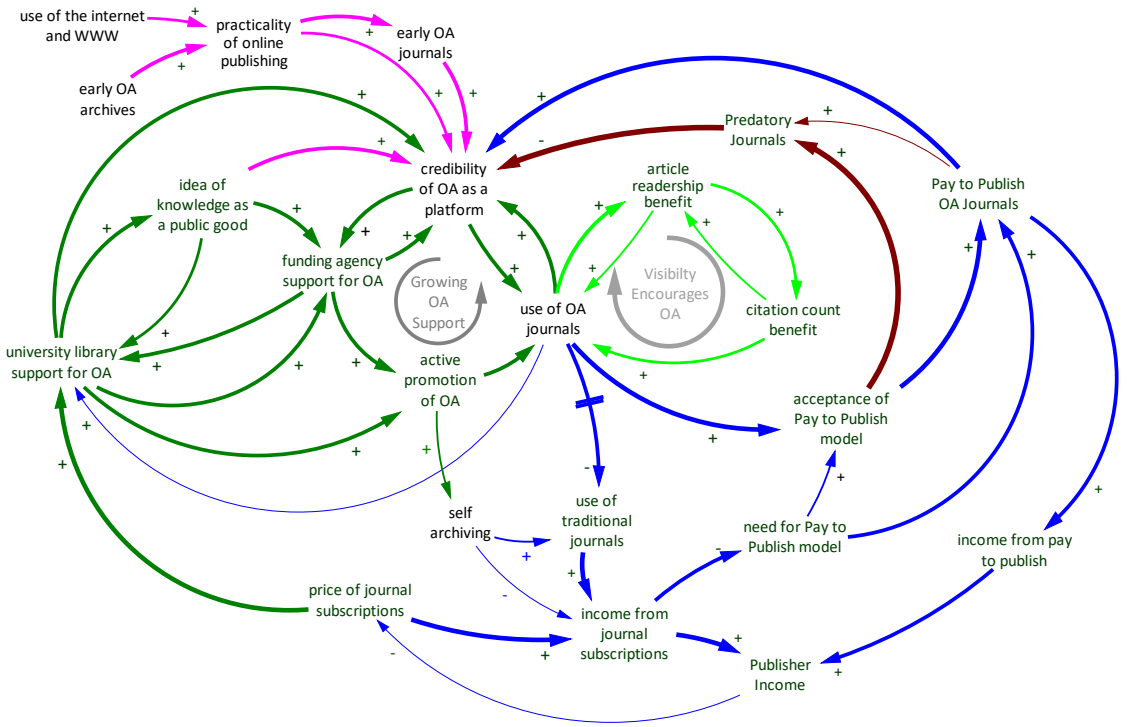

Figure 3. The rise of pay-to-publish and article processing fees has tended to reinforce pay-to-publish as the standard OA approach (blue arrows). Unfortunately, pay-to-publish also incentivizes predatory publishing (brown arrows). The increase in predatory journals in turn can degrade the overall credibility of OA as a platform; while this degradation may be limited, it disproportionally affects peripheral scholars.

Incentivizing Predators?

As the pay-to-publish model becomes more acceptable, increasing numbers of journals have allowed OA through this approach. This permits authors to continue publishing in their favorite/normal journals, and the new OA requirements of research funders can also be met. This new self reinforcing OA system provides additional income to publishers and enhances the wider availability of OA articles (Figure 3).

Unfortunately, an unintended consequence of the growing acceptance of the pay-to-publish model has been the creation of many new OA journals with minimal or no publishing standards (Butler, 2013; Shen & Björk, 2015). These publishers may deliberately seek out authors needing to publish their work by offering somewhat lower APCs and less stringent, or no real, peer review. Some of these, termed "predatory journals" (Beall, 2012), lack any academic credibility, and publishing in such journals carries a risk for authors who are attempting to build an academic reputation. In some cases, such journals merely seek out unsuspecting authors who can be charged fees, their papers perhaps never published at all (Figure 3). Details of predatory and substandard journals are discussed by Berger (2017).

The pay to publish approach is particularly problematic for independent/peripheral scholars and those at smaller institutions or departments where charges to publish academic work cannot be met. For these scholars, who have limited funds and often a requirement to publish, the cheaper, often predatory, OA journals may seem an attractive alternative (Figure 3). OA has provided substantial benefits to such scholars, but now the rise of pay-to-publish OA has created new barriers. The following section looks at this question in more detail.

CURRENT SITUATION—MORE DETAIL

Big Publishers Persist

Pay-to-publish OA is now the dominant component of the OA landscape, in spite of negative effects of predatory publishing. This is largely due to reinforcing feedbacks that tightly link the *reputation of established publishers* and the professional *reputation of authors* (Figure 4). Subscription journals now offering OA allow authors to continue using their traditional publication outlets and also satisfy the requirements of research funders (Figure 4, brown arrows). These established publishers seem important in maintaining journal quality via an established peer review process, well established editorial procedures, support for some professional societies, and a well-established web presence, with archives and data analytics growing in sophistication (e.g. see Aspesi & Brand, 2020). The most important attraction of these journals is the fact that they are already well established as the expected place for

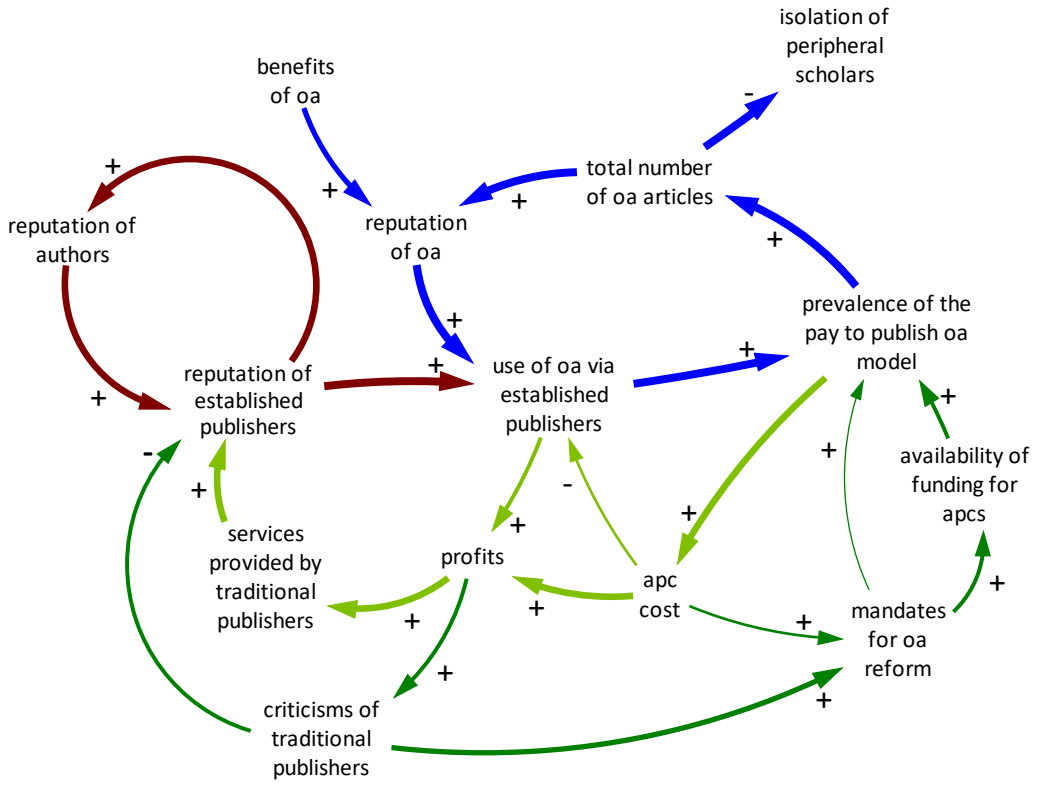

Figure 4. Authors tend to stick with known publishers with a good reputation (brown arrows). Demands for OA have reinforced use of APCs which fund further development of traditional publishers (light green). Growing criticisms (dark green) tended also to reinforce pay to publish by providing funding for APCs. These factors work together to reinforce the pay to publish OA model (dark blue).

academics, in a given field, to publish. Academics, to a large extent, are most comfortable publishing in these established journals. As these journals' reputations grow, authors' reputations can be enhanced by publishing in them. This positive feedback continues to enhance the attractiveness of established journals even as OA publishing expands. This also allows publishers to charge higher APCs to maintain or improve their income stream. See Reinsfelder (2012) for a discussion of factors influencing publishers and authors within the publishing system.

Journal reputation has come to be measured by journal impact factors that track citations of a journal's articles (Garfield, 1999, 2006). These impact factors have come under increased criticism and alternatives have been proposed (Anon., 2012; Brembs, Button, & Munafò, 2013). Nevertheless, at least in general, journals with higher impact factors tend to charge higher

APCs (Solomon & Björk, 2012). That is, authors can pay more for higher impact[12]. According to ECAC (2018) the current hybrid open access system has actually increased the total cost of scholarly communication, undermining an original OA goal of lowering costs. This has led to a renewed criticism of traditional publishers' high profits. Interestingly some of this push for reform has increased funding for APCs further increasing AO profitability (Figure 4).

Plan S Problems

The current (2018–2020) controversies regarding hybrid OA and Plan S are related to both journal and scholar reputation. One unusual aspect of Plan S is the insistence that scholarly papers not be published in hybrid OA journals—journals that publish both OA and non-OA papers. This requirement is meant to force all papers to be OA, even though most would remain pay-to-publish. Plan S has met with significant resistance both from publishers, who wish to continue with subscription based as well as OA options, and from scientists and other scholars. Scholarly resistance is based on the concern that forcing everyone to use OA will: likely lock in place high APCs, may prevent scholars from publishing in their preferred journals, may place severe limitations on journals published by professional societies, and may cause a loss of income for professional societies (Brainard, 2019b; Clarke, 2018; Kamerlin et al., 2018; Research Community, 2018; Several authors, 2019).[13]

Opposition to Plan S is a new phase in the continuing push for OA reform (Figure 5). In this case reformers seem to be requesting a step backward… to the continuation of subscription-based journals. Pending a better resolution of how OA publishing will be funded, many are concerned about weakening the original goal of the OA movement: open access to scholarly knowledge, ideally both its consumption and creation.

The significant progress toward OA has certainly helped peripheral scholars by providing access to newly available, and archived, knowledge. However, the form that OA has now taken increases *isolation of peripheral scholars* (Figure 5 red arrows). They will be less able to publish their work because, typically, they have no funds to pay APCs. OA, as it is being implemented is increasing the likelihood that these scholars will publish in sub-standard journals. This same outcome might also appear in academic fields that have less research funding but nevertheless have scholars who are expected to publish (Alizon, 2018; Edwards, 2015).

[12] Publishers of selective journals claim higher APCs are justified due to high selectivity requiring more articles to be rejected thus higher costs (e.g. see comments in Else, 2019b).

[13] In May 2019 it was announced that implementation of plan S was to be delayed (Else, 2019a).

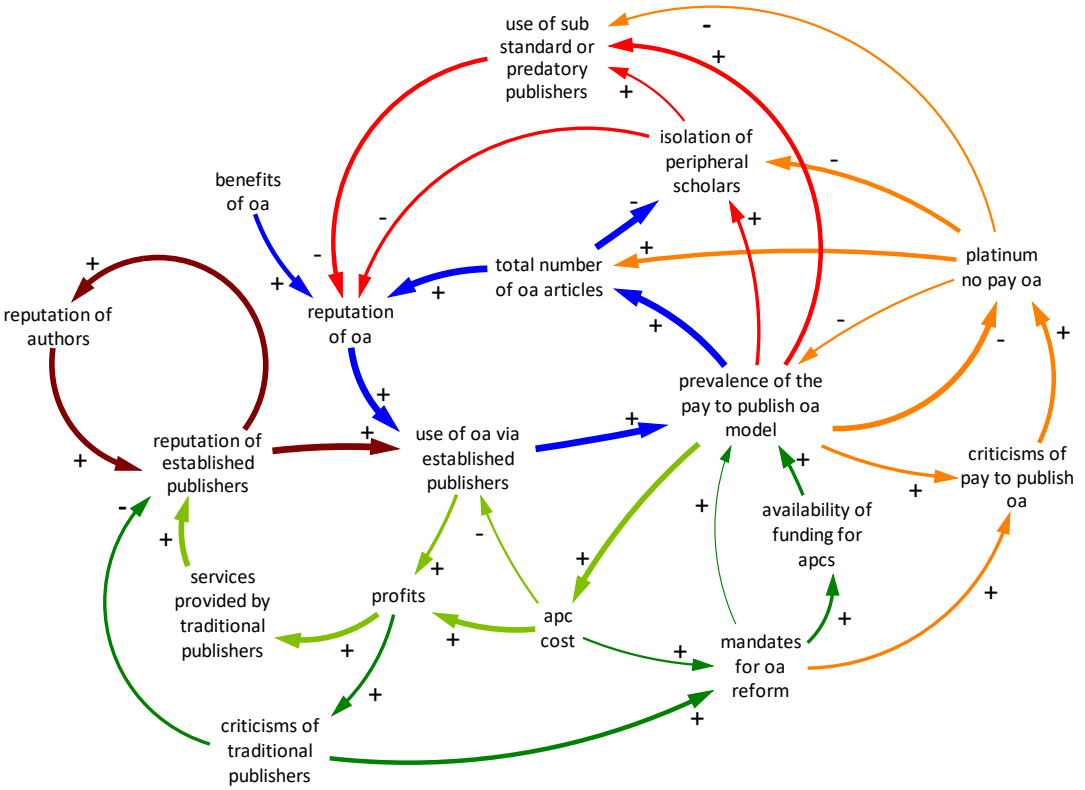

Figure 5. Current situation. The dominance of pay to publish OA (blue) and its reinforcing factors (light green) led to mandates for OA reform (dark green) which continued to focus on promoting OA via pay to publish, which also incentivized sub-standard and predatory journals. Efforts at platinum OA (see footnote 15) remain weak (orange).

Efforts to establish platinum[14], no-pay, OA are still limited due to the lack of well-established funding options (Figure 5) as well as the self-reinforcement of existing publishing patterns. The dominance of big publishers and the academic community's acceptance of the pay-to-publish model have hurt platinum OA efforts. While some early efforts at platinum OA have succeeded, overall these successes form a very small part of the OA publishing landscape. To some extent this is due to the time needed to build a new journal's reputation, but certainly the solid reputation of existing journals and the acceptance of the pay to publish model limit progress toward platinum OA. The near term publishing landscape appears to favor pay-to-publish OA with a likely transitioning from hybrid to pure pay-to-publish OA (e.g. see Schimmer, Geschuhn, & Vogler, 2015). Sadly, this will further isolate peripheral scholars everywhere.

[14] Platinum OA articles are free to publish and free to read.

DISCUSSION

Ideally, true open access should remove financial barriers to publish articles as well as to read them—so-called platinum open access. In this way financial barriers would be removed, and articles could, in theory, be judged solely on merit. Few primary journals follow the platinum OA model.

Nevertheless, DOAJ lists over 9,000 platinum OA journals. Many of those cater to specialized readerships. Although DOAJ attempts to list only valid OA journals, cautious authors can also apply the tools suggested by Blas, Rele, and Kennedy (2019) to check journals prior to publication.

A perusal of DOAJ reveals several funding models for platinum OA journals. Some such as the Fishery Bulletin[15] are published by government agencies. Others such as Cultural Anthropology[16] are published directly by scholarly societies. A third platinum OA funding model draws on universities, in some cases on behalf of academic organizations. Three examples are: The *Journal of World-Systems Research*[17] published by the University of Pittsburg library system, the *Journal of Political Ecology*[18] published by the University of Arizona, and the *Revista de Biología Tropical*[19] published by the University of Costa Rica. A fourth platinum OA funding model, private foundation funding, supports, for example, *Conservation and Society* funded by the Ashoka Trust for Research in Ecology and the Environment (ATREE) [20], and The *Journal of Open Source Software (JOSS)* sponsored by a non-profit umbrella organization NumFOCUS.[21, 22]

These examples illustrate free-to-read / free-to-publish OA funding approaches, which have persisted for many years. Platinum OA can be a viable publishing option. One might won-

[15] *Fishery Bulletin*: https://spo.nmfs.noaa.gov/fb.htm

[16] *Cultural Anthropology*: https://journal.culanth.org/index.php/ca/about

[17] *Journal of World-Systems Research*: https://jwsr.pitt.edu/ojs/index.php/jwsr

[18] *Journal of Political Ecology*: https://journals.uair.arizona.edu/index.php/JPE

[19] *Revista de Biología Tropical*: https://revistas.ucr.ac.cr/index.php/rbt/about

[20] *Conservation and Society*: http://www.conservationandsociety.org/, *ATREE*: https://atree.org/about

[21] *JOSS:* http://joss.theoj.org/about#about, *NumFOCUS*: https://numfocus.org/community

[22] Note that some journals listed on the DOAJ as platinum seem to be pay-to-publish journals that waive APCs for the first few years of the journal's existence, apparently using the no fee approach to gain authors.

der, if platinum OA is viable, why isn't it more common? To a certain extent the answers to this question lie in the self-reinforcing causal relationships illustrated in this paper, especially the dominance and acceptance of the APC publishing model.

OA has reached a critical mass and OA articles are read and cited more often than non-OA causing more authors to prefer, and more publishers/journals to offer, an open access option. We might imagine that competition for good papers would push APCs down making quality journals more widely accessible to both readers and writers. Unfortunately, the opposite seems to have happened. Data indicate that, in general, more prestigious journals charge higher APCs (e.g. see Khoo, 2019). Scholars continue to favor prestigious journals over less expensive alternatives making the emergence of new, cheaper key journals less likely.

Initially the increased availability of OA within each field increased its use, perhaps at the expense of subscription publications. The increasing OA readership stimulated further growth of OA. Sensing a possible loss of revenue from subscription journals, publishers initiated open access options using the author pays model. They were able to do this because of 1) the established reputation of key journals, and 2) the growing acceptance that research projects could fund APCs.

Under the previous subscription model, journal funding was quite removed from research funding…researchers at large institutions had very little knowledge of the total journal cost. It was not their concern. On the other hand, APC funding often comes straight from the research budget, a fact that researchers cannot ignore. Subsequent efforts on behalf of researchers resulted in changes that have further reinforced the author pays model: special accounts were set up, by universities and funding agencies, to pay the APCs on behalf of the authors. This helped reinforce the dominance of the APC approach to funding, which was already in use by the pure OA (non-hybrid) publishers.

Unfortunately, the APC approach hurts peripheral scholars who otherwise have greatly benefited from the growth of OA publishing. These financial (and other) barriers to publishing create a demand for "sub-standard journals." Publishing in those, to a large extent, diminishes the reputation of work carried out. This reinforces the existing dichotomy between scholars in wealthier and those in relatively poorer research situations and diminishes the idea of knowledge as a common good, equally shared, and created, by all.

EXPLORE FURTHER: DETAILED FIGURE DESCRIPTIONS

Figure 1: Knowledge builds on knowledge, but access is essential.

This diagram represents a very basic understanding of how scholarly knowledge is increased. In appearance it is a single clockwise positive (reinforcing) feedback loop with some additional features. Starting with the diagram element on the right we see: if *body of quality knowledge available to scholars* increases then the *quality of scholarly activities* will also increase (other things being equal). If *quality scholarly activities* increases then *new unpublished scholarly information* will also increase thus causing *quality scholarly publications* to increase (other things being equal) and thus increasing *potentially available scholarly knowledge*. This in turn will help to further increase the *body of quality knowledge available to scholars*.

Importantly some additional elements are attached to this positive causal feedback loop. The body of quality knowledge available to scholars is also dependent on *access to scholarly publications* and, if the *cost to access to these publications* increases, the *access to scholarly publications* will decrease in turn causing a decrease in *the body of quality knowledge available to scholars*. Similarly, if the *cost to publish findings* increases the *ability to publish findings* will decrease, decreasing *quality scholarly publications*.

Two additional model elements are present as well: *obsolescence of knowledge* will decrease *new unpublished scholarly information* and will also decrease *potentially available scholarly knowledge*. There is also the element *loss of knowledge* which dissipates *new unpublished scholarly information*… prior to it being published.

Figure 2: Several factors reinforce the growth of the OA movement.

This causal loop diagram consists of three prominent feedback loops and several smaller ones that are all related to the positive reinforcement of the use of OA journals. There are also some additional factors in the diagram related to early effects on the OA movement.

At the top of the diagram, outside the feedback loops, we see that early *use of the Internet and World Wide Web* coupled with *early OA archives* reinforced the *practicality of online publishing*. The pra*cticality of online publishing* reinforces the use of *early OA journals* and also *established the credibility of OA as a platform* as did the *early OA journals*.

In the central part of the diagram to the left there are two interlinked feedback loops. One

of these involves *funding agency support for OA* and *library support for OA*. These two are linked to each other whereby *library support for OA* helped establish the funding agency support and funding agency support in turn helps support libraries (by supporting the move away from subscription journals and toward research funding of OA publishing). A smaller feedback affect involves the *idea of knowledge as a public good* which is supported by libraries and the *idea that knowledge is a public good* supports the existence of libraries.

In the center of the diagram is a positive feedback loop, labeled growing OA support, involving the following logic: the *credibility of OA as a platform* enhances *funding agency support for OA* which in turn reinforces *active promotion of open access*, further reinforcing the *use of OA journals* and completing the loop by further increasing the *credibility of OA as a platform*.

To the right of the diagram is another feedback loop labeled visibility encourages OA. The logic of this feedback loop is that the *use of OA journals* enhances the *article readership benefit* to authors which in turn increases *citation count benefit* to authors which, closing the loop, further increases the *use of OA journals*.

There some additional influences shown in this diagram which will be further explored in the next. One of these is the link illustrating that if the *price of journal subscriptions* increases then *university support for OA* will also increase. The other indicates that *active promotion of OA* may also lead to an increase in *self archiving*.

Figure 3: This figure describes the rise and establishment of the pay to publish OA model and how that has, in turn, led to predatory publishing.

This diagram builds on diagram 2 by adding several components to the right of the previous diagram. Most of these new components indicate effects caused by the increasing use of OA journals.

The underlying logic of the main part of this loop is that increased *use of OA journals* tended to decrease the *use of traditional journals* causing a, real or perceived, drop in *income from journal subscriptions* which increased the *need for a pay to publish model* of journal funding. Further, the increasing *need for the pay to publish model* led to both *acceptance of the pay to publish model* and an increasing number of *pay to publish OA journals*. The increasing *acceptance of pay to publish OA journals* further reinforced the *credibility of OA as a publishing platform* further solidifying the *acceptance of the pay to publish financing model*. A second addition to the diagram is the fact that *acceptance of the pay to publish model* created in an incentive for *predatory journals* both via the obvious financial incentive and via the acceptability of pay to publish OA.

Some lesser influences in the diagram are also indicated: pay to publish journals create income for publishers and, in theory at least, that would decrease the price of subscription journals. Also, self-archiving, mentioned above, will lead to a continued use of traditional journals but might cut into revenue from those journals somewhat.

Figure 4: This figure and the next look at a slightly different aspect of open access publishing: how OA via traditional publishers has become the norm and the effects of that normalization.

In appearance the diagram contains two prominent causal loops in the upper half in and number of smaller, but important, causal loops and influences in the lower half.

In the upper left is a two-element causal loop linking the *reputation of established publishers* which reinforces the *reputation of authors* (who publish in those journals) and the *reputation of authors* (and their good papers) which help to reinforce the *reputation of established publishers*.

The *reputation of established publishers* also affects *use of open access via established publishers* which is also influenced by the growing *reputation of OA* in a second feedback loop. This indicates that the *use of open access via established publishers* is reinforced by the *reputation of established publishers*. This in turn reinforces the *prevalence of the pay to publish OA model* which can cause a further increase the *total number of OA articles* which further enhances the *reputation of OA*. Importantly, it is likely that as the *total number of OA articles* published using the pay to publish model increases, the *isolation of peripheral scholars* will decrease (other things being equal) because they have access to more articles.

The lower half of this diagram includes the following causal connections: as the *use of open access via established publishers* has increased, their *profits* have also increased, and this has led to an increase in *services provided by traditional publishers* further improving their reputation. At the same time, the *prevalence of the pay to publish OA model* has led to an increase in the *article processing charges* (APC) which has further enhanced the profits. The increased APCs coupled with the high profits of traditional publisher profits have increased *criticisms of traditional publishers* which in turn has increased *mandates for OA reform*.

Importantly, *mandates for OA reform* have led to an increase in the *availability of funding for APCs* which has further reinforced the *prevalence of the pay to publish OA model*.

Figure 5: This figure is built on the previous figure visually to the upper part and right. It adds two ideas to the diagram: 1) the idea that the *prevalence of the pay to*

***publish OA model* will increase *isolation of peripheral scholars* and 2) some additional links that might make it possible to establish a *platinum no-pay* OA financing model.**

The first element illustrates the links from *prevalence of the pay to publish OA model* directly increasing the *isolation of peripheral scholars* because it limits their ability to publish. This is in direct opposition to the previous link whereby the *total number of OA articles* decreases the isolation of peripheral scholars. (The point here is that without money to pay for the publishing of their own articles peripheral scholars will become more isolated even though they will have an increased access to other people's articles.) The *prevalence of the pay to publish OA model* also increases the *use of substandard or predatory journals*. The further isolation of peripheral scholars, because they can't afford to pay to publish, also leads to an increase in the use of substandard or predatory publishers, because these can be cheaper outlets for publications.

The second element added to this diagram is the idea of *platinum no pay OA* (that is open access publishing that is free to read and to publish). In this part of the diagram *mandates for OA reform* lead to *criticisms of pay to publish OA. Criticisms of pay to publish OA* also provide incentive for *platinum no pay OA*. However, the apparent overwhelming *prevalence of the pay to publish OA model* currently prevent *platinum no pay* OA from growing. If established, *platinum no pay OA* could help decrease *isolation of peripheral scholars* which would also lead to a decreased *use of substandard and predatory publishers*. This in turn would result in positive influences on the *reputation of OA*.

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