Scholarly Communication and Open Access in Psychology:

Current Considerations for Researchers

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Abstract

Scholarly communication and open access practices in psychological science are rapidly evolving. However, most published works that focus on scholarly communication issues do not target the specific discipline, and instead take a more "one size fits all" approach. When it comes to scholarly communication, practices and traditions vary greatly across the disciplines. It is important to look at issues such as open access (of all types), reproducibility, research data management, citation metrics, the emergence of preprint options, the evolution of new peer review models, coauthorship conventions, and use of scholarly networking sites such as ResearchGate and Academia.edu from a disciplinary perspective. Important issues in scholarly publishing for psychology include uptake of authors' use of open access megajournals, how open science is represented in psychology journals, challenges of interdisciplinarity, and how authors avail themselves of green and gold open access strategies. This overview presents a discipline-focused treatment of selected scholarly communication topics that will allow psychology researchers and others to get up to speed on this expansive topic. Further study into researcher behavior in terms of scholarly communication in psychology would create more understanding of existing culture as well as provide early career researchers with a more effective roadmap to the current landscape. As no other single work provides a study of scholarly communication and open access in psychology, this work aims to partially fill that niche.

Scholarly Communication and Open Access in Psychology: Current Considerations for Researchers

Across the disciplines, scholarly communication is in a time of disruption and transition. It is important to understand the current landscape through a disciplinary lens, and from a stakeholder perspective. Whether researcher, author, librarian, or publisher, this is a fast moving time of rapid change, largely due to technological advances and the power and reach of the internet. In terms of psychology, some traditional aspects of scholarly publishing remain the same, while many others continue to evolve. Authors find themselves writing for the more global audience that the internet continues to enable. Sharing articles online with colleagues near and far has become part of research culture, and collaboration is now possible across and between institutions and countries. Publishers are adapting to a changing culture of scholarly sharing and networking that authors have come to expect from the internet culture. Universities want to take advantage of services that showcase the work of their authors, using new metrics and research information systems that demonstrate impact in an age of assessment.

One major aspect of this new scholarly landscape is the phenomenon of open access. Open access has grown and become mainstream and many versions of a single article can exist in multiple institutional or subject repositories online. Readers find these early articles more easily discoverable via searching the popular Google Scholar, and by using new tools such as Unpaywall (http://unpaywall.org/), a free service that provides enhanced discoverability and access to available repository versions of subscription articles. (Chawla, 2017a) Alternately, the Open Access Button (https://openaccessbutton.org/) can assist readers unaffiliated with subscribing institutions in accessing the scholarly literature. The future of scholarly publishing is in some ways unclear, but it does include more open access of all types, enhanced collaboration, more online sharing of research results, and increasing accessibility to the data that underlies and supplements scholarly publications. Funders are increasingly mandating that authors and universities provide open access to the results of taxpayer funded research, even as there are fewer research dollars available than in the past. Research libraries are also undergoing seismic changes, and librarians are increasingly taking on consulting roles in scholarly communication and open access areas. In this complex environment, faculty, students and researchers may be seeking information on products, systems, new modes of publishing, and other strategies so that they may be able to take advantage of the myriad opportunities that the internet is providing to share the results of research. Communication of research findings to the public via the internet has become an expectation of funders, universities and readers, and psychological science has many opportunities to reach larger audiences of interested readers than in the days when print materials could be accessed on site in public research libraries or via interlibrary loan by request of the reader from their public libraries.

The transformational move from print to electronic dissemination of research information was messy and chaotic at times, but at this point it can be said that most of the research level

journal literature in psychology has been moved to the online environment, accessed either free or via library or personal subscriptions on the internet. Many traditional aspects remain, such as the specific field differences in scholarly communication practices that continue on. The standards for scholarly communication in psychology will continue based on field traditions and transitions through evolutions in technology as well as various factors such as a continued emphasis on assessment of scholars and universities. The wheels of change turn slowly in the promotion and tenure systems and cultures of most universities, many of whom have adopted an "audit culture" that has added increasing pressure to a system that requires faculty to demonstrate impact. The traditions of scientific communication within disciplinary culture, particularly in the case of some new behaviors such as sharing preprints (which existed in the paper world in some disciplines and made the transition easily to the online situation), predate the internet. Over time, it is assumed that some scientific communication in the electronic realm might promote the development of more similarities in the way disciplines behave online. Studies about the way that various disciplines approach the newer aspects of scholarly communication and open access have shown that there is no "one size fits all" and that there is still great variety in the way disciplinary scholarship is funded and disseminated to readers and researchers. Severin, Egger, Eve, & Hurlimann concluded in 2018 in a study that analyzed all of the existing discipline-specific studies on "open access publishing practices and barriers to change" that:

> Over the last three decades, scholarly publishing has experienced a shift from "closed" access to OA as the proportion of scholarly literature that is openly accessible has increased continuously. The shift towards OA is however even across disciplines in two respects: first, the growth of OA has been uneven across disciplines, which manifests itself in varying OA prevalence levels. Second, disciplines use different OA publishing channels to make research outputs OA. (p.1)

While psychology appears in some large scale bibliometric (and other) studies of amount and type of open access, for example, there seem no large surveys of current psychology faculty and other researchers that would assist in painting a picture of how authors make their work OA, and why. More research into the scholarly communication behavior of psychological scientists would help to facilitate change in the system by allowing a true understanding of the pressures as well as the opportunities at play in the current scholarly communication and open access ecosystem in the discipline. It is not clear how psychology is positioning itself to move forward intentionally to take advantage of all of the ways to most effectively disseminate and utilize research results in this internet-enabled scholarly publishing environment. Psychology does not jump out as a leader among disciplines in opening up its literature to a wider swath of readers and researchers. The wheels of change have turned slowly. Psychology's current focus on aspects of open science and reproducibility are positive and visible reminders of some aspects of a move toward openness.

Some early pioneers in the electronic communication space for psychology (and one of a "core group of enthusiasts" that are the key players in the early days of the open access movement) include cognitive scientist Stevan Harnad, the editor of *Psycholoquy*, a very early electronic peer reviewed journal introduced in 1990. (Kling & McKim, 2000) *Psycholoquy* was

started by Harnad in 1990 with support from the American Psychological Association and Princeton University, and was an early electronic journal that was associated with the successful Cambridge University Press-published journal "*Behavioral Brain Sciences (BBS)."* Harnad reported in 1996 that it was much more difficult to get authors to submit to the electronic *Psycholoquy* than it was to the print counterpart *BBS*, and that *Psycholoquy* was a "slow starter." (Taubes, 1996) However, in those early days of electronic scholarly publishing, Harnad (also affiliated with the CogPrints eprints archive he launched in 1997) and some others had started a revolution in publishing psychological science that still continues in today's publishing space. It has taken many more years to realize open access than Harnad and his colleagues could have imagined when they began innovating in the 1990s.

Harnad was also the author of the famous "subversive proposal," posted to a mailing list in 1994, that asked all researchers to make their papers freely available on the internet. At that time, Harnad had also been editing the aforementioned journal *Behavioral and Brain Sciences*, which included "open peer commentary," all of these were early efforts toward "open online access and interaction." (Poynder, 2014) At the time that the first issues of *BBS* were published, only one other scholarly journal, *Current Anthropology* (*CA*) was using open peer commentary, successfully at that, and that was the inspiration for *BBS*'s own open, post publication review concept. ("Editorial," 1978) To this day, *Behavioral and Brain Sciences* enjoys one of the highest impact factors in behavioral sciences (20.415, #1 in Behavioral Sciences and Psychology, Biological and #2 in Neurosciences (2015 Thomson Reuters, now Clarivate Analytics Journal Citation Reports). Harnad's subversive proposal was more fully presented in the 1995 book "*Scholarly Journals at the Crossroads: A Subversive Proposal for Electronic Publishing."* (Okerson & O'Donnell, 1995). This "subversive proposal" is often referenced today in conversations around open access.

Besides the move of many publishers to embracing digital publication processes, for the most part, journal publishing has not really changed for hundreds of years as the vehicle for certification of scientific research results. Many articles in the literature describe the process of scholarly publishing, providing valuable historical background information. (Nosek & Bar-Anan, 2012) There is a long history to consider when discussing potential changes to the scholarly communication system of psychological science. The traditional systems of scholarly journal publishing have been with us for more than 350 years. (Guedon, 2001). Since 1665, when the *Journal des Sçavans* (France) and the *Philosophical Transactions of the Royal Society of London (*England) began publishing "with the intent to advance scientific knowledge by building on colleagues' results and (to) avoid duplication of results, and established both the principles of scientific priority and peer review." (Larivière, Haustein, & Mongeon, 2015, p. 1) In this long history, authors have never been paid for writing and contributing scholarly articles to the literature, and publishers have taken care of the publishing process, often managing the peer review process. Since the advent of the internet, some of the publishing and sharing practices of scientists have been disrupted and transformed, but scholarly communication in psychology still has its focus on the publication of research results using traditional vehicles such as peer reviewed journals and scholarly book chapters. Some aspects of the publishing process may be considered anachronistic, and many experiments are ongoing, with and without publisher

cooperation. Innovation is constantly pushing boundaries of the system that is ingrained and familiar to all faculty and researchers. Some are wary of the changes that the internet has brought to scholarly communication in psychology, some welcome innovations, and some see a role in pushing the envelope toward looking beyond traditional journal publication altogether. Those seeking new methods seek to ensure the rapid and wide dissemination of research results on the internet, with many also pushing for not only public reader access to psychology scholarship but to define open access to include optimal reuse and remixing of content. This definition of open access, sometimes called "libre open access" and carrying a Creative Commons Attribution (CC-BY) license allows the most reuse, sharing and innovation and facilitates the ability of researchers to build on previous research results.

Recent History of Scholarly/Scientific Communication Specific to Psychology

By studying journal citation data in a variety of ways, it becomes easier to understand the structure and organization of psychology as a scientific discipline. Scientific and bibliometric analysis of the literature of psychological science within the larger ecosystem continues to demonstrate that "psychology is a hub science" and by 2000, seven hub disciplines could be identified and mapped based on a "similarity measure based on co-citations."

> Not surprisingly, given scientific specialization over the past century, contemporary sciences no longer originate from a single source. Instead, seven hub sciences can be identified: mathematics, physics, chemistry, earth sciences, medicine, psychology, and the social sciences. Yes, psychology emerged as one of the hub disciplines of science! (Cacioppo, 2007)

Creating these maps allows visualization of the importance of psychology to other fields. For instance, "public health, neuroscience, neurology, radiology, cardiology, and genetics are sciences that fall between psychology and medicine" on the map. A major study by Boyack, Klavans & Borner in 2005 used citation data from one million articles published in 7,121 journals (both citing and cited journals, and more than 23 million references) that were published in the year 2000 and sourced from the former Thomson Reuters (now Clarivate Analytics) Science Citation Index and Social Sciences Citation Index. The result was a "mapping of science," based on the journals' "citation interlinkages," and demonstrated location of each scientific discipline relative to others around it. The impact of disciplines on other disciplines, and degrees of interdisciplinarity (high for psychology) is visible. (Cacioppo, 2007); (Boyack, Klavans, & Borner, 2005) As a follow up (in 2009) to Boyack et al.'s work, Yang and Chiu delved deeper into the "hub" of psychology, studying networks using citation records taken from the PsycINFO database over a 40-year span (1979-2009). Within psychology, it has been shown using journal citation studies that clinical psychology has been identified as an important "knowledge broker," for other related areas of psychology. A knowledge broker is defined thus: "a journal becomes a knowledge broker when it absorbs knowledge from one set of journals, integrates and transforms the knowledge, and disseminates the end products to another set of journals" (p.349). It is interesting to note how the roles of new journals (in this case, APA journals), impact the other established journals. This work provides an update after a lengthy absence of other similar studies (since 1985) that specifically focus on psychological science.

(Yang & Chiu, 2009) Further work on clinical psychology and its subdisciplines studied the organization of the literature and citations in clinical psychology (another "hub"), and it was further demonstrated that the scholarly communication practices of the subdisciplines of clinical psychology do not readily cross boundaries and publication behavior is more insular than might be expected. As for the subdisciplines of clinical psychology, researchers tended to publish in the literature of their own subdisciplines, rarely venturing across boundaries into the other subdisciplines or even to outside literature. The subdiscipline of cognitive-behavioral psychology's articles' citations are most likely to cross boundaries out into the journal literature of more general psychology and other related fields. (Kiselica & Ruscio, 2014) Studies that continue to analyze the structure of scientific communication within psychology and outside of its boundaries would be helpful for understanding exactly how and where collaboration is occurring, or where possibilities for interdisciplinary, cross disciplinary or transdisciplinary work exist today.

Interdisciplinary Research and Collaboration in Psychology

Interdisciplinary research is a target interest of funding agencies, and is a general trend in research. Funders are quite specific on this point: "In recognition of the promise that interdisciplinary research holds for addressing complex scientific problems with societal implications, the National Science Foundation (NSF) directs grant reviewers to consider a proposal's plan to disseminate findings across disciplinary bounds in order to have a broader impact." (Solomon, Carley, & Porter, 2016, p. 2) The 2015 book *Rethinking Interdisciplinarity Across the Social Sciences and Neurosciences* discusses many of the pragmatic issues of actually doing research and publishing in the integrated space where disciplines come together. Aspects of the cultures of disciplines and fields in terms of issues such as co-authorship patterns must evolve with interdisciplinarity. (Callard & Fitzgerald, 2015)

The field of Cognitive Science, considered highly interdisciplinary, has been the focus of recent studies that have focused on citation patterns in journals. One study focused on two of the highest impact factor journals, *Science* and *Nature*, which include content in areas of psychology. These high profile journals cover all fields of science, are multidisciplinary and cited at a very high rate. A recent study of cited references by Solomon et al. (2016) focused on how interdisciplinary *Science* and *Nature*'s content is in comparison to the level of interdisciplinary research found in a representative disciplinary title, *Cognitive Science*. *Science* and *Nature* have such a wide reach that anything published therein is likely result in a higher "diffusion of knowledge." However, in comparison to other fields studied (Cell Biology and Physical Chemistry), the field of Cognitive Science, showed a high integration score (the relative degree to which one subject area's journals -as defined by Web of Science- cite those of other subject areas, indicating a diversity of cited references). Using metrics such as Integration and Diffusion scores, developed by the National Academies Keck Futures Initiative can help to measure interdisciplinarity by assessing the diversity of a paper's cited references. It must be noted that it is difficult to study interdisciplinarity and there are other available measures as well. The Solomon et al. study also demonstrated that, as measured by their cited references, the articles in *Science* and *Nature* studied within each of the fields "are not significantly more

interdisciplinary than are those sampled in the disciplinary journals" (for instance, the journal *Cognitive Science*).

Bergmann, Dale, Sattari, Heit & Bhat (2016), also focusing on the journal *Cognitive Science,* discussed another new metric for interdisciplinarity, based on co-author publication history.

> A published article that has co-authors with quite different publication histories can be deemed relatively "interdisciplinary," in that the article reflects a convergence of previous research in distinct sets of publication outlets. In recent work, we have shown that this interdisciplinarity metric can predict citations. Here, we show that the journal *Cognitive Science* tends to contain collaborations that are relatively high on this interdisciplinarity metric, at about the 80th percentile of all journals across both social and natural sciences. (p.1)

This study focused not on citation patterns but instead on whether scientists previously publishing papers in other domains were coauthoring papers together in *Cognitive Science* and looking at "coauthor publication history." Scores on interdisciplinarity are then compared to other scientific fields and journals, especially within a group of cognitive science and neuroscience journals. (Bergmann et al., 2016) Porter and Rafols (2009) looked at Neurosciences and five other research domains (all subject categories in Web of Science) to see whether science was becoming more interdisciplinary over the thirty-year span from 1975-2005. Using a "combination of interdisciplinary metrics with science mapping enables us to characterize research interdisciplinarity with a detail not previously available" (p. 740) and it was concluded that "science is indeed becoming more interdisciplinary, but in small steps. Research knowledge transfer, as evidenced by citation, draws mainly on neighboring fields. Only slowly do we see increase in the small proportion of sources from more disparate disciplines" (p.741) and "particularly striking is the extent to which research is now a team effort" (p. 740) In Neurosciences, it was also shown that there was a 90% increase over the time span in the number of authors per paper.

The emergence of a greater emphasis on "team science" is an important trend that follows (or creates an enhanced environment for) interdisciplinary research. Many recent studies of interdisciplinarity are important for psychology, and do seem to suggest that one of the personal costs of interdisciplinary research could be a lessening of a scientists' productivity in terms of quantity of papers published, or even getting credit where credit is due for various parts of the research and publication process. While collaboration is a laudable goal for the advancement of science, in at least one study in biomedicine, there may need to be more conversation around incentives for researchers. The UK Academy of Medical Sciences studied this issue and found that "academic reward and recognition systems have failed to match the needs of team and large scale collaborations"(p.7) and another team at MIT has called for a new "science of collaboration" to look at all aspects of this complex phenomenon in practice. (Allen, 2017) There are many issues with the effective design, incentivizing, management and assessment of the elaborate environment of collaboration, whether global, national or even local. Making sure that scholarly communication practices keep up with the needs of researchers working in

collaborative research environments will need to continue as an important focus of universities, consortia, and funders.

Suggestions for ways to enhance the reproducibility of published research include calls for more collaboration and team science, and also for using team science with student training. This would ensure early experience with wide collaboration for students engaged in research. A working example of this concept, demonstrated by conducting replications with students in research methods courses in psychology is "The Collaborative Replications and Education Project (CREP)" (https://osf.io/wfc6u/) An example of team science and wide collaboration from the behavioral sciences is the "Many Labs" replication project, where "dozens of laboratories implementing the same research protocol to obtain highly precise estimates of effect sizes, and evaluate variability across samples and settings." (Munafò et al., 2017) Many Labs projects demonstrate results in replicability by "crowdsourcing dozens of laboratories running an identical procedure." (Klein et al., 2014, p.151) The massive Many Labs 2 project involved participants from 36 countries and territories conducting "preregistered replications of 28 classic and contemporary published findings." (Klein et al., 2018, p.447) The results of this study were published as a Registered Replication Report (as a single article) in the Research Practices section of *Methods and Practices in Psychological Science*, which is the home (after 2017) for APS Registered Replication Reports. (https://www.psychologicalscience.org/publications/ampps) Another initiative, the "Psychological Science Accelerator (PSA), led by Christopher Cartier (Ashland University, Ohio), is bringing together 170 labs on six continents that will allow researchers to collect data on a massive scale. Using a selection committee to make a final call on proposals after a vetting period, each submission to the PSA is considered based on "factors such as how important the research quesiton is, what impact it might have on the field, and how feasible data collection would be." (Chawla, 2017b)

Coauthorship and Assignment of Credit in Psychology Scholarship

Increasingly, teams have been dominating over solo efforts in research production in the sciences and social sciences. In a 2007 study of millions of articles by Wuchty, Jones & Uzzi showed that psychology, economics and political science showed the largest shift, and that, over a 45-year period "with regard to average team size, psychology, the closest of the social sciences to a lab science, has the highest growth (75.1 %)…" (p. 1037). The study also showed that writing papers in teams produced the highest impact research.

Similar to the situation in many other fields, co-authorship rose in all areas of psychology during the years 1980-2013. In a study of 4.5 million articles from the social sciences that included psychology (taken from the Social Sciences Citation Index) Henriksen analyzed fields of psychology and determined that co-authorship is up in all areas of psychology. For 10 categories of psychology (not including Psychoanalysis Psychology where co-authorship is found less often), the percentage of co-authored articles rose from 1980 figures of 47.4%-65.5% to 2013 figures of 82.2-92.1%. Throughout the 30-year time period, mean numbers of co-authored articles in the 10 total categories of Psychology went from 1980 numbers of 1.4-2.3

authors per article to 2013 numbers of 2-5.3. Psychoanalysis was once again an outlier with median number of authors per article most likely to be one. (Henriksen, 2016)

In recent years, there has been more emphasis on the issues around co-authorship and assigning credit for an article as well as the difficulty that trends in multiple authorship in psychology and other sciences are causing. Conventions exist for placement of coauthors on articles in most fields. "In psychology, for example, the first author is usually (but not always) the researcher who has done the most work." (Chawla, 2015b).

Describing authorship conventions in psychology, Chambers (2017) describes the published order of authors (with numerous caveats and exceptions) thus:

> The first-named author is usually the researcher who made the greatest intellectual contribution to the study and, again usually (but not always), the person who took responsibility for data analysis and much of the interpretation. Typically, the first author is also expected to take the lead in writing the paper and coordinating the drafting process with the other coauthors. After the first author, the next most important position is the last author. The last author, or senior author, is usually the principal investigator-the top dog who made the study possible either by holding the grant that funded it or by supervising the student that conducted it. (p.164)

There have been calls over the years for the development of some kind of formula that would assign credit for various aspects of the authoring of a journal article, but there are no hard and fast rules for psychology. Many studies have discussed the need to determine how best to assign credit for authorship. (Wagner, Dodds, & Bundy, 1994) One example, now dated, comes from Winston (1985) who developed a weighted point system that would assign a number of points for the various tasks required to produce a scholarly article. For instance, points would be assigned for "conceptualizing and refining research ideas, literature search, creating research design…" (p. 516) The collaborators on an article would agree as a group that the contributor with the highest number of points would be senior author. Studies in the 1970s and 80s showed differing opinions on how to assign authorship credit, but "psychologists overwhelmingly believed that power and status should never enter into the determination of authorship credits." (Winston, 1985, p. 515) APA also makes resources available to assist with the issues of authorship, such as how to determine and negotiate authorship. (American Psychological Association, 2018)

Today, the discussion around assigning credit for the different roles of authors in collaborative writing of papers continues. Rather than leave author order to chance or one author's understanding of prevailing conventions, systems and standards are being proposed to enhance transparency and consistency around actual practices. Standards could be adopted by societies, funders and publishers. McNutt et al. (2018), reporting in a recent article in *PNAS,*

> recommend that journals adopt common and transparent standards for authorship, outline responsibilities for corresponding authors, adopt the Contributor Roles Taxonomy (CRediT) (docs.casrai.org/CRediT) methodology for attributing contributions, include

this information in article metadata, and require authors to use the ORCID persistent digital identifier (https://orcid.org). (p.2557)

McNutt et al. (2018) also report on the recently created National Academy of Sciences webpage entitled Transparency in Author Contributions in Science (TACS) (http://www.nasonline.org/about-nas/Transparency_Author_Contributions.html). The TACS page lists publishers and journals that adopt the CRediT taxonomy as well as whether they commit to requiring ORCID iDs for corresponding and other authors. Publishers listed at this stage include the *PLOS*, *Nature Research*, and *Science* families of journals. Because all authorship conventions vary so much across and between disciplines, understanding how credit is conferred (and understood when it comes to markers such as author order on articles) is essential, especially in today's "audit culture" of university research, including reporting personal impact for promotion and tenure in psychology. Today's move toward cross- and interdisciplinary work compounds the issues with defining credit for individual work via the list of authors on an article because "order of authorship can vary by discipline, which poses problems in adjusting for shared authorship when scientists work in different disciplines or publish interdisciplinary work." (Ruscio et al., 2012, p. 141)

Some issues in scholarly communication in psychology continue to resurface. Looking back at scientific communication in psychology from 50 years ago, it is found that psychological science has not been immune to various crises in its publishing practices. Garvey & Griffith (1972) analyzed the situation occurring with the psychological literature in the early 60s, and it is almost amazing how an analysis of the issues with the print tradition (with articles held in bricks and mortar libraries) so evocatively describes a situation similar to today's, albeit missing the total disruption of the internet. (Garvey & Griffith, 1972) Garvey and Griffith detail the existence of somewhat of a crisis in the early sixties, where only about 2000 scientists seemed responsible for the entire literature of psychology. The system of scholarly communication in psychology at this time has not appreciably changed-as a system-even if the tools have radically changed. Common aspects remain some fifty years later, now having moved online. These core behaviors that remain are the formal and informal ways scholars share ideas, the importance of scholarly societies, then need for robust peer review systems, the existence of preprints (or technical reports) for informal pre-publication sharing, a lag time from submission to publication in major journals, the long delay before articles would be abstracted in Psychological Abstracts, and the role of the major conference in the discipline for establishing reputation and networks. (Garvey & Griffith, 1972) Journals were important for final certification of scholarship, brands mattered, and there was a desire for research to "speed up." Of interest in Garvey and Griffith's works of decades ago (written before the advent of the internet) is the description of the informal system of preprints in psychology, providing current information exchange but only to a niche readership. The situation was described in 1967 by Garvey and Griffith as "the chain of events in a fast-moving research area, may begin with publication lag being so great that current information needs are unsatisfied. As a result, the exchange of preprints among scientists working in this area will increase" (Garvey & Griffith, 1967, p. 1012). Over time, this situation would eventually become formalized and possibly give rise to new scholarly journals. Today, we see preprint servers (such as PsyArXiv) emerging in psychology, adding the promise of sharing

current research with any potential reader, researcher or practitioner via the internet around the world. How will this sharing affect psychology? Adding impetus at this point in time is a sometimes overwhelming deluge of publications to discover and read in one's field, formal and informal, with university rankings and quantification of individual and institutional impact taking center stage.

Information Overload and Inertia for Changing the Existing System

The availability of this deluge of journal articles creates challenges for scientists, whether for keeping up, or for more requests for reviews, or for discovery in an internet article level discovery environment. More than 50 million scholarly articles have been published, but half of all of those articles have been published in only the last 25 years. (Jinha, 2010) For many of us, our roles as authors, librarians, faculty members or publishers have included a close relationship to the print journal, and its associated systems of abstracting and indexing, access, reading and preservation. Today, electronic access to scholarly journals from laptop, iPad or cell phone from outside the library or office is the norm. However, focus on peer review and journal impact factor remain. Studies have shown that peer review, for instance, is an element of the traditional scholarly communication system that faculty and researchers find essential for certification of scholarship. (Michael, 2016a) Surveys of faculty and ongoing research by Harley, Acord, Earl-Novell, Lawrence & King (2010) have provided a lot of data and analysis of the current situation with the scholarly communication system that most academic faculty work within and many endeavor to maintain. These studies show a conservative posture about many existing systems, especially as they surround assessment of faculty scholarship.

There is no mistaking the fact that more research on this whole system of peer review and especially academic promotion and tenure is necessary in order to create a sustainable system for the future of scholarly communication in the various disciplines. (Harley, 2013) Incentives also drive the system, and faculty may be loath to make the large scale changes to scientific communication to a more open system that is certainly possible. Incentives may need to originate from senior scholars in a field as there are career concerns for early career researchers hoping to see change in the system to more "open."

There are many new aspects to the ecosystem as of late. There has been a move to article-level discovery, new methods of measuring personal impact have emerged, and millions of authors are signing up for scholarly collaboration networks like ResearchGate or Academia.edu. Open access journals utilize a variety of business models in comparison to the subscription model, while still maintaining rigorous peer review. That said, where there is money to be made from eager authors, the phenomenon sometimes known as "predatory publishing" has grown exponentially in this "gold" open access space. Unscrupulous operators work the internet, creating bogus journals that attract authors with low article processing charges and opportunity for quick publication. Some authors know that journals are bogus, but just need to get an article published no matter what the outlet (and knowingly choose to submit to a low quality journal title). Writing and researching for publication has become more complex, with the need to sift through a deluge of academic papers online in order to discover an exhaustive list of potential papers to read and add to popular citation management tools like EndNote (Clarivate), RefWorks

(ProQuest) or Zotero (an open source option). Mendeley (now owned by Elsevier) is a popular product that adds collaboration, data options and even career networking to citation management. Strategies for discovering relevant scholarly literature have changed, as library search has added other new "web scale discovery" tools to the familiar abstracting and indexing services. Google Scholar (with its unpublished coverage criteria, covering everything it deems "scholarly" since its beta release in 2004) seems the most ubiquitous search tool. Its use is only growing. (John Bohannon, 2014)

The familiar online library catalog is beginning to be replaced on library websites by a web-scale discovery service's "one stop shop" single search box that leads to journals, books, articles and all kinds of electronic subscriptions (and some open access content). Library collections may be more difficult to browse, with researchers finding the web providing a different kind of serendipitous article-level discovery of relevant research papers (with all of their various versions, some possibly open access). Paper journal volumes, in the past browsed within a single volume taken off the library shelf, have often been moved off to remote storage or recycled. The package of the bound paper journal has been replaced by vast online library discovery systems of tagged articles. It becomes more important than ever to understand how systems of scholarly communication work in each discipline or subfield. There is no "one size fits all" to this system. One constant has been the need for each discipline to organize its scholarship within a current, constantly developing and easily understood set of parameters, enabled by useful systems and tools that can maximize the visibility of an individual's scholarship as well as to showcase the collective work of a field. Individual scholars as well as the important publications of each field will need to find ways to continue to demonstrate impact and remain highly relevant to an increasingly cross-disciplinary culture.

For those readers needing to access the literature, which is now comprised of a global readership searching the internet for peer-reviewed scholarship, there has been an exponential growth in available journal articles and other digital content. In 2015, there were more than 28,000 scholarly journals worldwide, containing more than 2 million articles every year, with continuing growth of 3-3.5 percent each year. (Research Information Network CIC, 2015) By mid-2018, *The STM Report: An Overview of Scientific and Scholarly Publishing* stated that "there were about 33,100 active scholarly peer-reviewed English-language journals… (plus a further 9,400 non-English-language journals), collectively publishing over 3 million articles a year." (Johnson, Watkinson, & Mabe, 2018, p.5) Time spent discovering and reading relevant literature may continue to present a challenge as far as "keeping up" for busy scientists. In one study of trends in publication patterns in the neuroscience and psychology categories and from 2006-2015 using Web of Science and Journal Citation Reports (JCR), the steadily rising number of papers can be seen as well as a shift toward "the more psychological and behavioural side of brain science" and also of note is the rise in number of citations authored by Chinese neuroscientists. (Neuroskeptic, 2017; Yeung, Goto, & Leung, 2017)

For psychology, the "information explosion" has produced some distinctive challenges for authors and researchers, such as the enormous growth in the number of cited references in articles, a practice that has pros and cons, and is tolerated by editors and reviewers. Rather than

just keeping up, the exponential growth of the research literature in psychology has altered author behavior and publisher expectations around issues of increasing rate of citations, for instance. Some have called for an end to the practice of excessive or gratuitous citation lists, citing a tradeoff between writing and pages of citations in articles with strict page limits. (Adair & Vohra, 2003) Once again, electronic publication would seem to allow for less strict limits on pages or other aspects of a print environment. However, boundaries are needed. The number of self-citations has also been of interest to psychology, especially as it relates to possible effects on the important journal impact factor. (Anseel, Duyck, De Baene, & Brysbaert, 2004) In a study of referencing practices in psychology journal articles and how authors view the articles they cite, it was seen that authors tended to view self-citations as very important to the paper (outside of other reasons). (Safer & Tang, 2009) Studying self-citation practices is an interesting aspect of the impact calculations of the journal literature.

Digital Object Identifiers (DOIs) for every Article and other Research Output

In fact, lengthy or not, reference lists accessed online now include actionable persistent links such as DOIs (Digital Object Identifiers), that create an enhanced environment for the reader that allows direct linking through to available background reference papers. Rather than returning to online indexing and abstracting sources, library databases, Wikipedia references, or Google Scholar, readers now click through from one article to another seamlessly. This is especially true for the growing corpus of open access articles easily accessed by anyone wanting to read or use them. Papers that have been made open access, and the widespread adoption of DOI links on most articles make this system more effective for all researchers and readers. One large seamless system of interlinking content, with as much content as possible available to be clicked through by the largest numbers of potential readers and researchers is coming to fruition, albeit slowly and not including all literature, obviously. There are currently 10 registration agencies that can assign DOIs, but the most popular are CrossRef (mainly used by publishers) and DataCite (often used by repositories and for data). Most of the links seen in Wikipedia, for instance, use CrossRef DOIs. It is estimated that "CrossRef has registered 67% of all DOIs in existence." (Himmelstein et al., 2018, p. 15) One anecdotal issue with DOIs is that some researchers feel that any article with a DOI is then "certified" as an authentic piece of scholarship, somehow has an imprimatur placed on it, or that it confers some sort of peer review. This is not the case, of course. The DOI (assigned by a registration agency) simply provides a unique and persistent identifier for articles (of all types), is clickable in online versions (resolving directly to the article) and is now required if available for citations using APA Style. This requirement for use of citations formulated with DOIs in APA Style has likely made DOIs more well known to readers and researchers of the psychology literature. All publishers now need to use DOIs and so this persistent identifier on citations is becoming ubiquitous in the scholarly publishing landscape. The availability of DOIs (from CrossRef or DataCite, for instance) has enhanced the discovery process for researchers, particularly because these persistent identifiers are now being included on all research products, whether articles, chapters, data, or even preprints. Using DOIs in citations ensures fewer broken links and lost access to cited content. The seamless online environment facilitates search and discovery (and thereby

research) via this web of DOIs, thereby enhancing easy access for all who surf the web looking for scholarly information in psychology or other fields.

A related development in making citations in articles more visible, more searchable and likely more citable by other researchers is a recent initiative whereby publishers have worked together to agree to make all references of articles, including their DOIs openly available. If the article is subscription-based and behind a paywall, all references will still be "separable" (able to be accessed and analyzed without having to access the article), open and visible (and machine readable) for use by researchers. This initiative, entitled "The Initiative for Open Citations I4OC (https://i4oc.org/) is a collaboration between scholarly publishers, researchers, and other interested parties to promote the unrestricted availability of scholarly citation data." Publishers enable the realization of this work via their assignment of DOIs through the CrossRef service. Clearly, the scholarly communication landscape is enhanced by all publishers in all disciplines linking articles, making all research products (including this amazing wealth of citations) discoverable and usable.

An ORCID iD for every Researcher

In addition to persistent identifiers (DOIs) for publications and other products of research such as data sets, it is now a fact that authors also need to be correctly identified and linked to their outputs in this new research environment. The use of unique, persistent digital identifiers now extends to the researcher, many of whom are expected to register for the ORCID iD (https://orcid.org/). The use of researcher identification systems (especially ORCID) to disambiguate one researcher from another with similar name makes discovery and attribution more accurate. An important development for scholarship has been the development of one major open and portable author identification system that authors across disciplines and countries can use. A single persistent ID and profiling system that is used by researchers, universities, publishers, grant funding agencies and others creates a worldwide network of researchers and papers, all with accurate author details. Many researchers, institutions, funders and publishers (all members) are now working with ORCID, a not-for profit organization that serves the research community in an open and transparent manner. (ORCID, 2017) An added bonus is the ease of use of ORCID's systems, and even early career researchers can become part of the research environment by registering for an ORCID iD at orcid.org, which takes only about 30 seconds. Automated features that can automatically add papers discovered by Scopus, CrossRef, and DataCite (for data and contents of some institutional repositories), for instance, make updating one's ORCID profile very easy and may someday be able to spin off a current CV for a researcher at the point of need. Some libraries and librarians are also involved in institutional implementations of the ORCID iD, adding librarian expertise to these new scholarly communication initiatives at the institutional level. Many institutional members work with ORCID to integrate their various university systems in an ORCID implementation, allowing seamless transfer of author profile, funder and publication information (and more) into various processes. This saves faculty time by automating linkages and scholarly communication processes and adds an important new piece to the researcher ecosystem bring built by universities today. In time, all systems in use by psychology researchers will likely be requiring

the ORCID iD, whether for grant or publication submission, or for adding to university profiling or current research information systems. The ORCID iD has become an integral part of every researcher's individual profile and more and more universities expect that faculty and even graduate students will have an ORCID iD.

As the global information landscape evolves, author lists become longer, and the sheer number of researchers writing for publication grows exponentially, there has been a need to ensure correct attribution of authors. This can be accomplished via use of the ORCID iD, which is available to all scientists. In fact, it has been stated that China's Ministry of Public Security estimates that "1.1 billion people, that is, roughly 85 percent of China's population, share just 129 surnames." (Tran & Lyon, 2017, p.172) This is an illustration of the difficulties that funders, publishers and other researchers may have with ensuring correct attribution of scholarly work. The ORCID iD is currently in use (as of August 2018), by more than 5 million researchers worldwide. Other researcher identification systems, such as Scopus Author Identifier (Elsevier) or ResearcherID (Clarivate) now work with ORCID.

The Growth of Open Access: A Boon for Authors, Readers, Researchers, and Institutions

Opening up access to the peer reviewed results of research articles and data has been an unprecedented public good, thanks in part to the powers of the internet (and some changes to traditional publisher permissions) to disseminate information to all corners of the globe. Research funders have made a significant impact by mandating open access to the products of funded research. Whether a researcher unaffiliated with the subscription riches of a well-endowed university, a reader needing access to research articles and data, a practitioner not associated with a research institution and its collections of books and journals, or a young person interested in learning more about psychological science in order to pursue a career, increasing the options for free and open access to research results in a benefit to research and to society. Most citizens can't or won't pay the high prices that commercial publishers charge to access single articles and many publicly accessible research libraries now limit the time that the public can access electronic subscriptions on site. For many cash-strapped researchers, and even those who object to paywalls on principle, accessing needed scholarly articles can be an incredible burden. For whole areas of the globe, subscription-based, traditional scholarly research publications are out of reach. One of the only questions left is not when, but how to continue to evolve an open access environment that reaches the goals of wide dissemination of research to all that need to access or discover it. It is impossible to calculate the impact of the lack of access to the scholarly literature that faces many readers around the world. There is one major initiative that provides an alternative for the research literature needs of developing nations. The multifaceted program, Research4Life, made up of 5 programs including Hinari (Research for Health) which is managed by the World Health Organization (in partnership with publishers and other organizations) and delivers free or low cost access to the scholarly peer reviewed literature to researchers in 8700 institutions in low-and middle-income nations. Major psychology-related publishers are partners in Hinari, including American Psychological Association, Springer Nature, SAGE Publishing, National Institute of Mental Health, Taylor & Francis, Society for

Neuroscience, and others. At present (2018), there are 70 countries where Hinari delivers free content from a long list of scholarly publishers. (https://www.research4life.org/)

Open access has arrived, and is now considered to be here to stay, or even "inevitable" and shows growth in all areas. (Lewis, 2012) As of 2013, with numbers now obsolete, a study of availability of scholarly publications estimated the numbers of openly available English-language papers at about 27 million, or about a quarter of all online scholarly publications including articles, conference papers, and dissertations. (Khabsa & Giles, 2014) Taking into account all versions of papers that are freely available to read on the internet (including papers that authors have self-archived or paid traditional subscription journals to publish as open access), the figure may rise much higher. In studies carried out by the Science-Metrix consultancy for the European Commission claims that researchers can "search the internet for any research article published in 2011, and you have a 50-50 chance of downloading it for free." (Van Noorden, 2013, p. 386) There is an upward trajectory of open access materials easily found with an internet search. Morrison, whose blog, Dramatic Growth of Open Access, announced in a December, 2018 post that 2018 was the "best year yet for net growth of open access" as measured by numbers of open access documents that can be discovered in online repositories and aggregators. Clearly, the experience of hitting a paywall (with prices that can reach about 41 U.S dollars per article) when searching for and discovering scholarly publications may be evolving in a positive direction. A global audience is now able to discover the literature of psychology, often from the convenience of home, or on a mobile device at the point of need. This vastly extends the reach and usefulness of the psychological science literature. Obviously, it is in the interest of all authors (and their publishers) looking to reach more readers to work for the open access and public accessibility of the discipline's literature.

The open access landscape is complex. The growth of open access repositories, numbers of articles flowing into repositories, open access journals (and the articles in them) shows no signs of slowing. As an example, the two most popular open access "mega-journal" outlets, *PLOS ONE* and Nature's *Scientific Reports* published a total of 38,088 articles in 2015 alone; 27,488 articles for *PLOS ONE* (down 9.3% from 2014) and 10,600 articles for Nature's *Scientific Reports* (up 169.4% from 2014). (Wakeling et al., 2016) These are by far the most prolific of the types of titles that psychological scientists are considering in the mix of journal publication options. Psychology is heavily represented in these megajournals (and other open access journals) and in repositories of all types. Authors need to understand their publication options, as well as their rights as authors in terms of sharing their work widely, and publishers and libraries need to find their places in a new landscape and adjust accordingly.

In fields of psychology, all types of open access have been introduced and are working effectively to disseminate scholarship to a global audience. Open access journals, hybrid subscription journals that contain a few OA articles in each issue, fully open access monographs, and author self-archiving of legal, post peer-reviewed versions of postprints (authors' accepted manuscripts) in both institutional and subject/disciplinary repositories as well as the existence of many more "author's original" preprints on the web have all become commonplace. A discussion of all of these methods of making articles and conference papers open access will often illustrate

the difficulty that authors face in decision-making about their choice of publication outlets as well as online dissemination strategies. Often, in the academy, the college or university library has taken up various open access roles related to development of institutional repositories, services related to author self-archiving of articles (green open access), and assistance with making supplementary data widely available from the institutional repository. Librarians provide consulting for psychology faculty and researchers around strategies for making their works open access, both from the institutional repository and also from other available services such as disciplinary repositories or preprint servers. Some psychology faculty members and others have stepped into roles as open access advocates, or as developers of new tools or policies that increase open access to the discipline's scholarly literature.

Institutional Open Access Policies and the Institutional Repositories used for their Implementation

Many universities have passed open access policies, usually by the vote of faculty governance bodies such as university senates or faculty councils. Institutional open access policies, particularly the popular "Harvard style" policies seek to ensure the ability of scholars to share their work via the retention of some rights to share and post accepted versions of their work out of the institutional repository. The development and passage of institutional open access policies such as the popular "Harvard model open access policy" (https://osc.hul.harvard.edu/modelpolicy/) can be seen as a popular statement by faculty at universities that open access is necessary and expected for wide impact. Open access policies help to preserve author rights to self-archive accepted manuscripts of research articles on the internet without fear of reprisal while increasing the amount of a university's scholarly available to a global readership.

Having a university open access policy lets publishers and others know that the university retains the rights for its authors to self-archive "accepted manuscript versions" of their work in the institutional repository (even before or after having signed a copyright transfer agreement) with the institution retaining only the nonexclusive right to make the works widely available on the internet via the institutional repository. Many universities in North America have passed OA policies, including Harvard, MIT, Rutgers, University of California, and more than 100 others as of this writing (August, 2018) that make up the membership of COAPI (Coalition of Open Access Policy Institutions) (https://sparcopen.org/coapi/). COAPI, an organization of North American institutions passing and implementing open access policies ensures the availability of a welcoming community focused on developing and maintaining best practices in this area. The number of universities passing policies, developing institutional repositories, and the number of articles in these repositories continues to increase each year. This type of repository-based open access, often called "green open access" carries no cost to authors and often results in final author versions (usually accepted manuscripts) of published articles being widely available on the internet to a global readership. The handy book entitled *Open Access,* authored by Peter Suber, one of the world's most recognizable experts on this topic, provides an excellent introduction to this topic, and is freely available on the internet. (Suber, 2012) Not only found in North America, open access policymaking is an area of growth around the world. There are more

open access policies being passed all the time by universities, other research institutions, and funders. Internationally, at the time of this writing (August, 2018) there are more than 900 open access policies and mandates listed in ROARMAP (Registry of Open Access Repository Mandates and Policies) (http://roarmap.eprints.org/).

For the creators of works of scholarship, the articles, conference proceedings and other works contributed without expectation of payment, open access policies stipulate that the author self-archive each article in the institutional repository, ensuring the works' discoverability by readers on the open web. Some repositories also employ automated processes that crawl the web (or target other aggregated sources of open access content) in search of articles authored by the university's faculty that can be added to the institutional repository. Often, implementation of the policy is carried out using the expertise of the university library and its librarians. Librarians, especially subject specialists holding positions in research libraries are able to share information effectively with departmental faculty on how OA works within the disciplinary context. These conversations allay faculty concerns that may arise when OA comes up. Even without a policy in place, many university libraries provide consulting on author strategies for making the results of research open access. For open access strategies for psychology faculty, a good source of information on strategies and practices for increasing the reach of scholarship via open access would be the library's subject specialist in psychology, or the scholarly communication librarian or repository manager. Even retrospective works may be able to be self-archived in the institutional or disciplinary repository, and librarians can consult with faculty and others on those possibilities. Many faculty authors are interested in marketing of their scholarly works to more communities and to new readers outside of those in the usual niche areas served by subscription publishers.

For the reader of the works of psychological science, whether researcher, practitioner or the public, passage of university open access policies have resulted in more access to this material. This is especially true where faculty and researchers take it upon themselves to commit to making sure each of their works of scholarship is available online via the self-archiving of a legal version of it (such as an accepted manuscript) in the institutional repository at the time of acceptance for publication, or by publishing in a fully OA journal (or book). For those affiliated with universities that have top tier electronic subscriptions, there is often a great dismay upon leaving the university and its subscription access to the research literature. Once a researcher becomes unaffiliated with a university and its research library or becomes a practitioner, access to the subscription research literature that was formerly taken for granted becomes an issue and is often turned off, even for alumni. We do not know who the readers of the scholarly literature are, and public access ensures that anyone will be able to read (and build upon) the articles, conference papers and other scholarship that enhances the reach of psychology. An important goal of university open access policies would be to gather the scholarship of a university together to showcase it and make it available on the internet. Departments and schools (or other academic units) of a university can make their collective works available online in an aggregated manner so that any reader or researcher in the world can access this corpus. The aim of these institutional policies is to ensure expanded access to the research outputs of universities, creating visibility and impact for the institution and its faculty and students.

Public as well as private funders have also instituted open access policies, and university policies complement these nicely. Universities will also likely want to maintain stewardship over the research data generated along with the publication, and funders have, in many cases, moved toward mandating that the data underlying the scholarly work also be made open access. One helpful resource where a researcher can see the requirements for open access by funders is the SHERPA Juliet database (http://v2.sherpa.ac.uk/juliet/). Failure to comply with open access policies now comes with consequences for future funding from the agency for any university and/or the principal investigator (PI). Many funding agencies in the past only encouraged open access and are now have moved to mandating it. Researchers will now find future funding in jeopardy if there is a lack of compliance with certain funder mandates. All researchers will need to understand open access strategies and potential costs (and sources of funding for those costs) as well as noting various compliance rules before beginning funded research. This will ensure that open access will be possible if it is stipulated, even if grant funding has run out or other issues surface. Not all psychology scholarship is funded, of course, and this does not impact the need to comply with the university open access policies in many cases as well. Open access policies passed by universities may also create an environment more focused on "open" in terms of university scholarly communication practices around publications and research data. Focusing on "open" in all aspects of psychology research and publication, including data, will create a new environment based around transparency that will produce positive change in the discipline's scholarly output.

Green Open Access: Strategies for Author Self-archiving of Works in Digital Repositories and other Services

Authors publishing in traditional subscription journals need to share their work, and many want to or have to (due to funder or university mandates) deposit a version of their article in their institutional or disciplinary repository. These repositories are crawled by Google and other search engines, making the content available on the web. The majority of traffic to article versions in digital repositories comes in from search engines, particularly Google Scholar, and not as frequently by readers and researchers visiting the repositories directly. This wide online availability on the internet (via a Google search of author or targeted keywords) ensures easy discovery by anyone doing simple web keyword searches.

Publishers vary greatly on how and whether they accommodate this "green open access" (repository route) for their articles. A look at the database, "SHERPA/RoMEO: Publisher copyright policies & author self-archiving" (www.sherpa.ac.uk/romeo/), which is searchable by journal title or publisher name turns up examples of self-archiving policies for publishers of psychology journals. These policies on self-archiving would range, for example, from more OA-amenable publishers like American Psychological Association (APA) and Association for Psychological Science (APS), whose rules (according to SHERPA/RoMEO) allow authors to self-archive and share accepted manuscript versions (as well as unrefereed preprints) -to the journals from some commercial publishers, an example being Taylor & Francis with *Psychological Inquiry* that requires a 12 month embargo (delay) before the author's accepted manuscript can be made available online. *Psychological Inquiry* is also an example of a hybrid

journal that has an open access option for the publisher's version of record (VoR), and charges 2950 USD to publish the final version as a fully open access article. Hybrid journals, a popular option for commercial publishers, offer a mix of some traditional subscription content and some articles that have been made open access in the same issue. The articles have been made open access, alongside other traditionally published articles because the author, funder or university has paid an APC (article processing charge). APCs are highest for commercial publishers at this juncture. This is a pain point for libraries already paying subscription prices for these commercial journals, and terms such as "double-dipping" have come to identify the practice of charging for both subscriptions and author-side payments (APCs) as well. Currently, individual institutions as well as whole countries have pushed back, requiring "offsetting" agreements or other accommodations for managing the costs inherent in the system.

According to SHERPA/RoMEO and the APA's website, the default policy for sharing articles in APA journals classifies them as "RoMEO green," and no embargo or delay is listed for posting of the final author version (often the Word document after completion of peer review). APA Journals states:

> "Authors of articles published in APA journals — the authoritative document, i.e., peer reviewed publication of record — may post a prepublication copy of the final manuscript, as accepted for publication as a word processing file, on their personal website, their employer's server, in their institution's repository, reference managers (e.g., Mendeley) and author social networks (e.g., Academia.edu and ResearchGate) after it is accepted for publication."

There are conditions set by APA that do prevail when authors are posting their own Word document version of an article (after peer review) at the time of acceptance for publication. These caveats include: placing a specific statement on the cover sheet or front of the posted article stating that the author's copy may not be an exact replica of the published version of record, the deposited version must link to the final version on the publisher website, and carry an APA copyright notice. (American Psychological Association, 2015). This type of publisher permission for authors to be able to self-archive their final accepted manuscript, making it open access on the web to readers and researchers worldwide, is a common scenario. Most publishers allow this posting with or without embargo, and with or without special conditions, but some are much more restrictive, issuing rules that make it more difficult for authors who wish to share their work online, and for readers who discover scholarly content and cannot read it without encountering roadblocks. While many universities make subscription content available to their affiliates (faculty, staff or students of the institution only), sometimes scholars forget about the legions of practitioners, budding scientists, unaffiliated researchers, students that have graduated, alumni of most universities, and readers around the globe who need to read the scholarly literature of psychology, and cannot access it online due to paywalls or issues of non-affiliation. For those ensconced comfortably in academia, a familiar refrain might be the "everyone who needs access to the material has it somehow." This is not the case, and one can imagine how the reach of psychological science is impacted. The issue of "paywalls" has become the major roadblock (although there are others), and has led to much consternation, and even was the

subject of a recent documentary film entitled, *Paywall: The Business of Scholarship.* (https://paywallthemovie.com/)

In terms of commercial publishers, *Perspectives in Psychological Science* is an APS (Association for Psychological Science) journal, but is published by the commercial publisher, SAGE. Unlike some of the others, SAGE has a liberal self-archiving policy and other open access practices that allow authors to share their work widely, possibly driving some traffic back to the journal and the publisher. Libraries would find SAGE to be the kind of publisher that facilitates the wide dissemination that authors and universities seek. (Mullen & Ross, 2016) Although many worry about harm to publishers, in terms of subscription cancellations or other negative consequences, at this point, that has not been the case. (Suber, 2016) In fact, various analyses, including one report from BernsteinResearch (Aspesi & Luong, 2014) are able to state that "11 years after the Berlin Declaration on Open Access, however, the rise of Open Access appears to inflict little or no damage on the leading subscription publishers" (p. 1) and that "OA funding may in fact be adding to the profits of STM." (p. 1) All major publishers now have open access options for authors and funders. Publishers are all also cognizant of the wide sharing of the research literature that currently exists (outside of established legal channels) that only continues to grow, and will deal with that somehow as time goes on.

There may be confusion over multiple versions of the same paper on the internet but there are clear methods of identifying versions in a repository, superseding an older version with a more current one, and finally linking to the version of record. It is true today that iterations of a single paper may have different DOIs, possibly causing concern or confusion. However, this is the expected scenario going forward. Each version of a paper needs its own DOI to identify that particular version for purposes of citation. Green OA, the "repository route" to open access makes papers available on the internet, often using an author version just before publication, the post-peer reviewed "Accepted Manuscript (AM)." This version may also be known as the "postprint." Postprint versions, (accepted articles, post peer review), usually have the same intellectual content as the published version of record. Some authors whose articles have undergone revisions are reticent about depositing versions that may not be identical, word for word, to the publisher version due to copyediting, or other changes made in the final publication process. However, some authors prefer to self-archive their accepted manuscript version as the "best available version," finalized as they prefer, with minor possible differences from the publisher-copyedited version of record. When self-archiving a work of scholarship, authors have control over the final iteration of their accepted manuscript, and they may add changes that have been made by copyediting to the deposited version as they wish. Each version of the article has its own DOI and is citable as an individual research output. Repositories practice "version control" and are able to direct readers from a superseded version to the most current version of the article. This information can now be prominently displayed on the article's cover sheet in the repository, directing readers via seamless linking to the publisher version of record. This final publisher version may be imprinted with the CrossMark logo, indicating the most current authoritative publisher version. For those wishing to self-archive older papers, a perennial problem is lack of author access to their accepted manuscript versions at any later point in time. Those working with authors on self-archiving their papers know that it is easiest for authors to

deposit their articles in the institutional repository "at the point of acceptance for publication," because this is the moment in time when the author is most likely to have the article's accepted manuscript right at hand for the simple deposit. It is possible now for repository managers or authors to retrieve the author's accepted manuscript from some publisher manuscript submission systems. (https://openaccessbutton.org/direct2aam)

The final published version of record (often in PDF) is often proprietary to the publisher, and authors are restricted from archiving this version in repositories or elsewhere on the web (unless they have paid an APC to the publisher to allow this posting in the case of a hybrid or fully OA journal). For traditional publishing, posting of the version of record online is disallowed. A small proportion of journal publishers allow the version of record to be placed in an institutional repository in compliance with mandates (funder or institutional), or even shared legally and openly on the web. A 2009 study reported that at that time, 5-19% of publishers allowed self-archiving of publisher versions. (Morris, 2009) The SHERPA/RoMEO website includes a listing (2015) of "Publishers allowing use of their PDFs in Repositories" (http://www.sherpa.ac.uk/romeo/PDFandIR.php?la=en). One example of a publisher allowing publisher branded copies to be self-archived is PsychOpen (http://www.psychopen.eu/). Even with all of the rules about self-archiving of peer reviewed articles easy to find (in author instructions or in services like SHERPA/RoMEO), there is evidence that plenty of authors post versions of record to their own websites, or to other web services. (Björk, Laakso, Welling, & Paetau, 2014)

In fact, many publishers that do not allow publisher versions to be posted to institutional repositories do allow posting to personal websites. This often strikes scholars as somewhat confusing. While institutional repositories are widely available to those affiliated with universities, and the subject/disciplinary repositories (and scholarly networking services such as ResearchGate) also provide valuable visibility for authors that self-archive their work, studies show that many authors prefer to place their works on personal websites. (Björk et al., 2014) While a popular option, using the personal (or departmental) website does not provide the preservation or migration of digital formats that digital repositories do. Repositories also employ a high level of search engine optimization (SEO), aiding discoverability of works more effectively than many personal or institutional websites. In a smaller 2009 study from Carnegie Mellon University that looked at faculty practices of placing electronic copies of their articles on faculty webpages, it was found that "publisher policy appears to neither influence the decision to self-archive nor the article version that is self-archived. Disciplinary norms are influential but not necessarily the driving factor" (p.225) and in this case, the university's psychology department showed one of the highest rates of providing access to full-text open access versions of articles on faculty webpages. (Covey, 2009) Online curricula vitae (CVs) have been studied to ascertain whether researchers are adding hyperlinks to openly available versions of articles, possibly furthering the reach of these articles. In a survey of European authors, in comparison to what publishers allow, there was not a significant use of the practice of linking to OA versions on online CVs. (Kousha & Thelwall, 2014)

Whereas publishers, libraries, the public and other stakeholders are motivated to move to a more open access environment for scholarly journals, there is evidence that the scientists that actually write the articles and often sign them away to the publisher (only retaining some rights to share their own works on the internet) are a group that may prefer the status quo. Within the current system of scholarly communication, with established incentives and rewards in place, getting published in as high an impact journal title as possible is the key to career advancement, and is still the real or perceived route to promotion and tenure in many cases. Many authors don't necessarily want change in the system, especially if there is any career risk. They routinely sign publication agreement forms, often signing their rights away, and possibly only later want to make greater use of the works than what the publisher allows. Other times, they sign an exclusive license. Most publishers (but certainly not all) contribute "rules" for sharing various versions on the internet on the aforementioned SHERPA/RoMEO service. Of course, some authors either do not understand what rights they are signing away, or simply don't pay attention to this final step in what may be a long publication process. Some authors simply post articles wherever they want, such as on personal websites or scholarly networking services, not even considering doing otherwise. Since they wrote the articles, they consider the work shareable. There is misunderstanding by authors over which versions of articles are allowable, and even questions about how to find information on how to share research publications on the web. Today's culture of sharing is so pervasive in practice that authors are sometimes shocked to find that publishers do not allow the wide sharing of articles on the internet. Sharing of the publisher proprietary branded version is, in most cases, illegal.

Publishers at one time were liberal with regards to author self-archiving, but in recent years, even though more publishers are known to be "green" according to SHERPA/RoMEO, a more restrictive environment may be seen, with longer publisher embargoes emerging and more rules attached to use of *any* version of an article, particularly in an institutional repository. (Gadd & Troll Covey, 2016) This will necessitate the use of proactive strategies and workarounds for universities that want to showcase their scholarship or comply with funder mandates.

In psychology, time from article acceptance to publication could be two years, although some publishers now place "in press" articles online (Nosek & Bar-Anan, 2012). For authors of accepted articles, many will want to self-archive the author's accepted manuscript even before the publisher's earliest posting. By placing an accepted manuscript online, early impact may be demonstrated. Many open repositories and other services disseminating "green" article versions can provide usage statistics, usually in the form of downloads from specific geographic areas. This type of alternative metrics service allows an author to create a narrative about a specific work, being able to suggest that impact may be demonstrated by charts and visualizations showing tens or hundreds of downloads from many countries (in a specific time period, for instance). It can be very compelling for an author to open up access to scholarship through making works (in early versions such as preprints or accepted manuscripts) freely available on the internet, and then to watch the reader traffic that ensues. Some universities deploy large real-time mapping visualizations that show downloads of institutional scholarship as it is happening. Depositing green copies of papers online as soon as they are accepted for publication accomplishes many goals for the scholar, namely getting the work out as soon as it is accepted,

getting novel ideas date stamped, often before the final publisher version of record is made available. This allows early sharing of the DOI from the repository, and early download statistics can start to accrue. Self-archiving is also an effective way of marketing one's work online, as Google Scholar crawls repositories and makes papers available on the internet within a short time frame. When the published article becomes available, repository versions can link to that publisher-supplied DOI.

The Continuing Emergence of Preprints: Online Dissemination of Authors' Originals

Unrefereed early versions, known as preprints or "author's originals (AO)" are a topic of significant current interest to authors, funders, and publishers. Interestingly, the choice of using preprints to disseminate scholarship has had a long history in psychology. Garvey & Griffith (1972) described how informal scholarly communication in the early 1960s included the practice of dissemination of preprints as a way to seek comments and feedback on research. Before the internet made sharing early versions of articles (allowable by most publishers) easy, psychological scientists used other means to distribute these early versions. "In 1963, for example, about half of the authors of articles published in major psychology journals distributed an average of 10 preprints." (p.131) Further,

> preprint distribution appears to serve both the recipient and the author. Over 60 per cent of those authors who distributed preprints received feedback that prompted them to modify their manuscripts. These modifications were not simply a matter of improvement in the grammar and style of the manuscript but, instead, involved significant modifications such as reanalysis of data, redefinition of concepts, etc. Consequently, preprint distribution is, for many authors, an effective means of obtaining independent evaluation of the scientific worth of their work. (p.131)

This focus on getting completed articles (before peer review) out to colleagues in order to solicit feedback is now facilitated through disciplinary preprint servers and institutional repositories that serve to put "author's originals (AO)" on the internet so the sharing can be maximized. In this current practice. we see echoes of the scientific communication practices of 50 years ago. The Author's Original (AO) is just one version of a work that can exist along continuum, with clarity regarding versions provided for readers by the use of consistent NISO (National Information Standards Organization) versioning language terms. (NISO/ALPSP Journal Article Versions (JAV) Technical Working Group, 2008) Use of standardized terms assists with the issue of the identification of versions of a particular work, where each article may have many iterations on the internet. Institutional repositories often use the addition of "cover sheets" on each article to identify version of the article as well as to provide a link to any final publisher version that may be available to the reader. Many preprints exist only in this early version, and are never formally published. They exist, identified by their DOIs (or "handles") online as a unique contribution to the research literature of a discipline or university. Preprints may be considered as "author's originals" or "works in progress" on a scientist's publication record.

The establishment of informal networks of scientists has been paramount throughout recent history in psychology, leading Garvey & Griffith (1972) to discuss the results of their study that found that:

> In other words, research ideas and problem development cannot be primarily influenced by the published channels of scientific information exchange. In a study of over 200 research efforts in psychology, we found that ideas for less than one out of seven originated from sources such as journal articles, presentations at national meetings, etc. Instead, the scientist relies heavily on informal networks of information exchange to keep abreast of current activities and the current views of the community on the value and relevance of specific research problems. (p.128)

Where some publishers lament the extent of the sharing that goes on in scholarly networking platforms, such as ResearchGate or Academia.edu, it is important to remember that wide sharing was always the goal of productive psychological scientists. At this point, the most well-known preprint server is unquestionably arXiv, an integral part of the established disciplinary culture of physics, mathematics, computer science and related fields. An early innovation of the scientific communication systems in disciplines that use it, arXiv, developed in 1991 by Paul Ginsparg at Los Alamos National Laboratory and taken over by Cornell University in 2001, is now supported by more than 50 universities. Recently, Cornell announced arXiv's transition from its Library to Cornell Computing & Information Science (CIS). (https://cis.cornell.edu/arxiv-looks-future-move-cornell-cis) At one time, arXiv asked for support from universities that had many uploading authors. (Björk, 2014) Still, even with nearly 1,500,000 papers in arXiv as of this writing (August, 2018), there are always questions raised about sustainability for all of these services, or the possibility of buyout by some commercial firm with interests of a different kind. It is noted that Elsevier recently acquired both Mendeley and SSRN (Social Sciences Research Network). Still, the preprint culture solidified in the scholarly landscape by arXiv and now being established in multiple new disciplinary areas during 2016 alone is notable.

As for preprints, there are many who question why the successful model that arXiv represents has not translated to other disciplines. Even though the culture of social sciences supports fairly traditional scholarly communication systems, recently, SocArXiv (Peet, 2016) was developed after the model of arXiv. SocArXiv is a new preprint server for the social sciences that is overseen by a distinguished steering committee and is partnering with the University of Maryland, the Center for Open Science and SHARE (a higher education initiative, http://www.share-research.org/). (P. Cohen, 2016) These are early days for these efforts, and the future of these innovations in scholarly communication (for those disciplines not accustomed to such sharing of early unrefereed versions) is still unclear. The impetus may be growing for change, and some publishers will innovate and provide options for authors. Other publishers may not evolve and continue with the status quo, not offering authors the choice to share their work more widely and prior to publication. There may be other pressures on authors to use preprints. In 2017, the National Institutes of Health (NIH) followed the lead of the UK's Medical Research Council (MRC) and as of March 27, 2017, began to allow preprints to be submitted as part of the

grant proposal process. There was some contentious discussion during the decision-making process about the use of these "interim research products" and issues with use of non-peer reviewed papers in proposals. However, response from scientists has been positive. (Vence, 2017b)

As online preprints continue to proliferate, there is an important new option in psychology due to the establishment and development of the new dedicated preprint service, PsyArXiv. (Center for Open Science, 2017a) This new preprint option for psychology, PsyArXiv was launched in December, 2016. PsyArXiv is one of the open source disciplinary preprint services made available by the Center for Open Science and run by its Open Science Framework (OSF) Preprints service. Center for Open Science (COS) is an established innovator in the open science landscape. COS grew, in its first four years from a staff of two to an organization of 60 staff with an 8 million USD operating budget, and its OSF software was used (as of 2017) by 50,000 scientists that are sharing their research methods and data. (Winerman, 2017). It will be interesting to watch the progress of this psychology preprints initiative: how many authors participate, how papers evolve to more final publication, and how the existence of preprints will interface with formal journal publication. PsyArXiv follows the recent launches of bioRxiv (operated by Cold Spring Harbor Laboratory), and ChemRxiv (established by the American Chemical Society). Two other new preprint services opening alongside PsyArXiv are the aforementioned SocArXiv and also engrXiv for engineering. This is a rapidly developing phenomenon for many disciplines. As these services become more popular and proliferate, a proposal to connect and centralize preprint services in an initiative called "The Commons" could resonate in an increasingly cross-disciplinary scholarly landscape. The proposal for The Commons states: "The Commons will connect preprint services in a community-based model. For the typical user discovery interface, The Commons will facilitate discovery of preprints on various hosted preprint services and guide users to engage with the preprint on that hosting service." (Nosek, 2017)

Along with this new emphasis on preprints in many disciplines (including psychology), occasional discussions sometimes persist about a once debated topic, the "Ingelfinger rule." (Altman, 1996) The Ingelfinger rule developed traction as it forbade duplicate or prior publication of any research that would be submitted to a peer reviewed journal. How does this idea translate in an age of internet posting of research results, especially preprints? The number of publishers expressly allowing posting of preprints online has seemed to put this issue to rest. There may be added incentives and advantages for authors of having early versions of articles available for all to read on the internet. Preprints may catch the eye of journal editors seeking promising content for their publications. There is evidence that "preprint editors" in some fields are examining preprint servers to discover promising articles for possible publication in their journals, for example, as is the case with *PLOS Genetics* and BioMed Central's *Genome Biology*. (Vence, 2017a) Uploading articles to disciplinary preprint servers may be an effective way of marketing to editors seeking relevant articles for their publications.

Historically, this issue of "prior publication" was addressed in psychology in 1996:

One of the most widely publicized Internet publication policies came from the American Psychological Association (1996) whose interim policy asserted: Authors are instructed not to put their manuscripts on the Internet at any stage (draft, submitted for publication, in press, or published). Authors should be aware that they run a risk of having (a) their papers stolen, altered, or distributed without their permission and, very importantly, (b) an editor regard such papers as previously "published" and not eligible as a submission—a position taken by most APA journal editors. In addition, after acceptance for publication, the publisher is the copyright holder. APA does not permit authors to post the full text of their APA-published papers on the Internet at this time, as developments in the on-line world cannot be predicted. The APA will, however, closely follow such Internet developments. The P&C Board will establish a task force in June 1997 to investigate developments and recommend a longer term APA policy. (Kling & McKim, 2000, p. 1312)

This policy certainly evolved. Many (if not most) journal and publisher policies today allow posting of preprints in repositories and other web services, and in some disciplines, there is an established culture around archiving preprints. Major psychology publishers *do* allow the posting of preprints. Some have some minor rules around the practice. APA is an example of a publisher that *does* allow preprints to be self-archived. As for permissions to post preprints on the open web, the SHERPA/RoMEO service lists APA's permission to post preprints, and the APA website (http://www.apa.org/pubs/authors/posting.aspx) lists this information:

APA Journals Internet Posting Guidelines

Update effective November 25, 2015

If a paper is unpublished, the author may distribute it on the Internet or post it on a website but should label the paper with the date and with a statement that the paper has not (yet) been published and is not therefore the authoritative document of record. (Example: "Draft version 1.3, 1/5/16. This paper has not been peer reviewed. Please do not copy or cite without author's permission.")

These early, original articles, once deposited in an institutional or subject repository (or on a preprint server like PsyArXiv), do pick up downloads and citations and can serve to establish early authority, as well as provide a mechanism for authors to receive constructive feedback on early drafts. This serves the purpose of crowdsourcing informal review, and feedback can improve later drafts. The announcement that the third party platform service, Hypothesis, would partner with some of the preprint services of Center for Open Science (including PsyArXiv) to provide the ability for readers to annotate and discuss preprints was welcome. This valuable enhancement allows the community to provide constructive feedback on a preprint within the text (rather than in comments at the end), aiding efforts at transparency and collaboration in scholarly communication in psychology. (https://web.hypothes.is/blog/hypothesis-live-on-cos-osf/)

Posting a preprint online also date stamps the article, aiding efforts at getting current work out quickly, as well as preventing "scooping." Being scooped would be one of the

considerations researchers would consider when disclosing results before a paper is submitted for publication. Thursby, Haeussler, Thursby, & Jiang (2018) found a lack of research about how the disciplines view "prepublication open disclosure," and studied reasons and motivations as to why scientists do or do not share results before publication via posting of preprints (but also by using web postings or conference presentations to disclose). While psychology was not one of the nine specific fields analyzed by Thursby et al., for "scientific disclosure before publication," results showed that "across all fields, obtaining feedback is the most important," (p.2) and that the motivations to disclose (and the timing of disclosure) varied across fields. In the disciplines, levels of competition and commercialization matter a lot to decisions to disclose, with lowest levels of both competition and commercialization found in social sciences and mathematics. Further, "not coincidentally, social sciences and mathematics have a greater degree of disclosure to general audiences than medical basic science" (p. 10) and "social scientists are the most likely to disclose at the conceptual stage." (p.2) Seeking a greater understanding about how and when psychology researchers disclose research results before formal publication would assist publishers, developers of preprint services, and conference organizers in making services available that would attract those seeking to get their work out as early as possible to the widest potential readership in order to spur innovation and further research.

This practice of posting preprints has been the culture of some fields such as high-energy physics and computer science, with their preprint server, arXiv, since the early 1990s. As of this writing, it remains to be seen whether the practice of sharing preprints online via repositories or services like PsyArXiv, for instance, will become standard practice in psychological science. It also depends on how much commentary and open peer review are desirable and acceptable as articles develop from preprint stage to more final versions. In psychology, with PsyArXiv still relatively new, it remains to be seen whether there will be an appetite for sharing non peer-reviewed versions of articles online. The emergence of PsyArXiv will also serve to demonstrate whether in psychology a preprint environment will behave like the established culture of arXiv's, or whether the discipline's researchers will instead stick to the publishing status quo. Authors posting papers on PsyArXiv are able to choose to license their work using the two Creative Commons licenses that the service supports, whether to put the work in the public domain, or to use the popular CC-BY license. CC-BY, which allows for liberal reuse of the work while requiring attribution, is the most popular on PsyArXiv so far. As of April, 2018, 57% of authors have chosen CC-BY, 29% have chosen CC0 (public domain) and 13% have not placed a license on their uploaded work. (Moshontz, 2018) Adding an option for a more restrictive CC license may encourage authors to post longer form preprints that may develop into monographs later. These authors of longer form works can put no license on their works in repositories or preprint servers, but this approach is less than ideal even if it does signal that the author wants to retain copyright while receiving feedback from the community on the content contained in a longer than customary preprint (in the case of the possibility of a resulting book contract). This allows early posting of book-length manuscripts, sharing the content with a community, or multiple disciplinary communities. While most book publishers would not consider an already posted manuscript, some open access publishers (such as SAGE Open), do allow posting of a draft or early version of a possible publication before it is submitted for review.

Preprints in many disciplinary areas can often be posted by authors directly on the web (via preprint servers or various repositories) as they are not yet peer reviewed or in a "submitted" or "accepted" category, and therefore are not yet under the control of a traditional publisher. The term "preprints" can be problematic as the word has been used in different ways by some journals and publishers as a way to describe any version of an article as it exists online before formal publication. A reader might see use of this term to describe accepted versions that have not yet been assigned pagination or an issue number, or for papers that are submitted manuscripts under review (but posted online by the author). More recently, use of the term may be more universally identified and understood as the "author's original (AO)" (to use the NISO term) article which has not undergone peer review by a publisher. Some articles will never end up undergoing peer review, but instead will remain online in preprint form, circulating and being read widely by interested readers and researchers. These preprints are cited with their DOIs in the literature of many disciplines, and that would be the expectation for psychology as well.

Preprints that never go on to more formal publication can still demonstrate informal impact through the counting of institutional and subject repository downloads and via the use of other alternative metrics. In terms of the publisher's proprietary versions (including article versions such as "Proof" or "Version of Record)," recent takedown notices levied against university websites and scholarly communication networks by publishers (including APA) may make authors increasingly wary about posting the publisher's version of an article online. On the other hand, it may embolden those that want to share their work and don't want to be dissuaded or even threatened by the same publisher that was chosen for submitting the work. Distribution of takedown notices often gets attention quickly, and to avoid this scenario, authors may turn to depositing preprints in services and institutional repositories, taking advantage of the more liberal publisher permissions that currently exist for preprints.

For now, many authors continue to deposit versions other than the allowable preprint in digital repositories and on websites. It remains to be seen whether recent actions by publishers to send out takedown notices when "illegally posted" articles on websites are discovered will make a difference and cause authors to abandon posting final publisher versions on the internet (and possibly switch to depositing earlier prepublication versions online). In a recent high profile example from 2017, the American Psychological Association (APA), began a pilot program that initially started by analyzing where final versions of five APA journals could be found posted illegally. APA then began sending Digital Millenium Copyright Act (DMCA) notices of infringement (takedown notices) to those sites that had posted these publisher final versions online. The program eventually expanded to all 29 APA-published journals. Universities informed their authors that they must remove APA articles that were posted illegally from university websites. The negative reaction from authors was swift. APA responded by refocusing their efforts away from sending notices to individual authors. Takedown notices instead went to pirate sites and popular scholarly collaboration networks such as ResearchGate and Academia.edu as well as to 80 universities. (Mills, 2017) On June 16, 2017, McCook (2018) reported that:

the publisher had sent takedown letters-citing the Digital Millennium Copyright Act (DMCA), which enables internet users to protect their own content — to nearly 350 academic institutions (and 12,460 letters to piracy sites). The spokesperson told us the APA doesn't plan to send any more letters to academic websites 'at this time'. But the publisher is still discussing whether to rescind the takedown notices that academic sites have already received.

Up to now, there has been no successful way to manage the dissemination of scholarly articles in final publisher version of record that occurs around the web. Takedown notices or lawsuits that target authors (or their universities) would seem to be a counterproductive strategy that could drive authors away from submission to certain publishers' offerings and would refocus attention on a publisher's posting guidelines. This kind of program is just not good for authors, libraries or readers' relationships with publishers. This leaves publishers in a position where they may have no real recourse but to acknowledge the sharing of published scholarship that is going on. It leaves authors in a position where they may acknowledge that they *know* the rules (once they sign the copyright transfer agreement) but don't necessarily *agree* with those rules and they want to ensure that there is open access and wide sharing of the article's version of record. The practice of posting articles on the web may just become so commonplace as to become unstoppable by any publisher or other entity. In any case, publishers will not want to resort to suing their own authors, and may also understand that some sharing may be driving traffic (and possibly some resulting impact) to their articles and websites. After all, added visibility of an article is always good for publishers and citing conventions will drive researchers to seek out the publisher version of record if it is accessible to them. If there is no subscription access, other versions will suffice. It is unclear, at this juncture, how article sharing (or in what form) will or will not create the kind of harm that would cause an end or an irreversible disruption to traditional scholarly publishing as it currently exists.

Subject or Disciplinary Repositories Available for Psychology Authors and Researchers

Many psychology researchers have searched for scholarly publications or uploaded their own works to one of the few online disciplinary or subject repositories that are available for psychology. Unlike some other disciplines, psychology does not necessarily have an ingrained culture of participation in subject or disciplinary repositories, but works can be found across a few of the major repositories. Participation in subject or disciplinary repositories is another green OA strategy useful in the goal of wide dissemination of psychology papers.

Certain of the subject repositories have risen above the entire landscape of digital repositories not only in sheer size and volume of content, but in their centrality to certain fields as the gathering place for scholarship and collaboration. Studies have placed four major subject repositories in this position. SSRN (Social Science Research Network) is multidisciplinary but has prominence especially for law and economics scholars, PubMed Central (PMC) is the largest subject repository and the target of biomedical scholarship, arXiv has, since the early 1990s been central to physics, mathematics, computer science and other related fields, and RePEC is well known and used by economists. (Li, Thelwall, & Kousha, 2015) None of these four largest subject repositories has a particular focus on psychological science, and some studies have

shown that a higher percentage of archived open access papers overall can be found in fields that have a dedicated subject repository. Such is the case with biomedical sciences, and also is reflective of the effects of the NIH mandate. PMC has arrangements with many publishers for deposit of papers associated with NIH funding, and as of August, 2018 lists five million publicly accessible articles. Without a strong preprint culture feeding it, most papers in PMC are accepted manuscript versions of published articles or final publisher versions.

One available online repository of interest to some areas of psychology is SSRN. SSRN is often viewed as a collaborative, sharing site for researchers and their early abstracts and papers in social sciences disciplines, and currently (as of August, 2018) it holds more than 800,000 research papers. SSRN is described on its website thus: "SSRN is devoted to the rapid worldwide dissemination of research and is composed of a number of specialized research networks" (https://www.ssrn.com/en/). One specialized research channel of interest to psychology is the Cognitive Science Network, which contains more than 22,000 papers as of August, 2018.

SSRN was started in 1992 (SSRN was never strictly an open access repository per se) and as of May, 2016 is owned by Elsevier. This raises some questions about its continuing with "business as usual." SSRN was started in 1994 by a small group of scholars whose backgrounds were mainly in economics and legal scholarship and it evolved as a business that offers various subscription services alongside its use as a repository of articles, working papers, conference papers and other scholarship. Over time, SSRN became one of the largest subject/disciplinary digital repositories, and is used by some researchers in psychology to upload papers. Eventually, SSRN was a corporation with a budget of more than one million dollars and more than a thousand volunteers were performing much of the labor (along with a small paid staff). (Björk, 2014). Still run by Gregg Gordon, (formerly President & CEO of SSRN before the Elsevier acquisition), SSRN is at this point still a heavily used networking, collaboration and research paper sharing site, especially for working papers and preprints in the social sciences and humanities (including content from the cognitive sciences).

One of the compelling aspects of SSRN is its use of rankings (of authors, papers, and institutions). (N. Cohen, 2008) In certain fields, like law, faculty may even worry about use of their institutional repository (IR) for a secondary deposit of articles, fearing a "dilution" of their SSRN downloads, which could create a resulting drop in the rankings. It has been demonstrated that deposit in the IR allows access of important scholarship (especially early versions containing current research results) to readers that are outside the primary group served by the SSRN channel. Deposit in more than one repository service, such as in the institutional repository as well as in SSRN broadens readership and exposes the work to new readers and researchers. (Donovan & Watson, 2012) It would seem advantageous for SSRN depositors to attract new reader traffic by moving outside of SSRN, especially since this practice does not damage SSRN rankings. There is no "rule" on where a given early version article can be deposited online and various channels have their own readership so multiple channels of dissemination of a researcher's work is possible. Preprints or accepted manuscripts can be deposited in multiple repository services online.

Subject repositories and/or "eprint archives" for psychology (and using the example of cognitive science), may not have evolved to attain the level of visibility of arXiv, for instance, but the two archives do share a long and common history. An early eprint repository that focused on cognitive science, neuroscience and a few other related disciplines, CogPrints, was founded (and is still moderated today) by cognitive scientist Stevan Harnad. CogPrints was launched in 1997 following the success of the eprints model that had been in place since the founding of arXiv for the use of the physics community by physicist Paul Ginsparg in 1991. Harnad wanted to extend the eprints model, which relied on author self-archiving of preprints and other papers to an electronic archive for cognitive science and related fields, even as he acknowledged the field differences that existed between physics/computer science and cognitive sciences in the sharing of unrefereed preprints. CogPrints was developed by Harnad based on software developed by Ginsparg at Los Alamos. (Taubes, 1996) The CogPrints archive now contains more than 4000 papers (as of August, 2018), with more than 1700 psychology articles included, and since the 1990s has demonstrated that cognitive science has had an eprint culture for almost as long as arXiv has served the physics and computer science community.

Subject/disciplinary repositories can be considered complementary to institutional repositories, which serve a different mission of making a university's publications and research output discoverable-across all disciplines- and available to a global readership. Institutional open access policies require and facilitate deposit in an institutional repository in order to showcase all of the institution's scholarship. Crawled by search engines such as Google, both institutional and disciplinary repository contents will be discovered by all searchers, while a much smaller group of searchers visit the repository itself to search for content. It has been reported that institutional repositories' contents are more discoverable than those of SSRN, for instance. One study demonstrates that SSRN content appears to searchers more slowly than papers in the institutional repository do, and represents different groups of searchers. Google keyword searches will pick up content in the institutional repository more quickly than searches of SSRN. The takeaway from this study is that using more than one repository strategy for uploading publications (such as depositing papers in SSRN and an IR) will achieve a greater readership than one or the other repository alone. (Donovan & Watson, 2012) While this study focuses on Law scholarship, it would make sense that depositing a single article in more than one repository will only increase its visibility and reach potentially different groups of readers. These reader groups may be mutually exclusive and thus extend the outward reach of the work.

It is not always a straightforward business for authors or others to ascertain whether publisher permissions allow or accommodate the deposit of papers into a subject or disciplinary repository. While many publishers make information about author self-archiving of preprints and other versions of article available on their websites or by adding information to the popular SHERPA/RoMEO service, it is often more difficult to find this information for subject/disciplinary repositories. Studies have shown that while many publishers expressly allow self-archiving on personal websites or institutional repositories, the permissions for archiving in subject repositories is more problematic and the number of publishers allowing deposit is lower. For example, in a study by Laakso et al. of 1.1 million subscription articles published in 2010 (in accepted manuscript or publisher version), it was found that 80.4% could be uploaded (allowed

by the publisher) to an institutional or subject repository (or personal website) within the first year of publication. Further analysis of this number showed that publishers were much more permissive about allowing the accepted manuscript to be uploaded to institutional repositories (79.9% of articles) or personal websites (78.1%) than they were to subject repositories (only 32.8%). At the time of this analysis, only about 12% of articles available for self-archiving in repositories actually were being made available open access via a repository. (Laakso, 2013) The practice of author self-archiving of non-proprietary earlier versions of articles or "green" open access has had a slow start but is the stated focus of most institutional repositories and open access policies. The continuing forward movement of green open access is still in the hands of authors and the research community and would grow much faster if they would take the simple action of uploading their papers with a few simple steps, thereby allowing Google and other search engines to disseminate these works to worldwide readers. Many authors do not self-archive and Stevan Harnad advocated early and often for them to simply perform "a few keystrokes," taking very little time out of busy schedules to deposit each scholarly work in a repository (enabling open access at no cost to them).

Psychology also appears as a percentage of open access papers in repository collections in biomedicine, while not showing large percentages of open access papers archived in any particular subject repository. There is clearly not a culture of using one subject repository in psychology. In fact, in a large scale study completed for the European Commission in 2014 that reported the availability of OA content by discipline, the category of "Psychology and Cognitive Science" did not show up in the top disciplines making papers available by either green (self-archiving in repositories) or gold (journals route) open access. However, in this large scale study that used the Scopus database, Psychology and Cognitive Science was the second highest grouping in the "other OA category," showing a proportion of 43% of open access papers to total papers published. The authors defined "other OA" in this study as papers freely available to readers due to their availability on the internet in services such as aggregator sites, "hybrid" articles (open access articles in subscriptions journals where the author has paid an article processing charge), or even articles found posted outside of publisher permissions. (Archambault et al., 2014)

Overall, in all disciplines studied, this analysis reports that:

> as of April 2014, more than 50% of the scientific papers published in 2007, 2008, 2009, 2010, 2011, and 2012 can be downloaded for free on the Internet. This is an important finding as only one year ago, in April 2013, the proportion of papers that was freely available was just a hair below 50% (49.54%) in 2011 and did not reach that mark for any other year. (Archambault et al., 2014, p. 2)

Open access availability is increasing. It would seem clear that psychology is a disciplinary area that could really benefit from placing more focus on open access and setting a goal of ensuring at least public reader access to much more of its scholarship. Green OA is attainable for most papers (sometimes with embargo), and may be seen as an author responsibility if more of the disciplinary literature is to reach every possible reader. It is not clear whether having available a disciplinary or subject repository (like the major ones found in other disciplines (such as with

arXiv for physics, for instance) would create more momentum. Recently, the aforementioned preprint server PsyArXiv has become a target for preprints in psychology. PsyArXiv will provide another vehicle for changing the open access culture in psychology. Even as psychology establishes a reputation for its leadership in areas of reproducibility and other areas of open science, will the discipline increase its uptake of open access practices or will it fall behind other disciplinary areas?

Some would rather see a focus on a move to more open access by focusing not so much on many versions of articles freely available online in subject, disciplinary, or institutional repositories, but instead to focus on more open access journal publication. Gold open access (the "journals route") is felt by some (for instance, by some funders in the UK) as the gold standard of OA because rather than earlier versions such as author's originals or accepted manuscripts, it is the version of record (proprietary publisher branded version) that is made available on the internet. Of course, publishers place the most restrictions on the "version of record," and that is the version most scholars would want to cite if at all possible. APA style, according to the 6th edition of the Publication Manual of the American Psychological Association (section 6.24 and 6.32) states that "As with references to material in print or other fixed media, it is preferable to cite the final version (i.e., archival copy or version of record; see section 6.24)" and further, it is stated that "if the most current version available was an advance release version at the time you originally cited it, recheck the sources and update its publication status as close as possible to the publication date of your work (see section 6.32)." (American Psychological Association, 2010) When authors do cite subject repository versions, at least one study has focused on how these major subject repositories end up providing citations to the cross-disciplinary scholarly journal literature. It was found that there is indeed a lot of citation activity outside the primary disciplines served by the major subject repositories. This shows that subject repositories can be valuable vehicles for disseminating articles outside of the primary disciplinary groups. (Li, Thelwall, & Kousha, 2015)

There are many options for the scholar who wants to (or must) archive every article in one or more digital repositories using green open access, maybe too many. Many institutions have set out an expectation that all scholarly works must be self-archived (or harvested by automated methods) into the institution's digital repository due to existing open access policies of the institution or funders. Authors will also want to participate in the repositories that represent their fields. The fact that scholars are in tune with the disciplinary communication norms of their fields may make the concept of deposit in institutional repositories seem redundant. It can be difficult to explain the purported value of self-archiving work in an institutional repository once researchers have aligned themselves with one or more of the disciplinary repositories or peer scholarly networking services. Many scholars may want to stick with, and affiliate with disciplinary (and not institutional) self-archiving solutions. Every scholar likely has chosen a preferred open access service (or sharing platform) that works and many are not eager to change behavior. The extra work (even spending the small amount of time required) of self-archiving with the institution often does not resonate in the same way as participation in the subject-based repository or other discipline-based solution. Busy researchers do not often see as much personal value to building a collection of work in an institutional solution that may not

be part of a larger network. Many institutions are involved in efforts now to aggregate all of the institutional repositories into a large scholarly network, creating a critical mass of freely available scholarly literature for the world's readers. Various aspects of the value of scholars' self-archiving in the institutional repository include the gathering of the works of all faculty together in one place (allowing discoverability and reporting of aggregated university scholarship), making university works visible for enhanced collaboration across the institution (and across disciplines), making sure every work has an associated DOI so every article or book chapter can be listed in profiles such as ORCID's, making sure all the works of every scholar are curated, preserved over time (formats migrated) and ensuring full text online access to the papers of every scholar from the institutional repository. One very important factor that authors may not always know is that publishers often allow self-archiving of the accepted manuscript of the paper (usually not the publishers' version of record) in more than one repository. Therefore, while an author may want to share papers in many ways, there is no limit on the ability of the author to participate in a variety of repositories or other collaborative solutions for any given paper in its preprint or postprint (accepted manuscript) version. In fact, making any paper available legally online may drive traffic to the publisher version, creating a "win-win" for readers, authors and journals/publishers. There are many strategies that authors can take advantage of and a currently emerging role of academic librarians is to consult with faculty on the various "green" open access options available to authors today. Authors are especially interested in open access solutions that don't carry the costs of the gold open access options, seeking instead these many green open access options for marketing their work and helping their scholarship reach new readers. For psychology, more readers can only confer benefits to authors and to society. Practitioners would all have access to the latest literature. Institutions with open access policies in place do realize higher institutional repository self-archiving rates, and so this is considered one strategy that an institution can have in place in order to place an importance on the need to make institutional scholarship freely available on the internet (to the extent possible). With pressure on institutions to take steps to rise in all of the various rankings, ensuring that all of a university's research output is freely available online may become a priority.

Looking at the average of all self-archived papers in psychology for the time period 2005-2010, Gargouri, Larivière, Gingras, Carr, and Harnad (2012) reported that 28% of all psychology journal articles published each year could be accessed free on the web. The percentage of green OA for psychology has continued to grow in recent years. Martín-Martín, Costas, van Leeuwen and López-Cózar (2018) also reported percentages of types (colors) of open access found across Web of Science disciplinary categories, including Psychology. For a large sample of openly available articles found to have full text links in Google Scholar, for Psychology, 57.8% of the sample were open access. By *type* (color) of OA, 2.8% of the sample was gold OA (published in open access journals), 4.2% were "Bronze OA," a category where all content is made freely available to the public online after a certain time period by the publisher, and 18.9% of articles were "green OA," found only in institutional or subject repositories. To compare these numbers to the Clinical Medicine category, for instance, demonstrates the large variability of results from one discipline to the next. It should also be noted that even subfields have great variations within a larger category. In comparison, the category Clinical Medicine had very similar total percentage of freely available articles (to Psychology), recorded at 56.9% of

the sample. However, the types of open access show quite a different result. In Clinical Medicine, the Gold OA percentage was 7.5%, 22.3 % were Bronze OA (a huge difference), and Green OA was 9.7%. Therefore, more biomedical researchers (than psychological scientists) are accustomed to publishers making articles freely available on their own platforms after a short time period. Another study by Piwowar, et al. (2018) analyzed a different data set (from oaDOI, a free service that "determines OA status for 67 million articles") that comprised three different sets of 100,000 articles each. This study estimated an overall OA proportion of the scholarly literature of 28%, and growing. In terms of looking specifically at psychology (in terms of its inclusion as a category in the NSF Specialties), this study showed that of 2,257 papers in the psychology sample, 1586 articles are *not* open access (70.3%), 122 (5.4%) were "bronze OA" (the delayed publisher OA), 2.0% were hybrid, 4.7% were gold OA, and 397 of the articles were green open access (17.6 %). Once again, comparing the Psychology sample in the Piwowar et al. (2018) study to the NSF category, Health, with a similar sample size of papers (2,121), a full 13% were bronze open access, once again showing a distinct disciplinary difference in how the Health publishers make papers open access on their platforms over time. This one small example of bronze OA uptake by percentage demonstrates why discussions of open access cannot be a "one size fits all" treatment. Those presenting information to mixed disciplinary audiences about OA or other aspects of scholarly communication cannot make broad pronouncements about current or future directions that will resonate with all groups. For the reader or librarian accessing the medical literature, making one's work green OA may not seem as essential as much of the current literature (except for the most recent 6 months) may already be available on the publisher platform, or in PubMed Central. If the bronze OA category grows in biomedicine, it still does not jeopardize the sale by publishers of the most valuable content in current journal articles. Only recently have these breakdowns in types of open access allowed researchers to see the differences in access by discipline. Each discipline and subfield can be said to have a certain "culture of open access behavior" which could be studied further. Understanding these specific cultures would be valuable to open access policy efforts, customization of approaches by funders, education of scholarly communication librarians, and to all efforts at understanding scientific culture in the disciplines. The open access conversation in the disciplines must be more nuanced in order to resonate with more authors and stakeholders.

Still, only the largest subject repositories are great contributors to the volume of "green" open access articles on the web. Björk's 2010 research on subject repositories does not show a huge emphasis on subject repositories in psychological sciences. He reported in 2010 that although 43% of all self-archived manuscript copies can be found in subject repositories, a full 94% of all of these can be found in arXiv or PubMedCentral. Björk compares subject repositories and institutional repositories and notes that the subject repositories lack some of the advantages that institutional repositories enjoy such as sustainable support from universities, an environment where more publishers allow self-archiving, and a trend toward open access policies promoting more self-archiving in the institutional repositories. Subject/disciplinary repositories (outside of the largest ones) may not be a growth area. For the largest repositories, other factors such as the role they have played for many years as part of disciplinary publishing culture may promote their continued success. Those fields (which don't include psychology) that rely on their subject repositories already had a working paper or preprint tradition prior to

the advent of the internet, and of course, NIH created an upward trajectory for PubMed Central with their public access mandate. Funder mandates could make a difference for psychology archiving in repositories. SSRN, arXiv and RePEC were subject repositories that were natural extension of earlier disciplinary preprint culture of certain disciplines. (Björk, 2014) However, scholarly communication in psychology did not develop in ways that promoted the natural growth of subject repositories and at this point, it would not seem that this would be an expected development in the future. PsyArXiv, with its set of open science services, may be the option that psychology has been waiting for, and may one of the game changers for scholarly communication in the discipline.

Innovations in Peer Review and Open Peer Review: Examples from Psychology

Innovations in peer review were summarized in a report commissioned by the Wellcome Trust in 2015, with major trends identified. This analysis was an attempt to inform the research community about the issues with peer review in a current scholarly communication landscape that focuses more and more on evaluation of researchers and institutions as evidenced by publications in high impact journals. This study reiterated the importance that the research community places on the "*principle* of peer review" and that the issue of the "*practice* of peer review" is instead at issue. (Research Information Network CIC, 2015) With the number of articles submitted to journals in the range of 3 million per year (and with a reviewer spending approximately 6 hours per review), it may be obvious that the system may be overburdened. (Jubb, 2016) Peer reviewers are not paid, and this part of the publication process must be managed, and can be a challenging part of the editor's role. Difficulty in finding reviewers with appropriate expertise for a deluge of article submissions, dissatisfaction with non-publication that can sometimes be due to the appearance of one negative online review can all lead to publication delays. This, in turn, can lead to issues with the currency of the psychological science literature.

Even with robust peer review systems in place, and an emphasis on high impact journals for career advancement and reputation, there is evidence that "the fraction of highly-cited articles published in non-elite journals increased steadily from 1995-2013. While the elite journals still publish a substantial fraction of high-impact articles, many more authors of well-regarded papers in a diverse array of research fields are choosing other venues." (Acharya et al., 2014, p.1) This study, using Google Scholar Metrics (https://scholar.google.com/scholar/metrics.html) also found that, due to accessibility of the research literature, more researchers are citing "work published everywhere," and over time a larger percentage of citations are going to articles in non-elite journals where "elite" was defined as the 10 most cited journals in each of 261 subject categories reported by Scholar Metrics.

Many studies have shown how peer review is valued by scientists. However, there is room for improvement, according to studies of researcher attitudes. (Mulligan, Hall, & Raphael, 2013) There are also issues with time lag and other negative consequences of a sometimes lengthy review process (for authors and journals) when the result is often "revise and resubmit." (Cochran, 2016) Journals, editors and researchers alike need to be able to speed up the publication process in these high stakes times, and all delays are more difficult to manage. While

much is changing, there is always an emphasis on the need to maintain robust peer review systems.

Peer review systems and practices are currently undergoing many innovations and experiments. For instance, *European Journal of Neuroscience* is beginning to publish full, bylined reviews attached to articles. According to the journal, "Open reviews, the argument goes, are more thorough and constructive-and the rich scientific debates they reveal can be a valuable educational tool." (Vlasits, 2017) The editors-in chief state in an editorial that "we believe this is the future." (Foxe & Bolam, 2017; Vlasits, 2017) The first experiments in open peer review, such the one *Nature* trialed in 2006, were not pursued due to low uptake. Things have evolved, as we even see the announcement that Elsevier will add an open peer review option to all of their journals by 2020. This option will be phased in, and follows the successful 2014 pilot (with five journals) of their "Publishing Peer Review" reports trial which demonstrated that many reviewers (from many different fields) were happy to have their reports published and have their names revealed. Elsevier also reports that the results of surveys show that open peer review does increase the quality of review reports. Elsevier gives published reviews their own DOIs, allowing those reviews to be "counted" as a type of publication output and included on CVs, for instance. (Pool, 2017)

Many psychological scientists looking to publish in newer open access journal titles such as the funder supported title *eLife* will find a different type of openness around peer review, and also a practice of reviewers discussing the paper with each other, synthesizing the reviews, and then publishing the review alongside the paper. Many of the working scientists that review for *eLife* sign their reviews. (Vlasits, 2017) As another incentive, the Publons service (https://publons.com/home/), which is partnering now with many publishers, is creating a profiling service where reviewers can receive credit for completing reviews. (Publons, 2017) Another newer initiative will pay reviewers a small fee (a part of the APC) for their work, whether the article is accepted or rejected. *Collabra,* a title initiated in 2105 by University of California Press, aimed to include articles from many disciplines, including behavioral sciences. (Chawla, 2015a) Recently, Collabra has "become a brand for our Open Access program of journals at UC Press, over time." *Collabra: Psychology* is now accepting papers and is the official journal of the Society for the Improvement of Psychological Science (SIPS). With an esteemed editorial board, "*Collabra: Psychology* and SIPS are excited to unite in a shared mission to improve psychological science, and scholarly communications broadly, through policies that support transparency, openness, diversity, and rigorous, ethical scientific research practices." (University of California Press, 2017)

Researchers in psychology will find many types of peer review processes going on in traditional subscription journals, the established open access journals, and the innovators that are moving toward new systems of publishing and journal certification systems. In 2016, one of the most interesting peer review trials of an innovation in the discipline involved publisher BioMed Central's open access journal, *BMC Psychology.* The goal of this trial was focused on the need to reduce publication bias using a "results-free" peer review process where reviewers do not see outcomes (as they do not have access to the results or discussion), but instead focus on approach

and methods. At the end of the review process (when results and discussion are made available), the same reviewers would expect that the "accepted" articles' results and discussion would not "deviate unjustifiably from the stated aims and methods. We believe that this could help reduce publication bias by basing the decision to publish purely on the scientific rigor of the study design." (Grant, 2016)

PLOS ONE, "the first multidisciplinary open access journal," includes many articles in psychological science. *PLOS ONE* is also a pioneer among new models of peer review, and now many of the open access "megajournals" follow its practices. The *PLOS ONE* model features the type of peer review where each article is reviewed by editors and reviewers for technical soundness, not for the potential impact of the publication to the field. Each article's assigned Academic Editor is responsible for the peer review process. The expert readership weighs in with post-publication feedback, adding to the impact of the article to its field. (PLOS ONE, 2017b) Taking open peer review a step further, the title *F1000Research* uses immediate publication "with no editorial bias" and a transparent peer review process that includes post publication commentary and availability of open underlying data. (F1000Research, 2017) *F1000Research,* was launched in 2013 by Vitek Tracz (creator of BioMed Central). Tracz felt that "peer review is sick and collapsing under its own weight" and that issues such as anonymous review leading to delayed publication were just some of the issues with the traditional practices. (Rabesandratana, 2013, p.67)

Another innovation in peer review, the use of "cascading (or portable) peer review," where an article's reviews are passed, upon rejection at a first choice journal to another title in the same publisher's stable is in use by some major publishers. This option is somewhat controversial in terms of how well it serves a particular publication that may be "downstream" from the journal of first submission. Convenience is one positive for authors, saving them time and trouble in investigating a new publisher and publication outlet. Management of the review process within a publisher's stable of journals is also attractive for publishers. In one example of cascading peer review in neuroscience, it is stated:

> The Neuroscience Peer Review Consortium (http://nprc.incf.org) is a cross-publisher transfer alliance covering some 40 journals that forward reviews upon authors' request, but take-up is small. Some publishers think that cross-publisher transfers reflect credit on them as good citizens; but as another said, 'why would I want to transfer an author, and the work we have put into a paper, to another publisher?' Even when they are willing to make reviews portable, the manual intervention in editorial management systems may be a disincentive." (Jubb, 2016, p. 17)

Where some major publishers already have cascading peer review systems in place (while others have decided not to do so), Elsevier has recently been awarded a U.S. Patent for their version, labeled "Online peer review system and method" (described as the "proprietary waterfall system"). Much debate ensued online over the necessity and potential negative consequences of patenting a peer review system. (Aspire Scientific, 2016)

Peer reviewers have been challenged by the evolution of the article itself. An article may no longer be a familiar text document. In many cases, the article "package" contains both text and published supplementary data. Over time, in some publications, the article text became less significant if the reader lacked access to all of the linked supplementary material. With the increasing prevalence of outbound links to sources of data sets, journals still had to vouch for the credibility and quality of the supplementary material, and that caused delays and issues for already overburdened reviewers. For example, in 2010, the *Journal of Neuroscience* announced that it would no longer include, host or review supplementary data alongside articles, citing time lag as busy reviewers were encountering a larger amount of data to review. Supplementary data could be hosted on an external site, with a pointer from the article. (Maunsell, 2010) Peer review currently continues under intense discussion and remains as an essential (but fraught) piece of the scientific communication system for psychology and all disciplines. As practices and tools continue to change, the underlying importance of peer review remains.

There are issues with how to best peer review research data. With the trend in growth of openly available research data (both underlying data deposited in repositories and supplementary materials to formally published journal articles), peer review of data has become a larger issue for researchers, publishers, and especially for reviewers that may need guidance on how to complete an effective review. With practices still developing, peer reviewers of research data will need very specific guidelines on the various aspects of this process. (Carpenter, 2017)

The "Gold Road:" Open Access Journals and Psychology

There are many fully open access journals (where all content in each issue is OA) available to psychology researchers for submission of their articles. Many carry article processing charges (APCs), but the majority do not. A very complex environment exists at present when it comes to scholarly publishing and access to the peer reviewed literature. Library subscriptions still pay for the cost of institutional subscriptions, and authors don't pay to publish papers in the traditionally published journals (but often sign away their copyright in their articles to the publishers). Certain articles may be made open access for a fee in an otherwise subscription supported journal (hybrid), or institutional memberships may be available from open access publishers to subsidize the APCs of affiliated authors (such as the case with BioMed Central, for example), and in many cases there are no fees to libraries or authors because publishing is subsidized by societies, libraries or others. An example from the author's institution of a quality open access psychology journal that carries no fees for readers, authors or libraries is *Pragmatic Case Studies in Psychotherapy (PCSP)* an open access, "peer-reviewed e-journal of systematic case studies & case study method articles" which has published 52 issues to date, and is indexed in PsycINFO. (https://pcsp.libraries.rutgers.edu/index.php/pcsp/index) *PCSP* is published by the Rutgers Graduate School of Applied and Professional Psychology (GSAPP) and the Rutgers University Libraries using Open Journal Systems (OJS) software, a popular open source journal publication system that is associated with more than 10000 journals. To date (since it began publishing in 2004), articles in *PCSP* have been downloaded more than 500,000 times by a global readership. Peer reviewed journals that do not charge authors or libraries do not differ from other scholarly publications in the field and are subject to the same scrutiny as

subscription publishers would be. Libraries are free to add them to collections, readers find them on the internet, and authors are able to publish without securing funding or paying fees. Open access journals are included in all major abstracting and indexing services as long as they reach the benchmarks for quality set out by coverage teams responsible for content at the database producers. Library collections also strive to include openly accessible scholarly content. A quick look at the WorldCat database (https://www.worldcat.org/) shows that more than 500 libraries have added *PCSP* to their collections, demonstrating a significant global reach for this openly accessible peer-reviewed psychology journal.

For psychology researchers, granting agencies may now have new rules that about the expectation of open access for the articles and data that emanate from funded research. Researchers need to understand the various fees and licensing rules that their eventual publications must take into account in order to comply with funder policies. Many funders pay for the cost of publishing either directly through a line item in grants (as does Wellcome Trust) or in some cases, the funders actually publish the journal, as is the case with the journal *eLife*. In an interesting development, funders are now also publishers. *eLife,* an open access biomedical and life science journal is actually published by the funders Howard Hughes Medical Institute, Max Planck Society, and Wellcome Trust. *eLife*, from its founding in 2012 to 2017 did not charge authors fees to publish, but has picked up traction and in February, 2017, began instituting an APC of 2500 USD. This approach was always part of eLife's plan for sustainability in the open access market. (Butler, 2016)

Wellcome Trust has an open access policy for the research that they fund, and they provide funds to cover article processing charges. All Wellcome-funded articles must be made available in open repositories. (Nosek & Bar-Anan, 2012) Wellcome also requires the use of liberal licenses on the paid up articles, using the CC-BY license, which even allows downstream commercial reuse. (Wellcome, 2017a) Going forward, after April, 2017, Wellcome-funded papers must be published in journals that comply with the new requirements (for licensing and deposit in repositories). The list of those publishers that are compliant with Wellcome rules include major psychology publishers such as the American Psychological Association (APA). (Wellcome, 2017b)

An example of a private funder with an open access policy that will pay APCs is the Bill & Melinda Gates Foundation, which also requires *final publisher versions* of articles supported by their funds to be made openly available at the time of publication. Interestingly, while an embargo period of 12 months on any paper was allowed between 2015 and 2017, after 2017, papers (and data) must be made available immediately. The Gates Open Access Policy also requires the use of the CC-BY license on the article and stipulates that all data that underlies the article also be made open access. (Bill & Melinda Gates Foundation, 2016) Some publishers have had issues with this kind of policy, especially those from funders that do not allow embargoes (delays) on articles that report research that they've funded. Some publishers, like the American Association for the Advancement of Science (AAAS) and its flagship journal *Science* announced special accommodations for working with Gates as some of the funder's stipulations present challenges for this publisher and a few others. Gates signed on to pay AAAS a fixed sum

of money (100,000 USD) for the first year (2017) of the pilot in order to pay for open access publication of Gates-funded articles. (Van Noorden, 2017) The Gates/AAAS pilot ended in June, 2018 after 26 papers (more may appear) had been published in 18 months (16 in the first pilot year). (Van Noorden, 2018) Obviously, the per article APC paid to AAAS was significant.

Many authors that choose an open access journal (or want to use a hybrid option in a subscription journal that is already monetized by subscription revenue) are faced with the need to pay an APC in order to publish. APCs range from very small amounts to 5,000 USD or more per article. The cost of APCs is all over the map and there seems no standard fee. For instance, the OA publisher Frontiers raised its APC for its title, *Frontiers in Psychology* from 2490 USD to 2950 USD in one year (2017-2018), an increase of 18%. (Morrison, 2018) In order to pay APCs, authors may be able to use existing grant money, apply to departments or research offices, or request a waiver from the publisher. Waivers are no longer as available as they once were for most authors, with the exception of some authors from low-and middle-income countries. (Lawson, 2015) Universities have, in many cases, instituted special funds (often referred to as OA Funds) to which authors can apply to receive funds to pay APCs for article publication. Whether an individual institution is a signatory of the principles of a solution like COPE (Compact for Open Access Publishing Equity), or has developed another type of fund to assist authors in paying APCs, this is another avenue for institutions can support faculty authors that don't have grant funding to facilitate the funding of individual open access articles. Some publishers will also point authors to lists of available university-based funds. Many of these funds set up to assist authors with paying APCs do not fund articles published in hybrid journals, instead they are more apt to pay for the APCs of fully open access journals where, without assistance, the university's authors would not be able to publish at all in the journal of their choice. Most hybrid journals offer authors of accepted articles a choice of traditional publishing or the use of the open access option via the payment of the APC. A comprehensive list of university-based OA funds is available from SPARC (Scholarly Publishing and Academic Resources Coalition). (SPARC, 2017)

Subscription or Traditional Journal Publishing in Psychology

Even though open access publishing is growing, there are of course, many other ways that scholarly content is disseminated, including the traditional subscription route where costs are borne by libraries and their institutions. Today, articles are also sold by publishers in a pay per view environment where readers can "pay by the drink." Familiar to researchers is the "paywall" that is encountered when the reader is asked to pay a fee to read or download the article, sometimes for a specified period of hours. In many ways, the paywall issue has fueled the open access movement because many readers cannot pay to read an article, especially because the buyer does not really know whether the article will even be useful at the point of discovery. If an article is not needed, there is no return policy. Some journals are also monetized by advertising revenue, but that model is not widespread in psychology.

Libraries have always spent a great deal of staff time, besides the funding via subscription revenue, on making journal articles easily accessible to institutional affiliates, whether in the days of print volumes, or now online in PDF format. Large FTE (full time

equivalent number of faculty and students) institutions pay more, even as people wonder why the transition to electronic distribution did not mitigate some of the traditional costs that were inherent in the print-based system of production and distribution. Costs to libraries and institutions of the content from some commercial publishers are often deemed unsustainable. Libraries supporting open access initiatives via their institutional repositories end up carrying costs on both sides. They are usually the responsible party in their institutions for the infrastructure costs as well as the staffing needs that open access initiatives require. Some libraries also carry responsibility for administering and sometimes paying for the open access funds that assist authors with paying APCs. Universities passing open access policies and asking their libraries to implement them are considered to be signalling support for the added resources required to support the development and staffing of repository efforts and associated outreach. Open access outreach requires targeted and sustainable outreach over time by both user services librarians, and the technical services colleagues with whom they collaborate on open access initiatives. Because psychology research spans many fields and traditions, open access and open data efforts require discipline-based open access expertise in implementation efforts. Alongside this work, libraries must make available the journal, book and video collections required for researchers (or effective, seamless delivery mechanisms to ensure access to needed scholarly content). Adding financial support in some cases for open access funds that assist authors with paying article processing charges for open access (or sometimes hybrid) articles, and supporting efforts at building a community controlled (or community aligned) infrastructure to support green open access initiatives further adds costs to sometimes underresourced academic library systems. Libraries are paying for open access in support of a transition in the way scholarly communication happens in the future. Librarians are a natural fit for this work with their knowledge and expertise in scholarly publishing, collection development, deep engagement with disciplinary faculty and students, and experience in both collection development and user services in research libraries. Some library leaders have proposed plans for supporting this "transition to open" that would ask academic libraries to set aside a certain percentage of their budgets for support of an open community infrastructure that would be built and aid in the transformation of scholarly communication. Lewis (2017) proposed the "2.5% Commitment," where libraries would agree to the commitment that "every academic library should commit to contribute 2.5% of its total budget to support the common infrastructure needed to create the open scholarly commons." While this support could cause some stress for already burdened libraries, intense discussion has ensued around the necessity of libraries taking on responsibility for support for development of new scholarly communication paradigms by contributing financial backing for this commons.

The cost to library budgets via their institutions to at least one of the major commercial publishers, Elsevier, has been the focus of many protests. such as the Cost of Knowledge campaign and its "won't publish" (with Elsevier) petition. The Cost of Knowledge boycott was started by Cambridge mathematician Timothy Gowers in 2012 against Elsevier (http://thecostofknowledge.com/) and at the time of this writing (December, 2018) lists more than 17000 signatories who have agreed not to publish, do editorial work, or referee for Elsevier. The Cost of Knowledge was a protest against Elsevier's business practices, specifically high

subscription prices, the "big deal" business model, and the publisher's support for various legislative initiatives. (Gowers, 2012)

In an evaluation by Heyman et al. (2016) of the effect of that petition on the future publishing habits of the 16,000 that had signed the petition agreeing not to publish, a study of the signatories from Chemistry and Psychology (500 signatories each) demonstrated that 17% of the psychology authors that signed the petition then went on to publish with Elsevier in the four years following the initiation of the campaign. The study took into account factors that affect authors' decisions on where to publish, such as issues of author order. In psychology, first and last author may be "typically reserved for the lead investigator and the supervisor or department head." (p.2) The signatories in psychology may have been coauthors, and not in the position to choose the publication outlet. However, for Psychology, even of the 46% that had coauthors, 26% of signatories were first author and 26% were in the last author position. (Heyman, Moors, & Storms, 2016) It will be interesting to continue to watch how various actions by academics affect publishers (or whether they don't). It may seem that publishers are immune from this sort of action at this point, and they continue on without repercussions (except a temporary spate of negative publicity). These boycotts may not have had much of a real effect, particularly on the publisher's bottom line or rate of submissions from authors eager to publish in known high impact titles with name value.

A prominent example for psychological science is the petition and action aimed at the journal *Cognition*, an Elsevier journal ranked 11/85 in the Experimental Psychology category in the Journal Citation Reports (JCR) in terms of impact factor in 2015. With an article processing charge (APC) considered excessive by some levied at authors who want or need to make the publisher version of an article open access, those in the *Cognition* community started a petition to get that fee reduced by Elsevier. In addition, also at *Cognition*, there is a movement to require authors to make versions of articles (preprints and postprints) available "green" open access via author self-archiving in preprint servers such as PsyArXiv or presumably in open access institutional repositories that are available at most universities. Authors using a strategy for self-archiving also satisfy the requirements of institutional or funder OA policies. At *Cognition*, the journal is calling this new requirement, "Instant Open Archiving" and the practice is focusing on depositing and updating versions of preprints. (Barner, Levy, & Snedeker, 2016) This practice requires very little extra work on the part of the author and is a common part of self-archiving behavior of many authors of traditionally-published scholarly articles.

As the practices of some commercial publishers continue to raise the ire of researchers, along with boycotts of titles and other protest actions, some entire editorial boards have walked away from a publisher's title. One example is when the Elsevier journal *Lingua* saw its board leave, and ultimately form a new journal, *Glossa: A Journal of General Linguistics*, an open access journal published by OA publisher Ubiquity Press. Sometimes, what has occurred is that when the board leaves, the publisher just goes ahead and forms a new editorial board, keeping the journal it owns in publication and leaving the field with two journals where the older title still retains some name value. Both journals may continue successful publication in the field, with likely many readers unaware of the situation that transpired.

Recently, members of the European Society for Cognitive Psychology (ESCoP) learned that, rather than continue with the publication of their journal, *Journal of Cognitive Psychology (JCP)* (*formerly European Journal of Cognitive Psychology (EJCP)*), the society would start a new rigorously peer reviewed open access journal. *JCP* has been published by Taylor & Francis and the society wished to move toward more open access availability. It was not possible for the society to reach its open access goals by remaining with the current publisher. The journal will have reasonable publication charges and follows open science principles. (Mathot, 2016) Taylor & Francis was amenable to the journal's new open science policy, including that the society had proposed adoption of the Transparency and Openness Promotion (TOP) Guidelines and other measures, and offered the option of an annual open access supplement. After discussion, the executive committee of the ESCoP came to the conclusion that the compromises being offered did not jibe with the open access aspirations of the society for its journal, and the relationship with the publisher was severed. The new *Journal of Cognition (JoC)* took the place of the *Journal of Cognitive Psychology* as the official journal of the ESCoP. After April 1, 2017, the society owns the title (instead of a commercial publisher) and the full board of associate editors remains with the new title, which has a global focus, not a European one. (Hartsuiker & Morey, 2017) However, this is not the first time that an editorial board has walked away from a publisher and started a new open access journal, only to have the publisher, in this case, Taylor & Francis continue to own the former title. In these cases, the publisher develops a new editorial board and the former title continues to receive submissions and retain its place in the memories of many authors and readers. Those starting the new journal often wish a clean break and success for the new journal, but the old title still retains followers and reputation that may hinder evolution of the new title for some time.

Academic libraries, historically the places that have made scholarly journal content available to faculty, students and sometimes the public have struggled for some time with sustainability of the status quo. Accessing (and licensing) rather than owning and archiving material has often reached somewhat of a breaking point. Prices to universities for commercial publisher content, reported to reach millions (even as libraries fall under non-disclosure clauses about pricing) have resulted in strain and sometimes have necessitated major journal cancellation projects. Cancellation projects have become more difficult in recent years due to "big deal" bundling of content in packages. According to Nosek & Bar-Anan (2012):

> For example, subscriptions to Elsevier journals alone cost MIT $2 million per year (MIT Libraries, n.d.), Purdue $2.3 million per year (Westberg, 2012) and Washington University's School of Medicine $1 million per year ("The Elsevier Boycott," 2012). Cutting access to journals is a major cost savings. In 2010, institutions such as Georgia Tech, University of Washington, University of California San Francisco, and Oregon State have each dropped hundreds of subscriptions in order to save hundreds of thousands of dollars per year (Peine, 2011), at the cost of reducing their researchers' access to the literature. (p.228)

Major stressors in the system have included the unsustainable outlay of institutional funds for commercial journals, and "publish or perish" pressures that focus on journal impact factor for

authors choosing outlets for their best scholarship. Faculty need access to all major journals as well as the more niche titles that represent their subfields. Psychology faculty and researchers may not even realize that their sought-after high impact journals of choice for their publications are tied to commercial publishers with their associated higher prices for subscriptions, pay per view options, and author fees. For their part, libraries have made subscription content available remotely from the faculty laptop or other mobile device, and readers may have lost the connection between the library and the journal content. Some may ask, "why do we need a library anymore?" The library is the middleman but may struggle with relevance in terms of being the go to place for journal collections. That association of the reader of journal articles with the library may have been severed for most faculty and students at this point. The provision of seamless electronic access to the research literature, delivered on any device, at the point of need is a goal of academic libraries.

Some libraries that subscribe to commercial publishers' offerings have become more invested in making sure that their university's authors do not sign away copyright to those same publishers, preventing them in many cases from making versions of their articles immediately available from the institutional repository. Many libraries are using the Liblicense Model License in their negotiations with publishers in order to assert the right of university authors to have more rights to the content that they have produced and provided to the commercial publisher that is selling the same content back to the university at sometimes unsustainable prices. (Liblicense CRL, 2014) The license can set out expectations that the publisher will take a broader view that provides benefits to the author and institution (and possibly funder as well) that provided the content in the first place. This would include rights such as liberal self-archiving rights to deposit content in the institutional repository, for instance.

Major publishers of "must-have" journals bundle titles into packages, making cancellation of individual titles a challenge (or even impossible). Large science packages, the "big deals" may consume the library budget, causing concern and dismay among humanists and others about availability of monographs and single journal titles that often show lower use in today's usage numbers-driven assessment reports. In fact, by 2013, a study by Larivière et al. (2015) of 45 million papers indexed in in Web of Science from 1973-2013 demonstrated that five large commercial firms published 50% of scholarly papers, with the most consolidation seen in social sciences (70% of all papers from five publishers). In fact, in natural and medical sciences, Reed-Elsevier, Springer, and Wiley-Blackwell were named, and "three publishers account for more than 47% of all papers in 2013…" (p.3) The trend in the concentration of publishing in social sciences and humanities among a handful of publishers is even more pronounced. This increase in the proportion of scientific output from a few publishers has been driven by the creation of new journals and due to publisher acquisitions of established journals. For psychology, the study results were dramatic, "with the top five publishers increasing from 17% (of papers) in 1995 to 71% in 2013." (Larivière et al., 2015, p.7)

Commercial publishers do not have the same mission or motivations as the society publishers, and psychology's learned societies still have a very prominent place in the scientific communication system for the discipline. APA's mission and vision statement (from the current

strategic plan at http://www.apa.org/about/apa/strategic-plan/) includes the following, reiterating the organization's major importance for psychological scientists:

> The American Psychological Association aspires to excel as a valuable, effective and influential organization advancing psychology as a science, serving as: A uniting force for the discipline, the major catalyst for the stimulation, growth and dissemination of psychological science and practice, The primary resource for all psychologists….

Further (from the plan), in one of the goals of the organization, (Goal 3) the APA seeks to:

> increase recognition of psychology as a science. The APA's central role in positioning psychology as the science of behavior leads to increased public awareness of the benefits psychology brings to daily living. Enhance psychology's prominence as a core STEM (Science, Technology, Engineering and Mathematics) discipline… (American Psychological Association, 2016b)

The scientific publishing system has been dysfunctional for a long time, with university and funder budgets unable to keep up, while commercial publisher revenues continue to rise. As an example, the evolution of profits of Reed-Elsevier (looking at the 1991-2013 period) shows profit margins continuing to increase. For Elsevier's Scientific, Technical & Medical division in particular, the profit margin has remained strong over time, for instance increasing from 30.6% in 2006 to 38.9% in 2013. (Larivière et al., 2015) Other commercial publishers also enjoy healthy profit margins. In fact, the unsustainability of the system which librarians knew well, may have been the impetus for some librarians, lamenting the "serials crisis" to look for a future where open access would provide a potential solution for the inability of library budgets to keep up with annual subscription price increases. Along the way, the serials crisis became an early motivator, but not the only reason that many libraries, librarians and academic faculty became driven to embrace open access (particularly of the "green(repository)" model). As time has evolved, institutional repositories disseminate many open access versions of articles published by commercial publishers. The connection of open access with a solution to the "serials crisis" has evolved and the two are not conflated as often at this point in time.

For their part, some commercial publishers have diversified more by moving into development of other scholarly communication-related services like "research information systems" (known as RIS or CRIS) that provide a variety of research and reporting solutions for institutions (for example, Elsevier's Pure), or altmetrics tools (such as Elsevier's Plum Analytics), or citation management/collaboration products for researchers (such as Elsevier's Mendeley).

There have been many proposed solutions, some radical, to fix the situation with journal publishing. For now, a growing chorus of stakeholders has been discussing the potential "flip" of the system from the traditional, subscription, closed access model to a worldwide adoption of an author or funder-pays model. This worldwide flip, a disruption without precedent, is under intense discussion at present. The current landscape supports many types of publishing business models, from traditional to the most innovative, and the eventual end point remains to be seen. The possibility of a "flip" of the traditional system to a gold open access future has been

discussed in many sectors in recent years. The very future of scholarship seems at stake, but in this new situation, it seems likely that publishers will still retain a revenue stream that will sustain them. (Solomon, Laakso, & Björk, 2016) Summaries from industry market forecasting reports allude to the future trends expected of gold open access, paid by APCs. (Simba Information, 2016) In 2018, a press release from Simba Information that announced their report, Open Access Journal Publishing 2018-2022, stated that "once viewed as a threat by traditional journal publishers, the global push for open access (OA) to research papers has delivered a fast-growing revenue stream that will continue to scale upwards" and that since their first report on this topic in 2014, "we were decidedly less optimistic about open access publishing than we are today."

The success of the gold open access model, especially for the author pays model, will be contingent upon author attitudes toward this type of open access, how much authors are really willing to pay, and to what publishers. (Tenopir et al., 2016). The availability of funder support for APCs in all disciplines that have such support will also need to further evolve in order to assure funding for submitting authors. How quickly this largescale change in scholarly communication, from a mostly electronic traditional subscription model where libraries pay subscriptions to a new model where most scholarship is funded by authors via their granting agencies or their institutions (at least for the sciences) is in large part dependent on the choices authors make and the needs that they have to share their work with the public, with taxpayers, or much more widely with colleagues. A corollary question is whether authors will choose the most liberal reuse licenses (from Creative Commons) for their work or whether they will want to go with more restrictive permissions if allowed by funders and universities.

As the "big deals" evolve, discussions of what are referred to as "Read and Publish" models have been introduced. Some universities, consortia and even whole countries are exploring these models where "the 'Big Deal' license that bundles together access to a publisher's subscription content with the ability to publish openly through its journals without paying individual APCs" is a focus (initially due to Europe's funder mandates). (Schonfeld, 2018). In the U.S. in 2018, The University of California System (made up of 10 campuses and 100 libraries) entered into negotiations where UC stipulated that the 10 million USD annual fee paid to Elsevier for journal subscriptions would need to be renegotiated to also include open access to the works of the UC system's authors. This action was extremely high visibility due to the UC system's large (almost 10 percent of the U.S.) level of research output. (McKenzie, 2018) These read and publish agreements are examples of the transformation of the scholarly communication system as it continues to evolve into something decidedly different and hopefully less chaotic and complex. Studies of how this new publishing landscape will affect psychology researchers and their universities and funders will be advantageous in understanding how the discipline's literature (and other research outputs) will be affected.

Predatory Journals, Publishers and Conferences: A Growing Phenomenon, and the "Whitelists" that Assist Researchers with Vetting Journals

As open access articles proliferate, there are some that conflate open access publishing with the phenomenon of unscrupulous publishers. As more "predatory" (bogus, fake or

fraudulent) publishers and journals seeking submissions flood the inboxes of many academics, some attribute some of this growth to the rise of open access. Of course, there are many high status journals that are open access, some having the highest impact factors in their respective disciplines. It is not the business model of a journal but the quality of its articles, judged by the scientific community, that separates the wheat from the chaff. However, a recent concern has arisen that due to various factors inherent in the global scholarly communication system, some authors do, in fact, intentionally choose to publish in journals that have been labeled "predatory," even paying the usually lower APCs themselves, in order to get published. These articles are showing up in the search results of PubMed and other places online (and are cited in other studies), possibly affecting the quality and credibility of the scientific record. (Manca et al., 2017) It is not only the inexperienced author that may get caught up in fraudulent journals, but there have been reports of well-known researchers publishing their work in bogus or fake journals. There are various explanations for this, but it is unclear why experienced scholars would fall prey to predatory publishers. (Retraction Watch, 2016) As it does appear that some researchers are choosing to publish in these fraudulent outlets, maybe universities and research departments would be interested in this phenomenon. One recent study analyzes possible rewards for publishing in predatory journals. (Pyne, 2017)

The so-called predatory publishers often display distinguished editorial boards on their websites, when in fact board members may have no knowledge of their position at the journal. As of January, 2017 (when it ceased publication), there were more than 1000 of these publishers recorded on Beall's List, a service that tracked these journals and publishers. Some publishers may just be new, or from geographically underrepresented regions and may be trying to break into OA publishing, but the vast majority are scam publishers. There have been many attempts to demonstrate how these journals will publish just about anything. To demonstrate the lack of rigor of peer review in a wide cross-section of OA journals, Bohannon (2013) sent bogus papers, papers that should be easily identified as such to large numbers of open access journals, and had them accepted. (Bohannon, 2013) This sting operation, while somewhat controversial in its tactics, did point out a variety of nefarious business practices of many new bogus journals. This sting was followed by many others that showed similar results.

In order to get a handle on this situation, some fields have analyzed the predatory publishing landscape from a specific disciplinary perspective. Publishing lists of problem publishers for each field may serve as a means of warning for those scholars that may not be able to readily identify some of these publishers. As an example, in a study of predatory publishing in neuroscience and neurology, 87 so-called predatory journals were identified as currently active (in 2016) in neurosciences, and those journals published 2404 articles between 2012 and 2016. (Manca et al., 2017) One can assume that these articles are now finding their way into the scholarly record of neuroscience. It would be interesting to track the trajectory of these articles to see their eventual citation impact.

A recent example from psychology illustrates just how clever the spammers have become. In a discussion of the offerings of the bogus publisher, American Research Institute for

Policy Development and their title listed as *Journal of Psychology & Behavioral Science,* that title's location and description revealed the following:

> "…that address is also listed as the office for the *Journal of Psychology & Behavioral Science,* but it is the bogus version, also run by the ARIPD, and should not be confused with the real *Journal of Psychology & Behavioral Research*." Both fake journal URLs use the same format—an acronym for the journal immediately followed by "net.com" so be on the lookout for that elsewhere." (Weinberg, 2016)

Many faculty and other researchers in psychological science have likely received solicitations in recent years from the publisher, OMICS Group (or OMICS International). OMICS boasts a sizeable list of more than 700 open access journals, such as the title, *Journal of Psychology and Psychotherapy*. The OMICS website even includes a definition of the term "psychology" alongside its long list of psychology journal offerings. (OMICS International, 2017) However, OMICS now garners the distinction of being the first publisher to be sued by the U.S. Federal Trade Commission for fraudulent practices. (Federal Trade Commission, 2016)

Early career researchers or those from certain geographical locations may especially vulnerable to these schemes that offer to quickly publish an article in a scholarly-sounding journal, or to present a paper at a familiar-sounding disciplinary conference. There have been many online guides prepared around this topic to help researchers identify quality publication outlets for their work. One high profile initiative, the product of publisher's groups and other interested organizations is a useful checklist entitled "Think. Check. Submit" (https://thinkchecksubmit.org/) which provides helpful information that can be used by authors to avoid the so-called "predatory" publishers. This tool gives all authors some guidelines to follow as they seek to ensure that open access journals under consideration are credible.

Once there was money to be made from authors eager to publish or present their work at conferences, unscrupulous parties set up shop to collect that money as well. The phenomenon of fake/bogus conferences is also growing and many psychology researchers at all stages of their careers have likely been invited to present at meetings that may even have names very similar to well-regarded conferences. Researchers eager to present their work may fall prey to conferences that either do not really happen, or are not credible. (Asadi, Rahbar, Rezvani, & Asadi, 2017)

It has been stated that "open access" is the reason for the exponential growth of predatory publishers, journal, and conferences. While open access is now a popular business model, used in various ways by all types of credible publishers, it should not be conflated with the use of the internet for publication schemes that are fraudulent. In every discipline and field, researchers need to be aware of the situation. Conflating open access with predatory publishing muddies the waters as scientific publishing is moving forward using open access methods of different types. Open access is a business model here to stay, so a more constructive strategy may be to make sure all available vetting tools are available in the OA landscape. Instead of using "blacklists," researchers will need to avail themselves of whitelists which contain credible lists of vetted open access journals in every field. One example is the Directory of Open Access Journals (DOAJ), which in September 2018 listed 240 journals in the category of Psychology (and more than

55,500 psychology articles). (Directory of Open Access Journals (DOAJ), 2017a) Another entrant into this space is The Journal Blacklist from Cabell's International. This database is likely not widely known as it is a subscription database only available in some libraries. (https://www2.cabells.com/about-blacklist)

Major Online Indexes for Open Access Journals and Articles in Psychology

The Directory of Open Access Journals (DOAJ) is a major index for fully open access journals and articles. This index, a major arbiter of quality for open access journals from around the world does exclude journals and articles that use embargoes (delays on publication) and those that employ the hybrid model (where only some articles in a journal have been paid up to be open access). This index has become a major source of open access content (journals as well as articles) and is included in many library catalogs and discovery systems. DOAJ also functions as somewhat of a whitelist for open access journals, especially since it required all journals to resubmit extensive information about a lengthy list of publishing practices in order to make sure each title reached the more stringent benchmarks for coverage in the index. As of March 2015, the index had winnowed down its list of included titles due to this quality assurance process, and from then on, all newly submitted journals to DOAJ had to attain certain specific characteristics in order to qualify for inclusion. The quality vetting process includes analyzing each open access journal for peer review process, copyright, plans for access by users, revenue sources, archiving plan, and more. DOAJ completed its reapplication process in December, 2017, with all included journals having reapplied to be included in the index. DOAJ can now be considered as a whitelist of fully open access journals. DOAJ carefully analyzed 6359 reapplications and 2058 were rejected, along with removing 2860 journals during this process because they did not reapply for inclusion. This entire process removed 40% of all journals in the database. (Directory of Open Access Journals (DOAJ), 2017b)

The major index, one probably found in all academic libraries (with all of its journal coverage vetted) for search and discovery of the scholarly literature in psychology is PsycINFO (produced by the American Psychological Association). Any journal seeking coverage by PsycINFO must meet strict criteria for inclusion. PsycINFO is likely one of the most recognized and popular resources in any academic library. It was produced in print (as Psychological Abstracts) for 80 years (from 1927-2006) and so has a long history as a resource for those looking for trusted scholarly articles in psychology. PsycINFO may now be utilized as well as a whitelist for psychology journals, and adds value by indexing all quality journal titles that meet its coverage criteria regardless of business model employed by the journal publisher. Open access journals listed in PsycINFO are searchable alongside subscription journal content and all are chosen after a rigorous application process (using published criteria) for relevance to the disciplines covered, scope, peer review, quality of publication practices and more. (American Psychological Association (APA), 2017) Since many subscription journals include some author-pays articles in various issues (hybrid), those articles are also included in PsycINFO, and the index now includes an indicator that identifies this open access content, and articles are searchable by this filter. There are many open access journals that meet and even exceed these

coverage guidelines. As of June, 2017, PsycINFO included 190 fully open access journals in its coverage list, bringing added credibility and visibility to each of those titles.

More than ever in this time of information overload, there is value in having a vetted discipline-based abstracting and indexing service that uses human indexing and is responsive to the needs of researchers, searchers and authors. Looking at a very large scale international survey of discovery that looked at the trend from 2005-2015 demonstrates that the use of abstracting and indexing tools are still valued in psychology. (T. Gardner & Inger, 2016) Searchers find that some aspects of PsycINFO searching cannot be replicated easily by using other tools and methods. For example, searching for articles by type of methodology adds value for the searcher and offers a contrast to the scattershot discovery process that a Google or Google Scholar search provides. There are many options for those doing serious research in psychological science. Academic librarians and their libraries serve up the collections, tools and services that facilitate research, and many libraries do include Google Scholar and other free tools as part of their suite of offerings. Besides PsycINFO, there are many library subscription databases (as well as freely available indexes (such as PubMed) that index psychology content. Academic and research libraries usually pull these resources together in subject lists of databases that are accessed on site or remotely by university affiliates and sometimes also on site by the general public. All of these indexes would include access to a subject-based corpus of open access journal article content.

There are other sources that psychology researchers can use to vet journals for quality. Examples would be the publishers that are listed as members on the websites of the Open Access Scholarly Publishers Association (OASPA), the Committee on Publication Ethics (COPE), and the World Association of Medical Editors (WAME). According to the OASPA website, these three organizations "have collaborated in an effort to identify principles of transparency and best practice for scholarly publications and to clarify that these principles form part of the criteria on which membership applications will be evaluated." (Redhead, 2013) Interestingly, at present, there have been so many recent requests for membership that COPE has had to issue a statement that they need to suspend membership applications for a brief time because of volume. (Committee on Publication Ethics (COPE), 2017) Journals that have been added to research library collections or library discovery services have usually been vetted for appropriate quality before being added to collections. Coverage by Ulrichsweb: Global Serials Directory (www.ulrichsweb.com/), another library database that indicates peer review status of a journal title, and coverage in all major citation and subject indexes such as Web of Science, Scopus, and many others accessed via research libraries indicates a diligent vetting process.

A major search engine for open access content, one used widely by faculty, students, practitioners and public would be Google, or especially the heavily used Google Scholar. Google Scholar has become prominent in the landscape of search (including search that starts in a library), and even looking at a comparison with Google, "people working in psychology have a strong preference for Google Scholar." (T. Gardner & Inger, 2016) Google Scholar provides a cross-disciplinary search of open access content, offering a selection of available versions of articles. Much psychology content may be discovered via a search of Google Scholar. With all

available versions of an article displaying, searchers will be able to freely access the author's manuscript, or if they are affiliated with a subscribing institution, they will be able to click through to access the otherwise paywalled content. Thus, Google Scholar is an excellent search engine for searching for open access content, and for checking to see if a free version of a subscription article has been made available by its author. The size of Google Scholar is still unknown, frustrating attempts to compare it with other citation databases. Unlike PsycINFO, Google Scholar is not transparent about its coverage; for instance, about its criteria of what it deems "scholarly" is not available. In fact, a Google Scholar search will also turn up articles from all publishers, and those deemed bogus or fraudulent would be included in results as well. One negative aspect is that Google Scholar searches do return results including articles in so-called "predatory" journals, so the coverage is fairly comprehensive as far as all journals are concerned (without quality checks of any kind).

It would seem a positive development for new search services to provide good alternatives to the comprehensive and popular Google Scholar. It is estimated that Google Scholar indexes 87 percent of all of the scholarly papers on the web, and a rough estimate published in 2014 showed about 114 million English language papers published (with approximately 100 million indexed in Google Scholar). The same study estimated that one in four scholarly papers overall are freely and publicly available on the web. (Khabsa & Giles, 2014) It would seem to be important to include Google Scholar in any search for psychology content, particularly open access content. Use of Google Scholar has certainly become a quick shortcut and alternative to subscription databases for many searchers seeking scholarly articles from many sources, or free versions of peer reviewed articles that are otherwise not owned by libraries (or are behind publisher paywalls). Many libraries partner with, and include Google Scholar alongside all of the other indexes and databases available to users directly from the library website. Libraries partnering with Google Scholar facilitate seamless access to subscription full text content. The value of Google Scholar as a freely available and easy to use discovery mechanism as well as a portal to a vast open access content is an amazing value add to the scholarly communication system for psychology and all other disciplines.

For those seeking only openly available articles, there is no comprehensive solution for an article-based delivery system that would include *all* OA content. One category that is problematic for discovery in libraries and on the open web are the open access articles in "hybrid journals" that have been made open access individually as part of traditional subscription journals. These articles, having been made open access through payments by authors (or funders) appear alongside paywalled articles in subscription journals. It has been difficult to study these random open access articles in the usual discovery systems or search results due to a lack of consistency around clear identification of the open status of these articles. (Chumbe, MacLeod, & Kelly, 2015) There is also a decided lack of analysis as well as a lack of transparency that prevents researchers at this time from understanding the effect of hybrid publishing on the open access landscape overall, and especially its effect on scholarly communication in psychology. In one study of hybrid open access articles published from the year 2007 to 2013, there was a "strong sustained growth in the volume of articles published as hybrid OA…" (Laakso & Björk, 2016, p. 919) In this same study (of the hybrid OA journal article output for the major

commercial publishers) for the Scopus journal category, Psychology, Laakso & Björk reported numbers of articles made OA in hybrid journals as 19 in 2007 with a steady rise until 2013, when the category included 471 articles. Overall, Björk (2017) reports steady growth of numbers in this hybrid category, stating that "The number of journals offering the hybrid option has increased from around 2,000 in 2009 to almost 10,000 in 2016. The number of individual articles has in the same period grown from an estimated 8,000 in 2009 to 45,000 in 2016." (p.1)

Uptake of hybrid has not been high, but the majority of traditional journals, especially those published by commercial publishers now include some open access articles alongside closed access articles within the same issue. For instance, in psychology, open access articles funded by author (or funder, such as Gates) payments can be found among the articles listed in tables of contents from commercial subscription-based journals published by Elsevier, Wiley, SAGE, Taylor & Francis and others. These hybrid journal titles, funded mainly by subscription revenues, also have some author or funder-paid articles that are published open access within an issue. Many traditionally-published subscription journals now have a hybrid OA option. For example, the American Psychological Association has a hybrid option available for all of its subscription journals, and charges an APC of 3000 dollars per article to publish the final publisher branded version of the article OA within a regular issue. Authors choose the traditional publishing route, or the open access option, for each article. (http://www.apa.org/pubs/authors/open-access.aspx)

Concerns around double-dipping or the possibility that any single open access article may be paid for twice (by the subscriber and by the author) have been part of open access conversations. This has led to the advent of offsetting deals from commercial publishers anxious to allay any of these concerns about the monetization of any given article in a subscription issue. There is concern over the total cost of publication of a system that includes hybrid journal publication, and where universities and/or funders are paying for subscriptions as well as APCs. APCs for articles in hybrid journals also tend to be higher than fees for article publication in fully open access journals. Due to the concern over the double-dipping issue, many university funds do not pay APCs for articles published in hybrid journals. In the U.K., where there has been a concern over the "total cost of publication" issue which takes into account the hybrid journal publishing taking place by commercial publishers, there has been a move to establish principles for publishers and academic institutions for negotiations around these offset agreements with an aim to reduce the additional cost of publication that is occurring. (Guy & Holl, 2016)

Many institutional open access policies are misunderstood to require that every article be made open access, thereby requiring either publication in a fully open access journal that charges APCs or, in the case of an article being published in a traditional journal, the requirement to pay for this hybrid publication. Many U.S. institutional OA policies are focused instead around green open access, and as subscribers to the traditional journal literature, many institutions do not expect or desire that any author will pay that commercial publisher to make an article OA at the publisher site. This "green OA approach" also preserves academic freedom, allowing for authors to publish in the journal of their choice, whether closed or open access.

Academic freedom has arisen in discussions of new funder initiatives requiring open access to funded research. Looking at the open access landscape going forward in all disciplines that rely on grant funding, there will be more change and disruption as mandates increase in strength. It is becoming clear that funders' patience with paywalls, embargoes and other impediments to open access is running out. On September 4, 2018, Science Europe's open access consortium, COAlition S, made up of 13 research funders from 13 countries (supported by the European Commission and the European Research Council) launched the "Plan S" initiative. The Plan consists of one target and 10 principles with the stated goal of "full and immediate OA to research publications." (https://www.scienceeurope.org/coalition-s/) The Bill & Melinda Gates Foundation and Wellcome Trust signed on shortly after the initial announcement, and the conversation also quickly made its way from Europe to the U.S. This particular mandate, unlike others, does not offer accommodations for some of the usual requirements of subscription publishers. Plan S's key principle requires that "After 1 January 2020, scientific publications (based) on the research funded by public grants provided by national and European research councils and funding bodies, must be published in compliant Open Access journals or on compliant Open Access platforms." (https://www.scienceeurope.org/wp-content/uploads/2018/09/Plan_S.pdf)

The announcement goes on to describe the rest of the requirements, stating that funders and universities (not individual researchers) would pick up the cost of open access publication, that the principles would apply to monographs as well (although it is understood that this part would take more time), and that the hybrid model would be disallowed. There is also language that supports the development of repositories and open archives. There was immediate reaction from stakeholder communities, especially in regard to the strong open access position of Plan S, and its emphasis on author rights and fully compliant open licensing. When Plan S moves forward, certain impediments currently existing in the system, such as embargoes, double dipping via hybrid and the "one off" rules of certain publishers that are considered roadblocks to self-archiving of accepted manuscripts will no longer be allowed. While those that view open access to the results of research as a goal for the dissemination of scholarly works on a global scale were emboldened and excited by the unveiling of Plan S, there were also faculty members and other stakeholders that considered Plan S as an affront to academic freedom. Funders would stipulate that authors could not publish research results in some of the most impactful journal titles (and highly regarded society titles), thereby potentially disadvantaging those authors from career advancement, awards or other aspects of the prestige economy. In a November 5, 2018 published letter entitled "Reaction of Researchers to Plan S; Too far, too risky: An Open Letter from Researchers to European Funding Agencies, Academies, Universities, Research Institutions, and Decision Makers" (https://zenodo.org/record/1477914#.W-9SWeJRdPY), about 800 scientists (as of November, 2018) laid out their concerns, such as the negative effect on learned societies that would occur if hybrid journals were banned as publication outlets, support of fully OA journals likely increasing the costs of the system, issues of the use of the liberal CC-BY license for every article, the too narrow mechanism required by the funders to achieve OA ("journals route only"), issues of preprints, and disciplinary differences in OA culture. (Rabesandratana, 2018) Another letter with hundreds of signatures from supportive academics and other open access advocates followed the earlier letter that opposed Plan S.

(http://michaeleisen.org/petition/signatures.php) A strong statement of support and an implementation plan was the response to Plan S from the Fair Open Access Alliance (FOAA). https://www.fairopenaccess.org/wp-content/uploads/2018/10/Fair-Open-Access-Alliance-recommendations-Plan-S.pdf/.   FOAA, which includes member, Psychology in Open Access (PsyOA), is described as "facilitating conversion to fair open access of journals in psychology." (http://psyoa.org/)

The development and implementation of Plan S may signal somewhat of a tipping point for the change to a different kind of future for scholarly communication, with open access to publications and to other research outputs now an expectation for research funding. The funders may increasingly make the open access rules, and publishers will need to adapt or risk losing funded authors. This potentially large disruption to the status quo will indeed include the major and minor publishers of psychological science research.

Open Access "Mega-Journals" (OAMJs) and their Significance to Scientific Communication in Psychology

The future of the traditional journal is not clear, and there are many concerns relating to the sustainability of societies and other factors closely tied to scholarly publishing. The very future of journals has been a question as "'nobody reads journals,' says science publisher Vitek Tracz, who has made a fortune from journals. 'People read papers.'" (Rabesandratana, 2013, p.66) Clearly, article-level discovery is here to stay, evidenced by popularity of the open access mega-journals (OAMJs) like *PLOS ONE* and Springer Nature's *Scientific Reports* which publish thousands of articles in a single issue each year, all discoverable via Google Scholar and other search engines, and all open access.

In fact, contrary to many disciplines where commercial publishers are publishing much of the literature, the proportion of the biomedical literature has actually declined in recent years due to author traffic moving to some of the mega-journals, particularly in the case of *PLOS ONE*, which published more than 30,000 articles in one issue per year. (Larivière et al., 2015). There is likely no denial that the open access mega-journals, beginning with the introduction of *PLOS ONE* in 2006 have disrupted scholarly journal publishing's "business as usual." With thousands of articles per issue, a business model funded solely by article processing charges (APCs) that may be considered "reasonable" (at least in comparison to commercial publisher APCs), and most importantly, a peer review model that only reviews for technical and scientific soundness rather than the more traditional peer review system that is utilized by high impact disciplinary journals. OAMJs also cover a wide span of subject areas in each annual issue rather than a focusing on any specific disciplinary or subfield niche. Popular examples well known to psychological scientists are *PLOS ONE*, *SAGE Open*, Nature's *Scientific Reports*, *F1000 Research* (known for post-publication reviewing) and others. Collectively, the OAMJs flood the internet with many thousands of research articles, all open access, each year. This leads to rapid dissemination of current scientific research on the internet, all optimized for article-level delivery. One study reporting sheer volume and growth of numbers of articles published each year showed that in a sample of 11 OAMJs, 44,820 articles were published in 2015, an increase of 15% over the 2014 figure (33,995)-a figure representing 2.5% of all 2015 articles indexed in

Elsevier's Scopus database. *PLOS ONE's* output is by far the highest in the category, while *Scientific Reports* is second in production. These were the only two OAMJs publishing more than 10,000 articles in 2015 alone. Certain of the OAMJs are more popular in one geographic region or another, for instance, demonstrating that there are distinctive characteristics to each of these publication outlets. (Wakeling et al., 2016)

A search of Google Scholar (for those unaffiliated with a university's databases), or a search of any subscription subject (or citation) database will include results from OAMJs. The formal citation impact of OAMJs (as compared with traditional journals) will need continuing study over the coming years; some early analyses are available now. In terms of citation studies, outside of the elite journals, it appears that the OAMJs may be performing similarly to traditional journals in the same impact factor range, less vigorous peer review notwithstanding. This could demonstrate that it is possible for OAMJs to achieve similar citation patterns using a very different system of peer review (reviewing only for scientific soundness and not eventual contribution to science). (Björk & Catani, 2016) With the major difference likely to be how promotion and tenure committees or national research assessment systems view the peer review status of the OAMJs, this phenomenon is here to stay. While some may have used the term "peer review lite" to initially describe how the OAMJs' systems differ, it may not be well known that the peer review performed, for instance by PLOS ONE (after a paper passes a quality control check and the paper is assigned to an Academic Editor with relevant expertise), that "The majority of PLOS ONE submissions are evaluated by 2 external reviewers, but it is up to the Academic Editor to determine the number of reviews required." (PLOS ONE, 2017a)

The newer type of peer review employed by the OAMJs where papers are reviewed for technical soundness (but not beyond that threshold) has caused some added focus on the aforementioned issue of cascading peer review, especially as used by larger publishing firms that may be rejecting many otherwise good quality papers from elite titles with low acceptance rates. Studies have shown that many rejected papers find a home in the same publisher's OAMJ (but this practice is not exclusive to OAMJs), and that option to move the paper to the OAMJ is presented at the time of the rejection. (Spezi et al., 2017) Average acceptance rates for OAMJs are often reported to be significantly higher than for traditional subscription publications. (Sugimoto, Larivière, Ni, & Cronin, 2013) Journal Impact Factor (JIF) and acceptance rate are still values that may matter when conferring prestige on all scholarly journal titles. The OAMJs are no different, with widely differing impact factors and other characteristics that distinguish one from another.

There are not many sources that compare acceptance rates among journals (or publishers) in psychology. A directory available at some academic libraries in print some years ago, Cabell's Directory of Publishing Opportunities in Psychology and Psychiatry contained analytical information on psychology journals. That print product is now subsumed into a database that covers 18 disciplines (including Psychology) that is able to compare and contrast hundreds of psychology journals by various factors, including acceptance rate. Acceptance rates are used, (along with Journal Impact Factor) by many in academia as proxy for quality and elite status. Using Cabell's data, it has been reported that open access journals in the psychology category

(not only the OAMJs) have significantly higher acceptance rates than non-open access journals listed in Cabell's. *PLOS ONE*, for instance, reported an acceptance rate of about 69% in 2012 (Sugimoto et al., 2013) and in 2017, reports an acceptance rate of about 50%. (McCook, 2017) By comparison with the traditionally "elite" journals that are thought to rise above the rest in the general/multidisciplinary category, AAAS's *Science* reports a rejection rate around 93%. (Larivière, Lozano, & Gingras, 2014) Before the phenomenon of OAMJs entered the landscape, it was once reported that rejection rates were very high for psychology authors, approaching 70-80%. (Adair & Vohra, 2003) In comparison, rates are lower for biology (50%) or physical sciences (20%), and rejection rates were also predictive of citation rates. Historically, articles in the Experimental category enjoyed lower rejection rates and had a higher impact according to Social Sciences Citation Index. (Rotton, Levitt, & Foos, 1993)

It has been difficult for various reasons to ascertain how the OAMJs such as *PLOS ONE* or *Scientific Reports* represent research literature in the various fields of psychology. Thus, it is not possible at this time to provide granular information on how these publications may or may not be affecting the dissemination of research results in psychology, especially how psychology would be represented in subject classifications focused on "science and medicine" or "biology and life sciences." Each of the OAMJs seems to have a different disciplinary focus (even though they are all multi-field publications. One journal, *SAGE Open*, was an important entrant in the field of OAMJs, as it focused on covering more of the social sciences and the humanities with an accessible publishing model and very reasonable APC (even for those without funding). Authors without funding could often afford a low APC (if that were an option) and would also be able to choose an open access journal option from a familiar publisher. *SAGE Open* (in 2015) had published 15.1% of its articles under the category of "psychology." However, *PLOS ONE*, in the same year published almost 5000 articles in the "social sciences" category. For *PLOS ONE*, in 2015, 94.6% of articles were assigned the PLOS subject category of "Biology and Life Sciences." In a comparison of *PLOS ONE* and Springer Nature's *Scientific Reports* using "proportion of journals citing the two largest OAMJs," *PLOS ONE* had a higher percentage of articles in the Scopus "Psychology" category than did *Scientific Reports* (which focuses much more on physical sciences). (Wakeling et al., 2016) *SAGE Open* (launched by SAGE Publishing in 2010) publishes all articles open access with reasonable fees, but also follows a model that works well for green open access institutional repository efforts. *Sage Open's* options allow for the needs of authors and universities. Currently, SAGE Open is moving into publishing open access monographs on its platform as part of the program "SAGE Open Long Form." SAGE will charge a reasonable book publishing charge (BPC) and the monographs will be published with the liberal CC-BY license.

Further comparisons between *PLOS ONE* and *Scientific Reports* demonstrate that both charge what would likely be considered "reasonable" article processing charges with *PLOS ONE's* APC at 1595 USD and *Scientific Reports'* (APC) at 1790 USD as of January, 2019. However, there are some subtle (or not so subtle) differences. In 2015, the Journal Impact Factor for *Scientific Reports* was reported as 5.228 while *PLOS ONE's* was listed at 3.057. Similar data in Journal Citation Reports for 2017 reports Journal Impact Factor for *Scientific Reports* at 4.122 and *PLOS ONE* at 2.766. *PLOS ONE's* strict open data policy may be an issue, and *Scientific*

Reports' policy might be seen by some as less onerous because it only asks that authors share data *upon request*, rather than having data availability as a requirement (except in rare exceptions). There also appears to be a slightly faster time to publication for *Scientific Reports*. These two journals appear destined for comparison and are obviously both important to psychological science. Whereas Springer Nature has a large stable of other subscription and gold open access journals surrounding its *Scientific Reports*, the PLOS journals are monetized strictly by APCs, with 91% of all PLOS papers published in 2015 found in *PLOS ONE*. Only 9% of articles were split among six other PLOS titles. (Davis, 2016) In 2017, PLOS published 7% fewer papers, and in 2018, publication output was down another 11%. Also, in 2017, *Scientific Reports* "overtook *PLOS ONE* as the largest scientific journal." (Davis, 2018) Do the OAMJ's have any dilution effect on the available disciplinary journals? Clearly, the open access mega-journals are a phenomenon to watch when it comes to scholarly communication in psychology.

An Evolving Funder Environment Requiring More Open Access Compliance

In recent years, funders in the United States and abroad began to mandate that the products of scholarship resulting from taxpayer funded research be made publicly available. Beginning with the NIH in (2005) and culminating in 2013 in the U.S. with the White House Directive (also known as the Obama Directive), the federal funder situation has evolved to encompass any U.S. federal agency that distributes more than 100 million dollars in research and development funding each year. (Stebbins, 2013) The list of these U.S. funders is lengthy and includes funders that have not previously dealt much with open access, including the various issues surrounding green open access and repositories. There was some scrambling for agencies to get up to speed by deadline. Publishers moved quickly to develop the CHORUS service which focuses on solutions for funder compliance. CHORUS has more than 100 members and signatories including the American Psychological Association and the Association for Psychological Science. (CHOR, 2017) At almost the same time, a university solution (SHARE) focused more on institutional repository self-archiving (green OA) was being developed to include a notifications service when a research output was made available. (http://www.arl.org/focus-areas/shared-access-research-ecosystem-share#.Wx2anyAh1PZ)

Many of the large U.S. federal funders currently under the directive are supporting psychology research. The monthly newsletter of the APA Science Directorate has listings of current funding opportunities available in psychology. (Directorate, 2017) Also, the database Grants.gov is a searchable resource useful for discovery of psychology grant opportunities. On these lists, common funders include National Science Foundation (NSF), National Institutes of Health (NIH), Department of Health & Human Services (DHHS), and Department of Defense (DOD). These agencies are all examples of the lengthy new list of funders that have new rules with regard to open access availability for publications and data with which authors of the scholarly literature must comply. A comprehensive list of these new federal funders' open access requirements with links to their implementation plans may be found at

http://datasharing.sparcopen.org/

Not only U.S. federal funders, but also private funders are developing more robust open access requirements as a condition of funding. Where data policies and open access mandates used a strategy of positive encouragement in the past that was not focused on compliance, more funders are moving to penalize researchers or institutions that do not comply. This has resulted in increased compliance and more open data, but there is still room for improvement. NIH and Wellcome Trust have both withheld funding from those that have not complied with the open access policies of the funders for previous work. (Van Noorden, 2014a) Compliance is not a given, even with policies having more "teeth." With more and more funders, both in the U.S. and abroad mandating that the publications and data emanating from funded research be open access, there is at least one study of more than 1.3 million articles whose open access status has been analyzed to determine whether these publications have actually been made OA as required by their funders. Larivière and Sugimoto (2018) were able to demonstrate that rates of compliance with OA rules (for 12 selected funding agencies), even within psychology (p.484), for instance, "vary greatly by funder." (p. 483) While some disciplines reach nearly full compliance (as seen in biomedicine, clinical medicine and health research), other discipline's rates of compliance are much lower. As for lower rates of compliance, "although researchers cite norms and needs within disciplines as a reason not to comply with open-access mandates, we believe that the funding agency is a stronger driver of open access than is the culture of any particular discipline." (p. 483) More study is needed to understand how (and how often) funded research is being made OA (as mandated) in psychology.

Researchers seeking funds from certain U.S. federal funders will need to make plans up front for complying with the new open access rules. The Obama directive was followed up in 2015 by a letter sent to all research offices of the Association of American Universities (AAU) and Association of Public and Land-grant Institutions (APLU) which stipulated that research data must be made publicly available (to the extent possible) and offered advice to universities on compliance with new rules. (Vaughn, 2015) Adding open access to research data to the previous focus on text publications was a game-changer for authors, publishers and universities. Member universities had to grapple with the research data management issue more seriously and monitor compliance at the local level. A focus on the research data that underpins published scholarship is a foundation of open science. This new directive (and other follow on initiatives) promises to continue to open up the psychology literature to researchers as well as the public (and more of the practitioner community) that needs access to it. For psychology, there is a need to ensure that research data is openly available online for reuse and replication of studies (within certain parameters of course). One issue with which psychology grapples involves problems with replication and reproducibility of research results (both publications and data). Opening up research data for innovation and reuse will add needed transparency to future research. This is an area of scholarly communication that needs to evolve in order to add clarity around privacy issues, data citation practices, and licensing of data.

Another aspect of open access and open licensing involves use of the research literature itself as the object of study. Sarma (2017) goes on to:

use the phrase *scientific literature text mining* to refer to data analysis of the scientific corpus, rather than the data sets that are produced by research studies. One can think of scientific literature text mining as representing a full-fledged generalization of review articles, systematic reviews, and meta-analyses whereby sophisticated tools from the modern data science toolkit are utilized to extract novel insights from the scientific corpus itself. (p.2)

Each discipline will have different practices in aspects of public and open access to research data, and the psychological science community will develop and share best practices in this dynamic new area. Universities and researchers are partnering with commercial and nonprofit data management services (such as figshare, https://figshare.com/), as well as a variety of domain and institutional repositories (such as Inter-university Consortium for Political and Social Research (ICPSR)) and local university repositories) to develop solutions for archiving of data as required by funders, some putting a focus the entire lifecycle of the data. (Inter-university Consortium for Political and Social Research (ICPSR), 2017) The need for information and assistance in preparing research data management plans is going to become more necessary as more funders require them. Writing data management plans may be new to many researchers and many university libraries and research offices provide guidance and services in this area. This is skill set that will need to be added to scholarly communication education for researchers. A useful addition to the literature would be discipline-specific information on writing data management plans for psychological science, but there are some general guides available in the literature that provide tips for novices to the process. (Michener, 2015) One useful book with practical information for psychology is *Managing your Research Data and Documentation* by Berenson (2018).

Many universities (usually via their libraries) are utilizing their institutional repositories to share, store and preserve research data. These digital institutional repositories have a mission of gathering, preserving and disseminating institutional scholarship and are able to ensure the availability of research data over time. Institutional repositories can link text publications and other research products to any supplemental and/or underlying data. Universities may one day decide that rather than just focusing on institutional open access policies that mandate public access to publications such as peer-reviewed article scholarship, that the research data produced at the institution must be publicly accessible on the internet for proof of funder compliance as well as for increased visibility and for demonstrating institutional impact. It is question open for discussion as to why universities have moved to develop open access policies that target publications, but they have not yet developed similar policies around curating and preserving the research data that emanates from funded research. Developing such policies would allow more focus on the development of university solutions for managing and preserving faculty and student research data, while ensuring university compliance with funder policies stipulating open data. The university is responsible for ensuring compliance (rather than the PI in most cases) and faculty and other researchers are in need of services and solutions for managing research data. University policies around research data would raise visibility of the need for discipline-based university-provided in house or outsourced solutions (such as development of appropriate platforms and repository services) for the complex area of research data management.

There is a large volume of studies that show that the research impact of scholarly publications is increased via open access. (SPARC Europe, 2015) Recent studies also show a citation advantage for sharing data as well. (Piwowar & Vision, 2013). Other universities do not necessarily focus on their institutional repository solutions, but instead have developed a suite of services (often as part of the library) that includes assistance with use of research data management tools and services such as the popular free, open source DMPTool (https://dmptool.org/) that has been used by many thousands of researchers to create data management plans.

Data policies have also been developed by publishers. An early adopter that is home to many psychology-related articles, PLOS developed an open data policy in 2014. (Bloom, Ganley, & Winker, 2014). By 2016, 60,000 articles in the PLOS journals were sharing open data sets, and PLOS has made available some useful examples in an Open Data Collection. (Lowenberg, Ross, & Ganley, 2016) Where there are no data policies per se, some editors do not want to review papers where the data are not freely accessible. One high profile case for psychology involved a consulting editor for APA's *Journal of Experimental Psychology: Learning, Memory, and Cognition (*where there is no formal open data policy), making the decision to reject papers where data are not open, or there is no reason stated for the lack of transparency. (Naik, 2017) This reviewer, Gert Storms, is one of hundreds of signatories to the Peer Reviewers' Openness Initiative, which is a coalition of reviewers that agree that papers must have open underlying data (or provide specific information about why data can't be open) in order to proceed through peer review. (Morey et al., 2016) Ubiquity Press's *Journal of Open Psychology Data* (https://openpsychologydata.metajnl.com/) publishes "data papers," and describes those articles as "a publication that is designed to make other researchers aware of data that is of potential use to them for scientific and educational purposes." Each paper describes methods used to create the dataset, discusses reuse potential and provides a link to the data set in an online data repository. Research articles might refer readers to the complementary data paper. As this focus on open data evolves, publishers will need to provide clarity around issues of open and transparent data for studies where there are no privacy or other such concerns to prevent this. Open data is a major tenet of the emerging open science movement, and psychology, with its current focus on reproducibility, is on the forefront in the development of disciplinary policies, tools and practices. In fact, in a major new publication, *Open Science by Design: Realizing a Vision for 21st Century Research* (2018) from The National Academies Press mentions psychology as a major force for open science, stating "New standards for data and code sharing in fields such as biomedical research and psychology are making it easier for researchers to reproduce and replicate reported work, strengthening scientific rigor and reliability." (p. 1)

A relatively new concern for those producing and creating organization around research data, as well as for those researchers wanting to use the data of others is the climate of legal uncertainty and the many questions researchers may have about intellectual property rights as they relate to research data. Particularly, issues of copyright, trade secrets, patents and Creative Commons licensing all come into play. It is useful for all who deal with rights surrounding research data to have an understanding of the issues. Carroll's article analyzing the intellectual

property law that comes into play with sharing research data covers the issues well. (Carroll, 2015)

It may be difficult to find information on research data management that is specific to the discipline, and there cannot be a "one size fits all" approach to this topic. More information and published examples are needed about how research data is managed and curated in specific subfields. Specific strategies and practices would be welcomed, such as the Borghi and Van Gulick (2018) analysis of research data management practices and perceptions in the field of neuroimaging. Although best practices are developing, psychology is still a long way from realizing a high level of access to open data. Even though the funder environment and the culture of the discipline may be moving more toward "open" when it comes to data, managing, curating and preserving that data may be still a work in progress for the profession. A 2015 survey of faculty in all disciplines showed that 90 percent still manage their data on their own computer. (Wolff, Rod, & Schonfeld, 2016)

Research data management is complex in psychological science, but there are excellent examples of guidelines and specifications available for review by researchers and others interested in the development of appropriate programs. For example, the recent publication of recommendations from initiatives of the German Psychological Society (Deutsche Gesellschaft fur Psychologie, DGPs) sets out clear guidelines for managing research data that is specific to psychological science. Issues such as storage of primary data, clarifying what constitutes a "trustworthy data repository," the use of DOIs for identification of data, the need to request support from third party funders, data privacy and copyright, rights of data sharers (to use embargoes, for instance), and duties of the secondary users of data are covered. In terms of trusted repositories, solutions such as PsychData or a "developed university repository" are mentioned. (Schonbrodt, Gollwitzer, & Abele-Brehm, 2017) Those repositories that are able to fulfill 16 requirements may be assessed by experts and receive the "Data Seal of Approval" (https://www.datasealofapproval.org/en/) after a peer review process.

Open Access and Research/Citation Impact in Psychology

One issue that has persisted in terms of open access is the question of whether publishing openly increases the impact of scholarship. Many studies demonstrate that open access increases research impact, with only a very few studies refuting this assertion. (McKiernan et al., 2016) These studies are aggregated on a website produced by SPARC Europe entitled The Open Access Citation Advantage (OACA). (SPARC Europe, 2015)

In another large study completed in 2016 of 3.3 million papers published from 2007-2009 (and indexed in the Web of Science), it was demonstrated that not only is there a citation advantage due to open access, it is "green" open access (OA due to repository deposited versions of papers) that produced the maximum research impact. When broken down by discipline, "Psychology & Cognitive Sciences (with more than 70,000 papers studied) also showed this open access impact, with the most impact for green OA articles. Hybrid articles were not included in this study. In terms of traditionally published articles, "publishing in paywalled journals is the least impactful strategy overall." (Archambault, Cote, Struck, & Voorons, 2016)

In an earlier cross-disciplinary study (2005) of ten disciplines including psychology (replicating earlier studies of single disciplines), it was also found that making papers OA confers a citation advantage. All disciplines in this 2005 study showed an OA citation advantage, with psychology showing a 108% higher citation advantage for papers that are OA (in comparison to 36% for biology, for instance). (Hajjem, Harnad, & Gingras, 2005)

Researchers must take note of open access strategies that can produce the most citation advantage for their papers. Institutions may promote the deposit of all university-authored scholarship in the institutional repository via the passage of open access policies in order to, in part, maximize the impact of the collective scholarship of all of its researchers. Both individual faculty members as well as institutions benefit from passing open access policies and developing institutional repositories and associated services that promote maximal green open access.

For studies analyzing the open access citation or research advantage for monographs, no such aggregation of positive studies results as is available for articles. However, there have been some analyses and suggestions of how the book literature might be studied for impact, and even if online usage is positively affected and enhanced by open access, a citation advantage is more difficult to ascertain. (Snijder, 2016) Snijder also remarks on an issue that is starting to infiltrate academia, and that is the existence of a newer "audit culture" that attempts to assess productivity or research impact of university faculty:

Lastly, if the importance of bibliometric analysis as a proxy for research quality is growing, it is vital to understand if there are significant dissimilarities between articles and monographs. Identifying specific differences between journal articles and books and the factors that underlie these differences will enable a comparison of scholarly impact of monographs and articles based on sound principles. (p.1873)

The Clarivate Analytics-produced index, Book Citation Index (a part of the Web of Science Core Collection) includes citation information (including "cited reference searching" for books that were produced from 2005 to the present). As this corpus of material continues to develop, studies will likely analyze the citation patterns of books. As more fully open access books (that use book processing charges-BPCs) to fund publication are made available, it will be possible to consider metrics for books in the same way as for articles and conference proceedings. As far as OA citation advantage for books, in time there will be ways to quantitatively describe the impact of books because some commercial and other scholarly publishers (including university presses such as the Luminos platform from University of California Press, (https://www.luminosoa.org/)) are now moving to offering an open access "author pays" model that levies BPCs in order to publish. While BPC amounts vary tremendously, using the example of Luminos, "the baseline $15,000 publishing cost is broken down into manageable amounts for the researcher, the university, the library, and us." (https://www.luminosoa.org/site/for_authors/) Fees are certainly lower for nonprofit publishers than they are for commercial presses. Commercial publishers also charge BPCs in open access programs for books. It is early yet to see what kind of uptake and subsequent citation impact can be expected for the author pays book programs, especially at the high fees that some charge. Established university subvention and open access funds will find the high BPCs of the

commercial publishers challenging and it remains to be seen whether (and from where) other funding will be available to authors interested in providing wide OA to their books. A useful addition to guides for authors of books in psychology would be the creation of a list of potential funding sources where open access funding assistance could be sought. The situation with open access monographs is fast evolving, and the recent report from the British Academy for the Humanities and Social Sciences announcing that the UK Reference Exercise Framework (REF) in its 2027 iteration had included an intention to extend an open access requirement for articles to include those research outputs published in books or other long form scholarly works. (British Academy, 2018).

Many psychology researchers decide to submit chapters to edited books. Book chapters in edited works have often been problematic in terms of citation impact and discoverability and many are behind a paywall. Bishop (2012) described the situation in a blog post entitled "How to bury your academic writing." She describes the lack of citedness and visibility of book chapters and suggests that "researchers who write book chapters might as well bury the paper in a hole in their garden." (Bishop, 2012) Open access has been mentioned as one method that can be used to mitigate the visibility problem of chapters, particularly green open access. There are many considerations and strategies that might be used for ensuring more visibility for book chapters. (Dunleavy, 2017) As book chapters are still an important and valued vehicle in psychology, both authors and publishers may need to expend more effort on the discoverability of these works.

Even though not included in easily found sources of "rules" around self-archiving by authors in repositories (such as those found in SHERPA/RoMEO), publishers have taken note of the marketing effect of allowing single chapters to be self-archived in institutional repositories or scholarly networking services such as ResearchGate. Adding book chapters alongside other works in collections of articles in repositories allows these works to receive individual DOIs (assigned by the repository), and these persistent identifiers allow the chapters (especially if they don't already have an assigned DOI) to participate more fully in the article-level economy that is promoted by seamless linking on the internet. Chapters with associated DOIs also facilitate inclusion in services that take advantage of the DOI environment such as Google Scholar. Book chapters now appear in publicly available Google Scholar Metrics profiles alongside books. In one study of UK academics (using the LSE PPG dataset), it was shown that, in psychology, the proportion of total cites (from various sources) to UK book chapters published from 2010 to 2013 was 5.5% This same dataset showed that "book chapters are almost completely uncited in psychology and economics." (Bastow, 2014) The ability of book chapters to have a chance to perform in the same open access and citation impact environment as journal articles will be a game changer for publishers and authors seeking to bolster the situation for book chapters and the citations to them.

Replication and Reproducibility: Recent "Meta-research" Issues Important to Psychology

The evolving scientific discipline of "meta-research" is important and pertinent to the future of research in psychological science, and has as its purpose the improving and evaluation of research practices and scientific publication. Meta-research can be categorized into five major areas: Methods, Reporting, Reproducibility, Evaluation and Incentives, and those areas cover

"how to perform, communicate, verify, evaluate, and reward research." (Ioannidis, Fanelli, Dunne, & Goodman, 2015, p.2)

Surely some issues for scholarly communication in psychology surround the replication of research results. A novel and innovative study is often of more interest to an editor than a redo of previous research that sets out to provide evidence of reproducibility. The rise of open data practices in psychology holds promise for increasing the ability of scholars to replicate the scientific studies published by others. The availability of the data behind the research creates the transparency needed to ensure the validity and usefulness of research results. (McKiernan et al., 2016)

Replication studies have not been common in psychology. Today, those scientists wishing to undertake and discuss replication studies have more options than in the past, and can use blogs, preprint servers, and may decide to use a publication outlet that welcomes (and even solicits) replications, such as *F1000 Research* (with its Preclinical Reproducibility and Robustness channel) or Nature's *Scientific Data.* Psychology has an interesting example of collaboration and replication found in APS's *Perspectives on Psychological Science.* The publication seeks nominations for replication of influential articles and the original author is engaged with the scientists doing the replication, and offers perspective on the result. The final results are published as a type of article called a "Registered Replication Report" (RRR)" described at https://www.psychologicalscience.org/publications/replication. ("Go forth and replicate!," 2016)

In psychology, even fabrication of research results has been a topic in the news media. In recent years, as researchers pursue the question of replication and of reproducibility, there is not always an easy answer to getting at the "truth" of the findings. When popular outlets such as th*e New York Times* and *Scientific American* picked up on the study known as the *Reproducibility Project: Psychology* (Center for Open Science, 2016), of which the results and analysis was subsequently published in *Science* in 2015, many took notice and an article in Scientific American even labelled the issue "Psychology's Credibility Crisis." (Horgan, 2016)

The original 2015 article in *Science* by the Open Science Collaboration (OSC) stated that "we report a large-scale, collaborative effort to obtain an initial estimate of the reproducibility of psychological science." (Open Science Collaboration, 2015, p. aac4716-1) This study involved conducting replications of 100 studies in three psychology journals (*Psychological Science, Journal of Personality and Social Psychology, and Journal of Experimental Psychology: Learning, Memory and Cognition.)* and mainly covered the subdisciplines of cognitive and social-personality psychology. The researchers examined five indicators and OSC concluded in a 2015 research article summary that "a large portion of replications produced weaker evidence for the original findings despite using materials provided by the original authors, review in advance for methodological fidelity, and high statistical power to detect the original effect sizes." (p.943)

Some studies paint a more positive picture. In a study of 100 top psychology journals (using 5-year impact factor), Makel et al. provided an analysis of replications that showed a

replication rate of 1.07%. with an increasing number of replications being published over time. Results demonstrated that:

> contrary to previous findings in other fields, this study found that the majority of replications in psychology journals reported similar findings to their original studies (i.e., they were successful replications). However, replications were significantly less likely to be successful when there was no overlap in authorship between the original and replicating articles. (Makel, Plucker, & Hegarty, 2012, p.537)

Following the OSC study of reproducibility, in some areas of psychology, response was swift. In *Science*, a published comment that followed (Gilbert, King, Pettigrew, & Wilson, 2016, p.1037-b) insisted that "the data are consistent with the opposite conclusion, namely, that the reproducibility of psychological science is quite high" and that "OSC's data clearly provide no evidence for a 'replication crisis' in psychological science." *Science* went on to publish the original authors' response to that comment, concluding that "OSC2015 provides initial, not definitive, evidence-just like the original studies it replicated" (Anderson et al., 2016, p. 1037-c).

One study revisiting the results of the aforementioned Open Science Collaboration initiative, (Reproducibility Project: Psychology) listed "publication bias in the psychological literature" as one factor in the Project's "failure to replicate many target effects." Etz & Vandekerckhove (2016) explain that:

> We conclude that the apparent failure of the Reproducibility Project to replicate many target effects can be adequately explained by overestimation of effect sizes (or overestimation of evidence against the null hypothesis) due to small sample sizes and publication bias in the psychological literature. We further conclude that traditional sample sizes are insufficient and that a more widespread adoption of Bayesian methods is desirable. (p.1)

There are other factors affecting reproducibility, for instance small sample size and low power. Button et al., analyzing the situation for neuroscience, "show that the average statistical power of studies in the neurosciences is very low. The consequences of this include overestimates of effect size and low reproducibility of results." (Button et al., 2013, p. 365) Others concur that in the Reproducibility Project: Psychology's findings, various explanations, for instance, small sample size may account for some of the low level of replication found in this large-scale project, and that the headlines that result from such a study informing the scientific community about a "crisis in psychological science" may be unnecessarily alarmist. (Patil, Peng, & Leek, 2016) In fact, some feel that rather than a crisis, the last seven (or so) years of improvements that have followed the decades when experimental psychologists were largely unaware of the problems that existed with data collection and analysis can be looked at very positively. A series of important events that began in 2010-2012 created a level of large-scale awareness and a series of changes that can be said to have led to "psychology's renaissance." (Nelson, Simmons & Simonsohn, p. 512)

Errors in statistical calculations and reporting are also found in the psychology literature. Bakker & Wicherts (2011) present the results of a study and offer some ideas and recommendations that would help to remedy this situation:

> In order to study the prevalence, nature (direction), and causes of reporting errors in psychology, we checked the consistency of reported test statistics, degrees of freedom, and p values in a random sample of high- and low-impact psychology journals. In a second study, we established the generality of reporting errors in a random sample of recent psychological articles. Our results, on the basis of 281 articles, indicate that around 18% of statistical results in the psychological literature are incorrectly reported. (p. 666)

Recommendations for establishing best practices to reduce "misreporting of statistical errors" that followed the study include: the need to follow closely the rules for reporting as set out in the *Publication Manual of the American Psychological Association*, reiterating that "statistical results should be accompanied by effect sizes and CIs when possible," making sure the results are checked by both coauthors and reviewers, using "sound statistical reviewing," and not using the error prone copy/paste feature, and ensuring that all raw data is available. (Bakker & Wicherts, 2011, p.666)

Even with the publication of corrective guidelines about the use and misuse of p-values, for instance, by the American Statistical Association in 2016 (and many other such guidelines published over the years), the problems of "misuse of statistical procedures and poor methods has persisted and possibly grown. In fields such as psychology, neuroscience and medicine, practices that increase false discoveries remain not only common, but normative" (p.2) and that "many prominent researchers believe that as much as half of the scientific literature—not only in medicine, by also in psychology and other fields—may be wrong." (p.2) In fact, for many years (since early exhortations about increasing power published in 1962), studies in psychology have suffered consistently from low statistical power. (Smaldino & McElreath, 2016)

The prevalence of statistical reporting errors in articles in psychology journals has been studied by other researchers and shown to be high. (Nuijten, Hartgerink, van Assen, Epskamp, & Wicherts, 2015). The availability of helpful new automated tools that have been created in order to efficiently carry out the work of checking statistics comes with some notes of caution about effects on researcher and journal reputation. One of those tools is the free, open-source R package and web app, "statcheck" (http://statcheck.io.). Statcheck "automatically extracts reported statistical results from papers and recalculates *p*-values" and works very well for psychology because APA reporting style requires reporting statistics in a consistent manner (and accuracy of the tool is decreased for those statistics that do not conform to APA statistical reporting conventions). (Nuijten, 2018)

In a study using statcheck that included psychology articles from four major publishers (two others would not allow the text mining necessary to do the research) constituting more than 50,000 articles and approximately 700,000 statistical test results, Hartgerink (2016) explains that "this dataset of statistical results and accompanying metadata can be used to inspect if specific papers include potential statistical errors or for trends in statistical results over time." (p.2)

Following this extensive study of a large subset of the psychology literature, the results will be posted to PubPeer, "an online platform for post-publication peer review." (https://pubpeer.com/) This initiative to put all of the studies in PubPeer will open up all of the articles to scrutiny and possible correction if needed. So far, reaction from researchers has been mixed. Hartgerink suggests that publishers might want to run the statcheck algorithm on all papers before publishing. (Chawla, 2016a) There has been pushback against this use of PubPeer without having contacted authors, and also questions about the use of the statcheck algorithm. One German research society, the Deutsche Gesellschaft fur Psychologie (DGPs) has called for an end to this use of PubPeer (based on statcheck), citing concern for researcher reputation. (Chawla, 2016b) In another study of statcheck accuracy, Nuijten found "statcheck to be very effective at flagging inconsistencies and gross inconsistencies, with an overall accuracy of 96.2% to 99.9%." (Nuijten, 2018)

Following the aforementioned analysis on the reproducibility of the scientific literature in psychology (OSC), Baker (2016) reported on a *Nature* survey that returned 1576 responses on a questionnaire focused on whether scientists feel there is a crisis in reproducibility in research:

> The data reveal sometimes-contradictory attitudes towards reproducibility. Although 52% of those surveyed agree that there is a significant 'crisis' of reproducibility, less than 31% think that failure to reproduce published results means that the result is probably wrong, and most say that they still trust the published literature. (p.452)

The same survey also revealed that "more than 70% of researchers have tried and failed to reproduce another scientist's experiments, and more than half have failed to reproduce their own experiments." The survey also was focused on asking respondents to rate different approaches to improving reproducibility in science. (p.452)

In 2011, a proposal labeled "Simple Solution to the Problem of False-Positive Publications" that listed six possible requirements for researchers, and four guidelines for reviewers that could possibly be remedies for some of the issues facing psychological science research and publication was put forth. These six requirements encompassed rules around data collection and reporting of experimental conditions, for instance, while not imposing a burden. The guidelines for reviewers, among other recommendations, would ensure that the rules for accepted practice would be followed. (Simmons, Nelson, & Simonsohn, 2011)

A follow up survey of 1292 psychologists was undertaken to determine if they would support these requirements and guidelines, and in general, whether they were open to change. While psychologists were found to be open to change, a majority of respondents did not support having hard and fast rules based on some of the requirements as a condition of publication. Respondents did consider the requirements to be standards of good practice even if they did not support all of them as conditions of publication. One requirement, that "authors must report all experimental conditions, including failed manipulations" did receive majority support as a condition of publication. A reminder was also issued that any sort of standards affecting the publication process must take into account the wide variety and diversity of psychological science research. (Fuchs, Jenny, & Fiedler, 2012)

Outside of current studies and controversy surrounding them, scholarly communication in psychology depends on a discussion of what gets published (and where) and what has impact. The research community will decide its direction in order to continue to build on credible research results. Achieving a degree of transparency and openness is integral to the research process if reproducibility of results is a goal. The American Psychological Association has also come out with the news that they have created a new position for an "Open Science and Methodology Chair" to work with its authors, reviewers, editors and publications board to understand and develop best practices for the evolving landscape of open science in psychological research." (Mills, 2018) Clearly, there is momentum to the move to openness for the publication and sharing of research results (including data) in psychology.

Incentivising open research and publication behavior is one way to ensure that researchers prioritize openness in practice. Nosek et al. (2015) mention that universities, funders and publishers provide different incentives for researchers focused on impact, and there is little coordination of effort toward openness. Some early career researchers have been willing to speak out about the benefits of practicing open science even while needing to succeed in the current academic environment with its existing system of incentives and evaluation practices. (McKiernan et al., 2016) At least one university has written an explicit statement in an advertisement for an available position that seeks to attract candidates who practice and will practice open science behaviors. The statement from the department of psychology at Ludwig-Maximilians-Universität (LMU) München reads (translated from German), "Our department embraces the values of open science and strives for replicable and reproducible research. For this goal we support transparent research with open data, open material, and pre-registrations. Candidates are asked to describe in what way they already pursued and plan to pursue these goals." (F. Schonbrodt, 2016) In a May, 2018 update, LMU's psychology department now uses an explicit hiring policy statement in all of its professorship job advertisements. Currently, "if you want to join the LMU psychology department as a professor, you should better have some open science track record." (F. Schonbrodt, 2018). In the U.S. on March 21, 2018, Southern Methodist University (SMU)'s Department of Psychology adopted an "open sciences practices policy for conducting research in the department." (https://www.smu.edu/Dedman/Academics/Departments/psychology) The policy recommends preregistration, data sharing and uploading preprints and states that "adopting the policy will be viewed very favorably by the chair and faculty members' efforts to adhere to the policy will be recognized in their annual reviews." (https://www.smu.edu/-/media/Site/Dedman/Academics/Departments/Psychology/2018/Policy-on-Open-Science-032218.pdf?la=en)

There are other coming pressures that will affect all researchers. The U.S. National Institutes of Health (NIH) is increasing its focus on the need for all grant submissions to demonstrate scientific rigor and reproducibility. This follows on earlier initiatives that promoted discussions about reproducibility in psychological science, for example in 2011 when the National Institute on Aging partnered with the Association for Psychological Science and the NIH Office of Behavioral and Social Science Research. (Desoto, 2016) Importantly, the NIH 2016-2020 strategic plan states: "NIH will take the lead in promoting new approaches toward

enhancing the rigor of experimental design, analysis, and reporting" and also will focus on "ensuring compliance with policies for open access to the published literature and data sharing." (National Institutes of Health, 2016, p.35). NIH's Grants & Funding webpage (https://grants.nih.gov/reproducibility/index.htm) describes scientific rigor as "the strict application of the scientific method to ensure robust and unbiased experimental design, methodology, analysis, interpretation, and reporting of results. This includes full transparency in reporting experimental details so that others may reproduce and extend the findings" and that "the NIH plans to require formal instruction in rigorous experimental design and transparency to enhance reproducibility for institutional training, institutional career development, and individual fellowship applications no sooner than 2017."

Much of the new focus on open science will affect the research practices of early career researchers going forward. All researchers, but in particular, the early career researchers will need to keep up with all new scholarly communication paradigms. That group can learn strategies for marketing early works, can follow the impact of their work in new metrics services and collaborate globally via new communication modes. For those early career researchers interested in open access and related areas, there are ways to engage. One global conference that focuses specifically on engaging early career researchers with "open" is OpenCon, a three-day annual conference that alternates between the U.S. and Europe, and provides an opportunity for intense learning and collaboration about open access, open data and open education. ("OpenCon 2017," 2017)

Open Research Practices for Psychological Science: Guidelines, Standards and Incentives for more Open Publication Practices in Psychology

There are many examples of the move to more open research practices now evident in the scholarly communication landscape for psychology. In terms of coalescing around shared standards, the example of the eight standards (and three levels) that make up the Transparency and Openness Promotion (TOP) Guidelines (http://cos.io/top/) demonstrates evidence of action by the scientific community to tackling issues such as reproducibility and data sharing. The TOP Guidelines are described on their webpage as "transparency, open sharing, and reproducibility are core values of science, but not always part of daily practice. Journals, funders, and scholarly societies can increase reproducibility of research by adopting the Transparency and Openness Promotion (TOP) Guidelines…" The eight standards are citation standards, data transparency, analytic methods (code) transparency, research materials transparency, design and analysis transparency, preregistration of studies, preregistration of analysis plans, and replication. (Nosek et al., 2015)

The list of signatories to the TOP Guidelines (over 5000 journals and organizations at the time of this writing in September, 2018) demonstrates participation and support by psychology publishers and journals for the ideals proffered in the Guidelines. Acknowledging disciplinary differences is paramount in this area and journals reporting the research results of psychological science will need time to reach a level of data sharing that, for instance, economics has achieved thus far (Nosek et al., 2015). Collaboration between publishers, authors, and other stakeholders will be necessary in developing the trust that will make sure everyone in the system understands

what needs to be made open and when, and how articles, data, code and other results of research will be produced and shared. The Association for Psychological Science (APS) and the Society for Personality and Social Psychology (SPSP), along with many individual psychology journals, are some of the signatories on the TOP Guidelines, and are utilizing some of the standards in their publications.

Some journals proudly display badges to signify compliance with open practices. An early example of a journal using open scientific practices and extending incentives such as badges to authors for using them was *Psychological Science* (Association for Psychological Science) (Eich, 2014). Instructions for authors for manuscripts accepted after Jan. 1, 2014 indicate that three badges are available: Open Data, Open Materials, and Preregistration. The APS webpage also publishes lists of recipients of badges, and full information for earning them. (Association for Psychological Science, 2016) As for results, when *Psychological Science* started the badges program in January, 2014, about 3% of articles included open data, and by the first half of 2015, that rate had risen to nearly 40% of articles. This was not the case for other psychology journals in the comparison group of publications without badges where incidence of open data was still low. Also, before badges, and in the comparison group, the study found that there was little actual sharing of data that was complete or usable. (Kidwell et al., 2016) As of the July 2018 issue of *Psychological Science*, "13 of the 15 'regular' articles received the data badge (nine also received the materials badge and we had three of the once-rare triple-badgers). We're not done yet." (Lindsay, 2018) Interestingly, it has also been suggested that authors may want to display badges on their curricula vitae as a way of signalling their use of open practices (in addition to the presentation of badges on the published paper alone). (Aarts, 2017)

Another study that sought to determine whether data sharing practices are becoming more open and transparent looked at articles in all issues for 2012 of 4 APA journals (*Emotion*, *Experimental and Clinical Psychopharmacology*, *Journal of Abnormal Psychology* and *Psychology and Aging*). Authors of the total of 394 papers were all contacted and asked to share their data, and only 38% of authors were willing and/or able to share their data. In fact, that APA's Ethical Principles of Psychologists and Code of Conduct stipulate how data is to be shared in psychology journals. (Vanpaemel, Vermorgen, Deriemaecker, & Storms, 2015) Some reviewers have also begun to take a strong stand on open data, stating that after January, 2017, they will reject papers if underlying data is not available for the process, or an adequate explanation has been given if it can't be. Scientists are adding their names as signatories on the Peer Reviewers' Openness Initiative, which hopes to increase transparency in psychology. (Naik, 2017)

In another response to a new scholarly communication landscape in psychology, the APA introduced a new and innovative open access journal in 2013, *Archives of Scientific Psychology*. This innovative publication covers all areas of psychology, and uses a unique approach that is summarized by seven attributes: all articles are open access via the internet for all readers worldwide, the description of methods used in each study is freely available on the internet, and the authors have made the data available (after agreement by the journal's review committee regarding usage) for verification of results. Two versions (one for scientists and one for the

public) of each article's Abstract and Method section are made available for readers. Two abstracts are prepared, one for retrieval of the scientific article and one that is written in nontechnical language for the public, and the Method section also includes a brief nontechnical summary. Comments by scholars and the authors' responses to them may also be published alongside the article. (Cooper & VandenBos, 2013). While the approach includes time spent on presenting the material in the article for a lay audience (and this is a laudable contribution), it will be interesting to see whether this extra step is meaningful for researchers and faculty authors that generally write and publish for promotion and tenure, not for communicating with the public. At least one study of promotion and tenure criteria shows that engaging with the public effectively around one's scholarly work does not necessarily help to advance an academic career. (June, 2018)

The APA's *Archives of Scientific Psychology* became the first adopter of the JARS (Journal Article Reporting Standards), published in 2011. (Cooper, 2011) Authors submitting articles to this publication complete a questionnaire version of the JARS, including detailed information on rationale, method, results and interpretation, and the Method section of the article links to it. Updated JARS (for qualitative and quantitative research) were published by APA in 2018. JARS information is made freely available from multiple APA-related sites. (Kazak, 2018*) Archives of Scientific Psychology* is the first APA journal to require sharing of research data by all authors. (Cooper, 2011). APA Journals now utilizes a specific data repository to make data associated with this publication available (https://osf.io/view/apa/). Clearly, the publication of *Archives of Scientific Psychology* uses a groundbreaking new approach to open access, open data and other open practices, and does serve as a model and an experiment to see how authors will respond and how soon other journals will follow suit.

Availability of open data is necessary to combat fraud and to allow replication and reuse of research results. In a 2011 case of scientific fraud, it is felt that the lack of openness and availability of research data can be listed as a factor that contributed to the large scale misconduct carried out over a period of years by the Dutch social psychologist Diederik Stapel. (Verfaellie & McGwin, 2011) In a review article, Gross (2016) examined the many issues with scientific misconduct (described as encompassing fabrication, falsification and plagiarism) that involve all disciplines, including psychology.

The prevalence of questionable research practices (QRPs) by research psychologists has been the focus of a recent study and was found to be "surprisingly high." Interestingly, "relatively high rates of QRPs were self-reported among the cognitive, neuroscience, and social disciplines, and among researchers using behavioral, experimental, and laboratory methodologies (for details, see Data Analysis in the Supplemental Material). Clinical psychologists reported relatively low rates of QRPs." (John, Loewenstein, & Prelec, 2012, p.529)

The issues of transparency and reproducibility are not unique to psychology but will need to be addressed going forward. Open source tools, such as the open lab notebooks in daily use by scientists create a culture of openness, and many are in use or development today. (Buck, 2015) PLOS has created the Open Source Toolkit to stimulate discussion and curation around the use

of open source hardware and software in research. ("Open Source Toolkit: a global forum for open source hardware and software research and applications," 2017).

There is increasing use of GitHub in many science disciplines, for example in neuroscience. "GitHub.com, a hugely popular website for collaborative work on software code" allows scientists to post data and others to add to that data. (Perkel, 2016) Of course, the 2018 acquisition of GitHub by Microsoft (https://news.microsoft.com/2018/06/04/microsoft-to-acquire-github-for-7-5-billion/) may cause some open source advocates to move in a different direction. Tools are now available to both facilitate the peer review of code and enhance the reproducibility of reported scientific findings right from the article. Code now can be cited with its DOI, and the platform Code Ocean is in use by researchers in psychology to share results in an open manner. This useful value add to scholarly publishing has been trialed at some Nature Research journals:

> Code Ocean is a computational reproducibility platform that aims to make code more readily executable and discoverable. The platform, which is based on Docker, hosts the code and data in the necessary computational environment and allows users to re-run the analysis in the cloud and reproduce the results, bypassing the need to install the software. (Pastrana & Swaminathan, 2018)

At present, Code Ocean is also being used by other publishers of psychology content, such as Taylor & Francis, where the Code Ocean widget is being integrated into the article, allowing readers to run the code right from the article. (https://codeocean.com/press-release/taking-the-journal-article-to-the-next-level-taylor-francis-partner-with-code-ocean) The first two psychology journals from Taylor & Francis that will integrate Code Ocean into articles are *Comprehensive Results in Social Psychology* and *Journal of Social Psychology*.

Code Ocean has built a solution to the need for computational reproducibility in psychology and delivered a practical and useful tool to the researcher and reader. At present, there may be a lack of use of the type of "container" technology (such as Docker) in psychology and scientists at Code Ocean have begun to detail step by step instructions for the use of the technology that underlies the platform. (Clyburne-Sherin & Green, 2018) The psychology article of the future will likely be a much enhanced package that ensures a heightened ability for readers and researchers to replicate and assess the results of research in real time.

Publication Bias, Excess Success, Retractions and Preregistration of Studies in Psychology

In diverse fields of cognitive science, evidence exists for the prevalence of publication and selective reporting biases. (Ioannidis, Munafò, Fusar-Poli, Nosek, & David, 2014). Ioannidis et al. provide analysis of the many studies of reported bias and offer some possible solutions to these problems. One example of an important issue is the existence of the persistent trend in the United States where most published studies report positive results. The worsening trend of the increase in the publication of positive outcomes, when studied across disciplines and countries, points out the psychology/psychiatry has one of the higher rates of increase. (Fanelli, 2012). With replication an issue, there is an issue with the "canonization of false facts" and calls for more publication of negative findings. Interestingly, new journals have cropped up that just focus

on negative findings, for instance PLOS ONE's Positively Negative collection. Negative findings might also at least be published online as preprints just to get them into circulation. (Nissen, Magidson, Gross, & Bergstrom, 2016) However, formal publication of negative findings, the aspiration of these new journals, have not necessarily found success. One such publication, Elsevier's New Negatives in Plant Sciences has been discontinued after the publication of only 12 articles. ("Publisher's Note," 2016); ("Editorial," 2015) Bias against the publication of negative results has many possible explanations, and needs continuing analysis. Increasingly, the article submitted to the journal must reach perfection, even aesthetically, while competing in an ever crowded field of submitted papers in an ever increasing "publish or perish" environment. (Giner-Sorolla, 2012) As to the question of why it is so difficult to publish negative results, there are many issues such as the attraction of proving theories correct, more excitement by journals in publishing positive findings, putting a positive spin on less than positive findings, and the prevalence of the common "file drawer effect." These issues are all under scrutiny. (Couzin-Frankel, 2013). Once again, a return to open practices and more sharing of all research results, including negative results, is possible now via the internet and only needs cultural and disciplinary practices to evolve (alongside the electronic). Beyond negative results, it is important to study carefully all issues that result in "unpublishable research results" and the important disciplinary differences that render important research unfit for publication and relegated to the "file drawer." (Tsou, Schickore, & Sugimoto, 2014)

In one study that analyzed experimental psychology papers published in the journal *Science* from 2005-2012, an example of "excess success" was found, showing that 83% of published articles with four or more experiments had positive study results. (Francis, Tanzman, & Matthews, 2014) This was similar to the study in *Psychological Science* of a four year grouping of articles containing at least four experiments that showed 82% positive results. (Francis, 2014)

In a follow up article (to Francis' study on "excess success"), van Boxtel and Koch (2016) focused on one particular article (their own), which had been flagged by Francis. In an example of the value of this type of analysis, van Boxtel and Koch (2016) stand behind their original study, which had been the focus of earlier independent replication. Wide availability of the literature and of these studies in a more open scholarly publishing landscape (and making sure to ensure more open data availability) can continue to keep these issues on the front burner and allow other scientists to respond both formally and informally.

The incidence and analysis of retractions in the literature seems to have become a more common topic of interest. In the past, it was difficult to keep up to date on retractions in one's field. It is now possible to follow retractions very closely online. The popular Retraction Watch blog is replete with announcements and analysis of recent retractions in psychology as well as other issues that may affect scholarly publishing in psychology. In recent years, notwithstanding some high profile cases of retractions in psychology, particularly of social psychologist Diederik Stapel, with a reported a spectacular 58 retractions as of 2015, (49 of them between 2013 and 2014), psychology has experienced a large increase in the rate of retractions in recent years. (Oransky, 2015) A new database for retractions, the Retraction Watch Database (including more

than 18,000 retractions on its launch date), for the first time makes it possible to discover all of psychology's retractions at once. (Retraction Watch, 2018)

Preregistration of Research Studies in Psychology

There are many initiatives developing at present that are working to combat problems such as publication bias by using new methods of peer review or modifications to the commonly existing steps in the formal publication process. More open processes help to create new opportunities for enhanced scrutiny of the research process. Preregistration of research studies is one strategy currently being used in psychology. In an example of a journal incorporating preregistration is *Cortex* (Elsevier), where a new format for empirical articles, "Registered Reports," will include review of initial manuscripts before data collection commences. Following an "in principle acceptance," the study will commence exactly as registered, and then a re-review process precedes formal publication. (C. D. Chambers, 2013). As of January, 2019, 156 journals (many in the behavioral sciences) have adopted the use of Registered Reports (sometimes referred to a RRs). A list of these journals is available from https://cos.io/rr/#journals. Funders may be able to use RRs as well, especially those funders that want to promote transparency and reproducibility in research. (Munafò et al., 2017) The new journal, *Nature Human Behavior* makes the registered report format available to authors and "a prerequisite for publication is that authors agree to share publicly their raw data, as well as their materials and any code (through deposition in a suitable repository or inclusion as supplementary material" and "by offering the registered report format, it is the journal's intention to support the research community's efforts for transparency, reproducibility, and open sharing."("Promoting reproducibility with registered reports," 2017, p.1) The adoption of more open practices coupled with open access to all results of research in the eventual publication process creates an optimal result for the scholarly record. Importantly, APA's *Journal of Personality and Social Psychology* includes information on preregistration as part of its extensive Open Science guidelines. (https://www.apa.org/pubs/journals/psp/?tab=4)

While an increase in preregistration strategies helps, this does not necessarily mitigate the issue of underreporting findings of results in published psychology research. In a study by Franco et al. (2016) in psychology, "the first to provide direct evidence of selective underreporting in psychology experiments"(p.8) which compared the final reported results of research published in corresponding journal articles using preregistrations and publicly available data available from the Time-sharing Experiments for the Social Sciences initiative (http:www.tessexperiments.org), where it was found that "published papers diverge substantially from research protocols, with extensive underreporting of outcome variables and experimental manipulations." (p.11) The findings of this particular study report that the authors:

> find that about 40% of studies fail to fully report all experimental conditions and about 70% of studies do not report all outcome variables included in the questionnaire. Reported effect sizes are about twice as large as unreported effect sizes and are about 3 times more likely to be statistically significant. (p. 8)

Continued discussions around publication bias as well as reliance on authors to take advantage of the many strategies (such as preregistration of studies) to make as many of the products of the research process available in a publicly open and accessible manner will be advantageous in creating a more transparent and credible scholarly communication environment for psychology. Chambers' 2017 book, *Seven Deadly Sins of Psychology: A Manifesto for Reforming the Culture of Scientific Practice* details the many issues affecting the research and scholarly publishing situation in psychology, including the issues of registered reports as the author suggests potential reforms. This particular book may be considered a "wake up call" for those thinking that there is little need for change in scholarly communication practices in psychology.

Traditional Citation Metrics and the Journal Impact Factor in Psychology

Traditional metrics, such as Journal Impact Factor (JIF) are heavily ensconced in academia. The JIF, a proprietary metric established years ago, has relevance to psychology and all other science and most social sciences disciplines. Debate rages over the JIF, but it maintains its followers in academia, and every year publishers, universities, editors and authors await the new annual JIF numbers to be reported in the *Journal Citation Reports (JCR),* a subscription index produced by Clarivate Analytics (formerly Thomson Reuters). There are a few whole countries as well that focus on this metric as a proxy for journal quality. Outside of research assessment exercises that use JIF to rank journals (beginning with the U.K.'s Research Assessment Exercise (RAE) in 1986, for instance), some countries even pay cash incentives to authors that are fortunate enough to author an article that is published in a high impact journal. One author in China has reportedly been paid various sums up to the equivalent of 165,000 USD for an article published in a high impact journal. One study reports that the average price of 43,000 USD is paid to a first author from China that is able to get an article published in *Science* or *Nature.* These two titles receive the largest cash rewards in China. Outside of those two high impact titles, payments are made for each eligible article based on its journal's JIF. Smaller sums are paid in some instances even in the U.S by certain institutions. This type of incentivizing the publication of research results is not widespread and can be problematic. (Abritis, McCook, & Retraction Watch, 2017)

In today's article-level publishing landscape, the JIF has little meaning for evaluating the impact of an individual article or author. One major criticism of the continuing use of the impact factor is that all articles in a high impact journal are obviously not of equal quality, and many stakeholders are eager to move instead to article-level metrics along with metrics that evaluate the work of individual scholars such as *h*-index. There are also issues with the coverage list that Clarivate Analytics uses and there are constant calls for new journals to be added to citation indexes and the Journal Citation Reports (JCR). Another issue with the JIF is that some fields have much higher impact factors across the titles within the discipline and so impact factor cannot be compared across different fields without normalization. Particularly for psychology, increasingly crossing into other disciplines and subfields, impact factors may be misunderstood as reported, with much lower numbers for some areas that cross more into social sciences areas, and highest for multidisciplinary journals like *Science* and *Nature* that reach a wide cross section

of scientists. Comparisons by number can only really be understood by those in the same niche area of scholarship. An added issue for psychology had been the split in the index between the sciences and social sciences, the two major groupings previously used in the JCR. In the newer iteration of the database, all of psychology is searched in one file. JIF can be accessed for each year, or as a five-year metric.

Because it is not business model (whether a title is open access or traditional subscription, for instance) of a particular journal, but instead citation traction that determines impact factor, open access journals can certainly attain top impact factors in many disciplines. In the JCR category, Biology, three fully open access (and fairly new) journals, *PLOS Biology*, *eLife* and *BMC Biology* have been in the top five for overall impact every year since 2013. (Clarivate Analytics, 2016) The situation is different for psychology and its fully open access titles. For psychology (all categories in the 2016 JCR), fully open access journals do not show up until title number 93 (of the top 100), sorted by JIF but there are many open access titles listed in journal coverage for the discipline. Two of the Frontiers journals, *Frontiers in Human Neuroscience* (JIF 3.209) and *Frontiers in Psychology* (JIF 2.323) are also the top two open access journals by total numbers of cites (12,836 and 14,320, respectively). Clearly, open access titles are important in the list of impactful psychology journal titles. Of course, many psychological scientists are publishing in the multidisciplinary titles such as those published by PLOS.

The coverage criteria for Journal Citation Reports is strict, and inclusion in this selective index is the result of a somewhat lengthy application and vetting process. For good or bad, some say that JCR only includes the "elite" journals of every discipline; many feel that inclusion in JCR has real meaning for a journal title. Others feel that the database should be much more inclusive, including journals from outside the U.S and UK/Europe, for instance. For strictly open access journals in all categories of Psychology in the JCR 2016 (reported in 2017), out of 747 total journals, 36 are listed as fully open access. Total numbers of psychology journals as well as numbers of open access titles have grown since the last annual JCR. The publisher Frontiers, in analyzing the 2015 JCR listings for its psychology titles states "the results are more significant if one considers (that) Frontiers does not engineer the IF by setting a rejection rate, and instead operates an impact neutral peer-review process. *Frontiers in Psychology* is only 6 years old and the results represented here are based on articles published between 2013-2014 (its 3rd and 4th year in existence)." (Frontiers Communications, 2015)

Frustration with the singular use of JIF for evaluating the evolution of a journal title has incentivized some journals to take a broader view of their status, using other tools available from Google, or from resources like Scopus and Web of Science. In order to understand the impact of the first 10 years of *the International Journal of Psychology & Psychological Therapy (IJP&PT)*, the title was studied in the three resources. This case study of a single psychology journal, published in Spain, using the three major citation databases showed once again that "This analysis has highlighted the disparity of the results that each database offers on the same goal: to know by who, when, and how many times a particular article published in a given journal was cited." (Roales-Nieto & O'Neill, 2012, p.474) Comparing and contrasting results in

these three databases creates some level of confusion with those using the various metrics sourced from these resources to evaluate journals, articles and individual scholars.

Due to frustration over unchanging patterns of evaluation for promotion and tenure that rely heavily on impact measured by the JIF, a variety of statements worldwide have been issued asking for reform of systems of evaluation that are entrenched in academia. A prominent statement, the 2012 San Francisco Declaration on Research Assessment (DORA) states that "there is a pressing need to improve the ways in which the output of scientific research is evaluated by funding agencies, academic institutions, and other parties." (American Society for Cell Biology) DORA states the deficiencies in the JIF and the use of journal-level metrics in promotion and tenure decisions and makes recommendations for stakeholder groups in moving away from the JIF as a proxy for research quality. At least one journal has even included DORA on their information for authors. *Perspectives in Psychological Science*, in the information on its website states that "The Association for Psychological Science is a signatory of DORA, which recommends that journal-based metrics not be used to assess individual scientist contributions, including for hiring, promotion, or funding decisions." (https://us.sagepub.com/en-us/nam/perspectives-on-psychological-science/journal201964) Similarly, the Leiden Manifesto offers a list of 10 principles to guide research evaluation and to combat what its framers see as "impact-factor obsession." (Hicks & Wouters, 2015) In a major exercise that reviewed the uses of various metrics and indicators for assessing the UK research system produced a report entitled *The Metric Tide.* One purpose of undertaking this large study was to compare the use of metrics and peer review and to make recommendations for going forward. Peer review retains an enviable position in the research system and the report states that "peer review, despite its flaws and limitations, continues to command widespread support across disciplines" and "metrics should support, not supplant, expert judgement." This report provides clear guidelines for the use of "responsible metrics" in evaluation and assessment, and the need to develop a "basket of metrics" that is appropriate to the discipline and subfield. (Wilsdon, 2015) In addition to large differences in impact factor numbers between disciplines (with the need to normalize across disciplines for comparison purposes), there are also vast difference in what each discipline considers its research outputs. Some disciplines are heavily book-based, others publish research primarily as conference proceedings, still other as working papers. For the Unit of Assessment (UoA) 4, Psychology in the REF2014 (comprising the areas of Psychology, Psychiatry and Neuroscience), the total of 9126 submitted research outputs includes: 10 authored books, 1 edited book, 16 chapters in books, 9086 journal articles, 4 conference contributions, 4 website content items, 1 research report, 1 "other" and 3 working papers. This list of output types demonstrates the similarity of the Psychology grouping to Biological Sciences, for instance, in terms of types of outputs, and how differently certain other disciplines represent their scholarly output. (Wilsdon, 2015) Seeing a chart of the four top disciplinary outputs submitted by each individual researcher who is required to do so by the REF allows a snapshot into what type of research outputs are valued by UK researchers in the various disciplines for submission to the highly important research exercises (REF).

Some early career researchers have signed onto DORA and other initiatives. However, the JIF does not show signs of going away, and this is one reason that those that work in areas of

OA (such as university OA policymaking) must continue to assure faculty authors that an institutional open access policy in no way changes the fact that authors must publish in the journal of their choice. Choice of journal publication is based on many factors, and certainly one of them would be JIF, reflecting the continued "publish or perish" situation that exists in academia today. When working on passage of open access policies and speaking with faculty across the institution, researchers often conflate an open access requirement for self-archiving of article-type scholarship with a mandate to publish in open access journals. On top of that, for many authors, open access has been associated with the media reports of the many bogus, fake (or predatory) scholarly journals. JIF is another imprimatur that authors and universities use to measure quality of outputs, even when it is not always the most appropriate metric. Keeping up with a deluge of journal titles (and an exponential growth of articles) as well as a variety of complex business models may be a challenge for busy academics. In terms of open access mandates of various kinds, the issue of academic freedom pops up occasionally, setting out the foundation that a basic tenet of academic work is the ability for a faculty member to choose the journal publication outlet unimpeded by outside factors, such as those imposed by funders around open access status of particular journals. For institutional open access policies that focus on green OA, the availability of the "opt out" for any specific article allays any such concerns.

As JIF has been the only journal level metric available for many years, in 2016, Elsevier debuted the new journal metric, CiteScore, available as part of the Scopus "basket of metrics." Because metrics are available for the more than 22,000 journals available in Scopus, CiteScore will necessarily cover a longer list of journals than what is found in JCR, but time will tell whether CiteScore will pick up traction as a true competitor to the JIF. This metric has become visible on journal homepages and provides an alternative measure of journal-based citation metrics. The metrics for journals listed in Scopus in the psychology category can be searched from the freely available CiteScore metrics page. (Elsevier, 2017)

Both Web of Science (Clarivate Analytics) and Scopus (Elsevier) provide an increasing variety of article-level metrics which scientists use to demonstrate citation impact for each of their works. These subscription indexes are likely consulted most often at the time of promotion and tenure actions in order to demonstrate research impact of the works of a particular author. While Google Scholar metrics are also widely used, there may be mixed reviews on the formal reporting of Scholar metrics in promotion and tenure actions due to the lack of transparency of the coverage criteria. Adding a next level (beyond only Web of Science and Scopus) of the various alternative metrics available would complete the information available on the impact of a work. All research metrics have different uses and audiences. Librarians in research institutions may be consulted for information around this complex area. Universities may want to make sure that certain librarians and those in research offices are available to consult with faculty and other researchers who are eager to understand the complex basket of metrics available. With increasing accountability expected for university faculty and reporting systems becoming more popular, appropriate use of article and journal-level metrics make a difference in the success of individuals and universities in this increasingly competitive research environment.

The open access status of publications has come into play of late in promotion and tenure actions in some institutions. Certain universities are moving toward requiring open access for all faculty (and in some cases, graduate student) publications, via availability in the institutional repository for all materials being submitted in promotion and tenure actions, or for reasons of compliance with funder mandates. In listing examples of universities that are moving toward openness in this way, Shieber and Suber (2017) explain:

> When the institution considers faculty for promotion, tenure, awards, funding, or raises, and when it reviews their publications as part of this process, then it should limit its review of their research articles to those on deposit in the institutional repository. Or it should use the institutional repository as the mechanism for submitting articles for use or review by internal committees.

An example of this trend may be found at Indiana University-Purdue University Indianapolis (IUPUI) in the U.S., where open practices are finding their way into promotion and tenure guidelines. This factor puts a focus on the importance of providing wide availability of the institution's scholarship as part of researchers' priorities. (Odell, Coates, & Palmer, 2016) However, recent research into the content of 850 review, promotion, and tenure (RPT) protocols has shown little mention (5%) of open access in guidelines published by institutions. ("Preliminary Findings from the Review, Promotion, and Tenure Study," 2018) There appears little real incentive for today's scholars to put a priority on making their work OA, at least in terms of formal university promotion and tenure guidelines.

In terms of research impact, there are new tools and services emerging all the time. Concern continues to exist about which metrics to use for measuring research, and also about the issue of "gaming" of citation metrics. (Patton, Stahl, & Wells, 2016) Challenges continue to exist with the use of the widening array of citation tools to quantify impact of research. In terms of citation analysis and metrics, the phenomenon of citation analysis and Journal Impact Factor JIF) calculation began with the print citation indexes produced by the Institute of Scientific Information (ISI) and was the brainchild of the late Eugene Garfield. In the print-based past, where the indexes for citation analysis and Journal Impact Factor were found in massive runs of volumes on shelves, psychology could be a challenge for librarians and researchers. Psychology always straddled the two print citation indexes, (Science Citation Index (SCI) and Social Sciences Citation Index (SSCI)) along with the print Journal Citation Reports (for the Journal Impact Factor). The print JCR (and earlier digital iterations of that resource) always presented a challenge for psychology due to the split between sciences and social sciences, with content likely in both sections. Elsevier's Scopus debuted in 2004, adding new tools and options for citation analysis to the mix. Web of Science (part of Clarivate's Web of Knowledge) also brought the discipline's content together and now includes the psychology content all in one completely integrated electronic index, making searching much easier than in the print days where the split between the disciplinary areas sometimes put different sections of the indexes in different physical libraries on the same or different campus. Web of Science was challenged by the development of Scopus where Elsevier endeavored to create an index that was more inclusive in terms of content, hence to be considered less "elite" in its coverage while still employing a

group of subject specialists to vet titles for coverage. At its outset, Scopus promised increased behavioral sciences content, more robust reporting of *h*-index, and a coverage list that included all of the titles included in Web of Science, as well as many more. As Scopus has developed, it has closed the gap in terms of years covered and metrics provided. Both Scopus and Web of Science offer different metrics and ways of presenting them, and both have criteria for coverage that presents a hurdle for some and an imprimatur of quality for others. "Cited reference searching," a key part of the demonstration of value of a particular article is still a main strategy for seeing all of today's current articles today that are citing an article from the past. Many publisher websites now also include "citing articles" information conveniently alongside research articles themselves. Some universities may not choose (or be able to) provide subscription access to both Web of Science and Scopus due to cost and also significant overlap between the two. Certainly, others feel that, at this point, both are necessary for current citation analysis and metrics purposes as well as for their usefulness in comprehensive cross-disciplinary search of the scholarly literature. Keeping an eye on the horizon shows new products emerging as competitors to the Elsevier and Clarivate products, for example Dimensions (from Digital Science, https://www.digital-science.com/products/dimensions/) with its freemium model and expanded coverage.

A free and heavily used alternative (for those without subscription products or for those that simply prefer its profiling and ease of use) exists in Google Scholar and its own available citation metrics found in the "Google Scholar Citations" service. In terms of what it covers, Google Scholar pushes the limit for coverage of everything that Google considers "scholarly" and does not publish its coverage index, creating a lack of transparency in some ways for the metrics it reports. For psychology, the products of scholarship included can be more wide-ranging than simply journal articles from high impact titles. Searchers using Google Scholar will find a much broader array of coverage, including high quality traditional and open access journal publications as well as items such as blog entries or magazine articles. Many users appreciate the many features it presents, such as pulling together all versions of a single article in one place (preprints, postprints, versions of record, for example) and the possibility of searching across many subjects at once (rather than searching a single subject's major index). Also, there is no fee for using Google Scholar on the web, which makes it the major discovery tool for connecting the world's researchers to available works, even works found in repositories or other open access vehicles on the web. Google Scholar is truly a gateway to finding scholarly open access content.

According to Google Scholar, the popular Google Scholar Citations resource:

> provide(s) a simple way for authors to keep track of citations to their articles. You can check who is citing your publications, graph citations over time, and compute several citation metrics. You can also make your profile public, so that it may appear in Google Scholar results when people search for your name…and your citation metrics are computed and updated automatically as Google Scholar finds new citations to your work on the web. (https://scholar.google.com/intl/en/scholar/citations.html)

The competition that exists with the citation indexes has ramped up both the number of metrics with which researchers need to grapple and as well as the number of various uses of

these analytics. In recent years, and with continuing development of the three major citation analysis databases, Web of Science (Clarivate), Scopus (Elsevier) and Google Scholar, researchers are presented with a variety of data and associated tools with which to analyze scholarly impact. With Web of Science once the only game in town, Scopus has continued to enhance retrospective literature (pre-1996) and other issues of coverage and at this point, can be used in direct comparisons with data in Web of Science. These databases, often accessed by academics through their university libraries (although many do not subscribe to one or both) are able to provide metrics for individual scholars such as *h*-index, as well as make available cited reference searching. Both provide search capabilities for users built on a quality-controlled corpus of scholarly publications. Comparisons cannot be made between disciplines using any of these tools in terms of metrics, without normalizing data. Certainly, an *h*-index of a biomedical researcher would differ greatly from that of a humanist. *H*-index is most often used for evaluation of particular individuals but sometimes is used in the aggregate (departmental *h*-index, for instance). *H*-index values differ greatly depending on the source of the data, a reason that many academics may have a preference for Google Scholar as its *h*-index values will be higher for any given scholar.

There have been calls for more cross-disciplinary comparisons of Web of Science, Scopus and Google Scholar. With an emphasis on metrics growing for individuals, universities and even entire countries, it is imperative that those performing evaluations as well as those being evaluated for promotion and tenure understand the strengths and weaknesses of each of these citation databases. Recent studies are making inroads in using the three major citation analysis databases for comparisons of research performance across a variety of disciplines. (Harzing & Alakangas, 2016) Also, each of these resources has a different value to the various disciplines. The literature of psychology is well covered by these citation databases. While there have been many analyses comparing citations found in Web of Science, Scopus and Google Scholar, Martín-Martín, Orunda-Malea, Thelwall, and Delgado López-Cózar (2018) have provided a detailed systematic investigation of nearly two and a half million citations to a set of highly cited documents from 252 GS subject categories, including psychology. Across the subject categories, Google Scholar "consistently found the largest percentage of citations across all areas," far exceeding that found in Scopus and Web of Science. (p.1160). However, the added citations found by Google Scholar were mainly from non-journal sources, such as dissertations, preprints, conference papers and more. Further, "the results suggest that as far as comprehensiveness in discovery of academic output, in all areas Google Scholar citation data is essentially a superset of Web of Science and Scopus, with substantial extra coverage" (p. 1160) and that "the scientific impact of these unique citations themselves is, on average, much lower than that of citations also found by Web of Science or Scopus, suggesting that the GS coverage advantage is mostly for low impact documents. Taken together, these results suggest caution if using Google Scholar instead of Web of Science or Scopus for citation evaluations." (p.1175) The specific findings from this study for psychology may be accessed at https://osf.10/t3sxh

Expertise in citation analysis and comparison of tools is often found in the library community, especially with scholarly communication librarians and library subject specialists. A psychology or behavioral sciences librarian could provide discipline-based expertise to users of

these products. While librarians, especially in the sciences and social sciences areas have always had expertise in research metrics, this role may indeed become more primary, presenting a strategic asset to the university and its faculty.

The importance of the journal, the traditional vehicle of discovery is still represented by the Journal Impact Factor or Elsevier's CiteScore, but today, the emphasis of discovery is often on the articles, each with a DOI, standing on their own. The move to an article-level economy where some journals (such as *PLOS ONE*) publish tens of thousands of articles in each single issue has caused disruption. Particularly, in a situation where journals have become unbound in an article level economy, searchers discover articles across a range of journal titles and peripheral subject areas, often using a search engine such as Google Scholar and "the most important literature is increasingly coming from a greater range of journals, not only the journals with the highest IF." (Lozano, Larivière, & Gingras, 2012, p.2144) Freely available discovery tools such as those from "1science" promise an "inclusive discovery platform aiming to index articles in all peer-reviewed journals, in all fields of research, in all languages and from all over the world." (https://www.1science.com/1findr/) The internet availability of research articles has created a type of "democracy" for individual articles, where articles are found, used and cited outside of their traditional container, the journal. Larivière et al. (2014) stated that, even for "elite journals," the situation exists that "since the late 1980s and early 1990s, several new and some long-established journals have been becoming more important, whereas traditional elite journals, including *Science* and *Nature,* are publishing a decreasing proportion of the top-cited papers" (p.653) and it has been demonstrated that "traditional 'elite' journals still have the highest citation impact, but other journals are also publishing an increasingly higher proportion of top-cited papers." (p.655)

Whether JIF will lose its relevance in a new world of discovery and a more even playing field remains to be seen. The trajectory toward irrelevance for the JIF may already be happening, even though it is still a major focus of research assessment exercises and a cornerstone metric for evaluation of the journals used by faculty authors and whole departments and universities. JIF is still a proprietary metric and a subscription is required to do comparisons of impact factors between psychology journals. Journal websites now often list Journal Impact Factors in order to attract authors to higher impact titles. Within psychology, across the subfields a researcher would have to expect a very wide range of impact factors and promotion and tenure and research assessment exercises would need to take that into account (rather than use any one size fits all approach).

With the move to measuring impact of individual articles and authors, and in this age of ramped up focus on citation rates, it is important to consider issues that may affect how frequently psychology researchers cite individual works. One example from Stevens and Duque (2018) is the possibility that APA Style's requirement for psychology (as compared to the conventions that exist for biology and geosciences) that in-text citations be alphabetized by surname "biases citation rates." The study, published in *Psychonomic Bulletin & Review* reports that "we found that surnames earlier in the alphabet were cited more often than those later in the alphabet when journals ordered citations alphabetically compared with chronologically or

numerically" and that "we suggest that journals using alphabetically ordered citations switch to chronological ordering to minimize this arbitrary alphabetical citation bias." (Abstract section)

Another Popular Metric for Evaluation of Individual Researchers and even Journal Publications: the *h*-index

Measuring journals against each other using impact factor did not satisfy those that wanted a metric to compare productivity of individual researchers. One metric that has developed traction in many fields for evaluation of an individual scientist is the *h*-index, proposed as "an easily computable index, *h*, which gives an estimate of the importance, significance, and broad impact of a scientist's cumulative research contributions." (Hirsch, 2005, p.16572) The *h*-index is felt to be a more effective indicator of an individual scientist's total contribution, and takes into consideration quantity of papers as well as citation activity of those papers. Although developed as a measure of impact for an individual scientist, some have used a subset of *h*-index to compare journals. Google has used *h*-index as the basis for two of its popular metrics services. Google Citations, a service where individual researchers set up citation profiles, will display the *h*-index of an author. Google Metrics also uses a subset of *h*-index to compare journals. (Antell, Foote, & Foote, 2016)

Google Scholar also has developed a metrics resource where *h*-index is used for publications, and journals can be browsed by subject category. (https://scholar.google.com/intl/en/scholar/metrics.html#overview) In Google's Scholar Metrics, the category "Psychology" is listed as a subcategory under "Health & Medical Sciences." Choosing the "*h*5-index" for any particular journal title displays highly cited papers from the last five calendar years in a publication. It remains to be seen, as time evolves, which metrics for both individuals and the journal publications that they choose will be most important to promotion and tenure committees or for university or funder reporting. For those that can use a variety of innovative metrics approaches (both inside and outside of rigid systems) there are many ways to leverage metrics in an individual's scholarly publishing behavior. Depending on motivation, some researchers are very engaged with demonstrating impact and using a quantitative approach to show the impact of their work. Others may learn to game systems to their advantage.

There are many issues with use of *h*-index including the importance of the genesis of the data behind the calculation. Promotion and tenure (or hiring committees) will want to make sure they understand whether the *h*-index was based on data from Google Scholar, for instance, which has very broad coverage but there is no transparency in what is indexed, or a curated disciplinary index such as PsycINFO, or the wide-ranging Elsevier index Scopus. Of course, the values for *h*-index of scholars varies greatly across the disciplines and subfields. In a cross-disciplinary study of Web of Science, Scopus and Google Scholar that includes *h*-index, Harzing et al. found that "in the Web of Science, the *h*-index of the average Life Sciences academic is nearly 8 times as high as for the average Humanities academic and nearly 3 times as high as for the average Social Scientist." (Harzing & Alakangas, 2016, p. 797) Those using *h*-index should only compare within a disciplinary niche and make sure that individuals do not consider their *h*-index as the only measure of their impact. Like "top lists" of everything else, lists of psychology researchers

with top *h*-index calculations are available (but not necessarily from credible or transparent sources) and have begun appearing on the internet.

Bishop has analyzed the use of "departmental *h*-index" as a predictor of eventual research funding from the UK Research Assessment Exercise (RAE). Could use of departmental *h*-index be a different approach to reporting impact for the next iteration of the exercise, the REF2014, (the UK Research Excellence Framework which was to assess the quality of the research output of 154 UK universities) that was proposed at that time? Bishop studied the research outputs from each of the 76 psychology departments that participated in the RAE for 2008 (using data from 2000-2007), utilizing an address search of data in the Web of Science, and concluded that this use of departmental *h*-index (not for every discipline, however) was acceptable as an alternative to the use of the journal impact factor as an indicator of impact for this type of UK funder research assessment exercise. (Bishop, 2013) One complication for psychology in use of bibliometrics for these large assessment exercises is interdisciplinarity and how it affects reporting of aggregated metrics. For instance, the REF2014 has 36 Units of Assessment (UoAs), including a grouping of Psychology, with an expert sub-panel working on each UoA. The psychology grouping (UoA 4) includes Psychology, Psychiatry and Neuroscience. Each of these areas would have different *h*-index profiles and other differences in terms of strict use of bibliometrics for assessment, pointing to the value of employing expert peer review panels in any type of evaluation that would assess impact appropriately for any area within (or on the periphery of) psychology. Use of the *h*-index has other benefits in evaluating research groups working in niche areas. Ruscio (2016) has reported on the advantages of *h*-index for analyzing citations and productivity, stating that:

> in addition, *h* is a transparent, reproducible, and objective measure of scholarly impact. This has the potential to reduce many kinds of bias that can influence judgments and decisions. It also affords the opportunity for systematic, quantitative evaluations, or comparisons. Unlike the more subjective reading of a CV, for example, one can explicitly select an appropriate reference group and sampling technique to obtain comparison data to help interpret the *h*-index. (p. 906)

Ruscio (2016) was also able to study a grouping of social psychologists to demonstrate the robustness of *h*-index when used as a citation-based metric for evaluation purposes of an individual.

Strategic use of *h*-index by researchers, funders and university departments in areas of psychological science has been discussed, but not extensively. Ruscio et al. (2012) provides a comprehensive look at 22 citation-based indices which might be useful to psychology and concludes that "the most attractive measures include *h*, several variations that credit citations outside the h square, and two variations that control for career stage." (p. 123) In two separate 2012 studies examining *h*-index and psychology faculty in U.S institutions, Ruscio & Prajapati (2013) present comparison studies of *h*-index calculations resulting from the use of citations gathered from both PsycINFO and Web of Science, and also offer a method of how one might compare an institution's psychological sciences faculty with peers in other disciplines. In the first study of *h*-index results (of 204 randomly selected psychology professors from 185 U.S.

psychology doctoral programs) between the two indexes, it was demonstrated that similar results in terms of comparable scores could be obtained from both PsycINFO and Web of Science. In another larger study of 1750 university-affiliated U.S. psychology faculty, it was shown how one might examine norms on h-index for psychological scientists by rank (assistant, associate, full professor). Ruscio & Prajapati (2013) recommend the use of PsycINFO and Web of Science (and not Google Scholar) due to the comparatively more robust and vetted data behind these major indexes. It is likely that many agree that, at this time, while Google Scholar is convenient, the coverage and messiness around its coverage, the lack of a public API that would allow more robust analysis, and the lack of refinement of its tools does not allow replication with other data sources or trusted results in comparison studies in the case of psychology.

The word "impact" has taken on various meanings when it comes to scholarly communication in any given discipline. While impact has taken on more and more of a quantitative meaning in recent years, with long lists of available metrics, and a few taking center stage (journal impact factor and h-index, for instance), it is interesting to consider which scientists have made the most impact to psychology. The impact of a person is never easy to quantify, but there are some whose reputations and work stand the test of time, with a few whose fellow scientists consider the most impactful. Sternberg (2003) edited a book that serves as a reminder that there is much more to impact than sheer numbers. *The Anatomy of Impact: What Makes the Great Works of Psychology Great* is a work that brings together a number of experts in the philosophy and history of psychology (as well as other distinguished psychologists), each of whom contribute a chapter on a single scholarly work by a preeminent author. Each chose a work of "monumental impact" and analyzed why "the work was so successful in terms of influencing the field. (p. ix) Further, it is stated that "the ultimate goal of any publication in psychology (or anything else) is to have an impact-to make a difference to a field." (p. ix) This book succeeds in defining impact differently than it is often discussed today through the use of examples of seminal works in psychology and what they have come to mean to the field over time.

Scholarly Collaboration Networks: Featuring ResearchGate and Academia.edu

The internet has also fueled the creation of the scholars' networks that allow collaboration between researchers and combine a social networking function with availability of papers. Millions have signed on to services like ResearchGate (RG), Academia.edu and others. These services may be known as "scholarly collaboration networks" or other names like "academic or scholarly social networks." More research is needed to ascertain how authors and researchers use these services, how they figure into the calculus of search, and whether there is a decided benefit to uploading work to these sites. These sites allow social collaboration along with access to articles, including the many publisher-branded versions that are uploaded without concern for publisher copyright. Millions of articles can be found in these multidisciplinary services, and publishers also need to understand the ramifications of the popularity of ResearchGate and Academia.edu and other similar sites. Usage statistics of works in these services are of interest to both publishers and authors. A focus on the collaboration aspects of these services (such as Q&A features, which are little used) may miss the point that the main

attraction may be the ability of researchers to not only connect with others, but more importantly, to upload and disseminate articles (many in proprietary publisher "version of record" format) and watch the subsequent citation and social media activity that results. A compelling aspect of these two sites is the ability to market and promote one's work via upload to ResearchGate or Academia.edu. This "sharing of full text papers" aspect has been considered a major contributor to the success of these sites. Authors are contributing their own content, not just following others' work. Sites like Academia.edu have some highly productive "producers" in comparison to mere "viewers" of content. (Ortega, 2016) A continuing issue is that authors continue to upload many proprietary publisher article versions, often violating the terms of the copyright agreements that they signed at the time of article submission. Major funders are now supporting these sites even though these services continue to fill with proprietary content.

Academia.edu, even one with a name that evokes "academia" is in fact backed by venture capitalists mainly interested in data mining. The enormity of the Academia.edu and ResearchGate communities allows for scale of collaboration, something otherwise not easily found in academia, or via the large network of subject or institutional repositories. Also, the scholarly collaboration networks often provide for researchers an invaluable collaboration platform where they may not only share papers, but ask research questions to the large audience, and receive answers that can spur new research directions or provide clarity on topics that are better discussed within a more scholarly online community. Some have likened these services to a "Facebook for academics." (Carrigan, 2016). Others see a whole new centralized online system incorporating all of the new elements of scientific communication that the web allows, pulling everything together into something akin to a "Facebook for science." (Buttliere, 2014) With every new system proposed, there has to be a very compelling reason for researchers to spend any time in deviating from their established disciplinary scholarly publishing practices. ResearchGate has made great inroads into the scholarly community and is not owned by any commercial entity at this point. For many, that fact makes a difference, and at this point, ResearchGate is an established and desirable service for many academics.

In the case of Academia.edu, due to its name, it is possible that many of its users confuse it with an actual service based in academia. Quite the contrary, Academia.edu was founded by Richard Price in 2008, and by August, 2014, it had raised 17.7 million USD from venture capitalists and had claimed 11 million users at that time who had uploaded 3 million papers. (Van Noorden, 2014b) Academia.edu has attractive value-added services such as the practice of sending an email to an author with information about the keywords someone searched while discovering his or her papers, the search engine used, and the geographic area of the search. For some researchers this is very valuable information, for other busy authors, it may be construed as spam. In fact, one of the complaints that users have about these platforms is the constant email bombardment that ensues on registration. Some academics have warned colleagues that there are better solutions for posting academic work online, and asked others to delete their Academia.edu accounts. There was a backlash in 2016 after Academia.edu suggested that users might want to pay for a "recommender" service in which Academia.edu would "boost" certain papers on the site. (Bond, 2017) Some enticing services that had once been free are no longer without cost and it is common now when hearing from Academia.edu with an enticing offer to find out

information about traffic to articles available there to be asked to pay for this and other services via their "Academia Premium" service (which started in December, 2016). Since Academia.edu was founded by a philosophy professor at Oxford University with the goal of connecting authors to readers, it isn't surprising that one recent study focused on the site's use by philosophy researchers. Academia.edu is used heavily by social sciences and humanities scholars, but at least in this study in 2013, psychology was the 5th highest (out of 39 subject areas) listed "broad research interest" of users. (Thelwall & Kousha, 2014)

ResearchGate is used by many scientists and studies demonstrate that it is well known (more than 88% if scientists and engineers in a recent study were aware of it, placing the site just behind Google Scholar. Along with Academia.edu as a commercial enterprise, ResearchGate (as of June, 2014) had secured 35 million USD from investors and claimed 14 million available papers. (Van Noorden, 2014b) By the fall of 2017, ResearchGate had reached 85 million dollars of venture capital (and other investor) funding. It is the most popular scholarly collaboration network and also boasts more traffic than even some of the largest publisher platforms. (Harrington, 2017) The site "launched in 2008 with the stated aim of helping researchers to communicate, cooperate, and share information" and as of August, 2015 had a robust 7 million users. By April, 2017, the ResearchGate website boasted more than 12 million members. The site has a social networking side alongside its use as a platform from which to disseminate scholarly research articles from an author's profile (which is a more popular use of ResearchGate). Although there are few studies of how psychology and neuroscience researchers use ResearchGate, it is clear that there is robust usage across these disciplinary areas. (Thelwall & Kousha, 2017). It would be useful to analyze, with a large scale study, how ResearchGate and other similar services are being used specifically by psychological science researchers. Where ResearchGate allows collaboration and has its Q&A service for engaging researchers, different disciplines would be expected to respond differently. Publishers and vendors of psychology research literature would want to understand how ResearchGate and other services are engaging their authors, and how published papers or accepted manuscripts are being uploaded to these sites. For any discipline, it is interesting (and a value add) that DOIs are now provided by ResearchGate for any item, such as an author's original contribution (such as a preprint), that does not already have one associated with it. (Nicholas, Clark, & Herman, 2016).

ResearchGate offers reputational metrics, 10 of which have been studied by researchers (beyond the oft-studied and well known "ResearchGate Score," undoubtedly the most well-known of the available metrics that purport to measure a researcher's reputation). There is a lack of information (and some say transparency) about the formulas used to calculate the various scores. (Nicholas et al., 2016) One aspect of ResearchGate that is either compelling or off-putting is the regular emails that are sent to users to enhance engagement with the site. ResearchGate is not "out of sight, out of mind." As for the reputational metrics and services, each discipline and university would likely view these differently. Each service a researcher joins represents a certain time sink, the most valuable commodity for most researchers. After funder and institutional policy, it remains to be seen how much more time can be invested by busy authors and researchers in these dissemination, networking and reputation management sites.

ResearchGate has high usage and the wide uptake across disciplines and countries may speak volumes about interest in reputational management.

Another issue for these platforms is the sharing of scholarship within them, often running afoul of publisher rules. Publishers have had to grapple with the amount of sharing that goes on within these tools, and they have moved to try to regulate this somewhat by setting out rules about which versions of articles are allowed to be shared. In fact, in 2015, the International Association of STM Publishers created some general guidelines for the ResearchGate user community and has sought buy-in to these guidelines from various stakeholder groups, including libraries. (Dylla, 2016) In one case, Elsevier sent 2800 takedown notices to researchers who had publicly posted publisher versions of their articles in Academia.edu. (Reller, 2013). With the large numbers of scholars using these services, this is a trend that is not going away. In a recent study regarding copyright compliance issues with ResearchGate, it was demonstrated just how often authors upload publisher-branded PDF versions of record, even when publishers allow other earlier versions to be uploaded legally. Authors infringe copyright often in using the "wrong version" of articles on the service. This may be due to authors' not understanding versioning issues, or it may be due to complexity and diversity of publisher policies. With ResearchGate, authors are responsible for the copyright clearance, which differs from the situation with some other less popular services, such as institutional repositories. (Jamali, 2017) Another explanation for the popularity of posting publisher PDFs in ResearchGate would be, as most would agree, that the publisher version is the one that authors want to share most often, and they do. With major funders now backing ResearchGate, there is a bit of a mixed message for authors in terms of what can and should be shared. Readers also want to search for and find the publisher version. ResearchGate's popularity speaks to the desires of researchers for broad dissemination of their work on a popular online open scholarly platform and this sharing anywhere possible will certainly continue unabated. Sharing is facilitated by the discovery of ResearchGate papers and is fueled by the use of Google Scholar for search (where ResearchGate can be indicated on papers). Previous studies have shown the importance of a rapidly growing ResearchGate corpus of papers for readers and researchers seeking accessible full-text of articles via online search. (Jamali, 2017) ResearchGate papers are identified as such in Google Scholar searches and readers know the chance is good that publisher full text is likely to be available from the site.

ResearchGate, with its enormous popularity and healthy funding support, experienced some issues in 2017. It remains to be seen how the service will respond to these challenges going forward. In what may be a boon for the institutional repository (which often checks publisher permissions), ResearchGate has had a series of communications from the international publishing community which has asked it to remove proprietary material. When asking did not produce action, lawsuits went out against ResearchGate. Publishers (initially Elsevier, American Chemical Society, Wolters Kluwer, Wiley and Brill), for their part, have formed a "Coalition of Responsible Sharing" to try to promote a culture of sharing of articles legally in ResearchGate. The International Association of Scientific, Technical and Medical Publishers (STM) has repeatedly (over a period of two years) tried to work with ResearchGate on the "legal sharing" of articles and issues of collaboration with publishers and has met with rejection. Following this

rejection, takedown notices were imminent, and a lawsuit from Elsevier and also the American Chemical Society (ACS) was filed in Germany. (Hinchliffe, 2017) Another lawsuit was filed in the U.S. (District of Maryland) in October, 2018 by Elsevier and ACS regarding massive copyright infringement of proprietary versions of papers. (https://www.infodocket.com/wp-content/uploads/2018/10/acs_elsevier_rgate.pdf) It remains to be seen how the participating faculty and others react to these continuing issues. ResearchGate goes on with business as usual for now. Authors accustomed to uploading publisher-branded PDFs in ResearchGate, and counting on ResearchGate to make the papers more discoverable while facilitating the sharing of those articles will now need to grapple with what the lawsuits and takedown threats mean. For all the authors of psychology articles, it may seem that ResearchGate may not be sustainable in the same way as it was before, in the way that it has facilitated a robust sharing and collaboration of scholars and their works across the globe. Who will win this tug of war over the sharing of scholarly information? Researchers and the reading public want seamless online access to peer reviewed (and other) literature and they will use whatever service can facilitate discovery and access, and ResearchGate is certainly one enormously popular way to access the scholarly literature. A common scenario in scholarly search increasingly seems to be starting with Google Scholar and ending up with the paper in a library, or in ResearchGate, and if some are not successful with the library or ResearchGate, it's possible that a pirate site like Sci-Hub may be the next stop for some. All of this is a dilemma for libraries and publishers as well, both of whom want the reader to have access to essential scholarly information.

Sharing Works Outside the "Formal" Scholarly Communication System, including the Sci-Hub Phenomenon

Much psychology literature is available to potential readers via popular crowdsourced sharing platforms and practices. There seems no stopping (by publishers) the sharing of PDF copies of scholarly articles online by communities of researchers on a global scale. Widespread sharing of research papers takes place on social media platforms and recently there have been studies of this activity on sites like Facebook, Reddit Scholar (a subforum of Reddit), and by use of the popular Twitter hashtag #icanhazpdf. This peer to peer sharing goes above and beyond the very popular informal sharing that goes on via email, for instance. Peer to peer sharing centers around a few high volume websites that host the files, namely Avaxhome, LibGen (The Library Genesis Project) and Sci-Hub. Will readers and researchers use traditionally available channels such as interlibrary loan or will they choose convenience and just go to a crowdsourced site and get an article that's likely been obtained illegally? (Gardner & Gardner, 2017) Often in the news, Sci-Hub, and its founder, neuroscientist Alexandra Elbakyan have created a site where much of the content of commercial and other publishers has been made available illegally since 2011 to searchers and readers worldwide. Lawsuits by Elsevier and the American Chemical Society have not been able to prevent the continued growth of Sci-Hub and its partner site, LibGen.

Controversy erupts whenever discussion of the use of these methods of gaining research paper access comes up, with some feeling that papers are meant to be read and shared in the open, and others acknowledging that the illegal nature of the sharing of the property of

publishers must be stopped. Larger issues involve the library and legal issues with how the content is obtained, which is often via use of user credentials outside of normal channels. Still, where researchers need access, it has been surprising to some the extent of the access that happens outside normal channels, and especially the fact that many who access are actually at affiliated institutions that have subscriptions, via their libraries, that allow legal access to that content. This fact was surprising to some, that "everyone" is downloading articles from Sci-Hub even if they have access via other channels such as through research libraries. (John Bohannon, 2016b) Also somewhat surprisingly, Elbakyan has made available an immense data set of 28 million download requests from the server logs of Sci-Hub representing the time period Sept. 1, 2015 to Feb. 29, 2016. Using publisher DOIs prefixes with this dataset allows one to see the content of many publishers of psychological science that are included in Sci-Hub, including major players as well as smaller presses. (John Bohannon, 2016a) Sci-Hub may be considered a pirate site, but a study by Himmelstein et al. (2018) reveals a situation that is truly a game changer for scholarly communication in all fields. As of March, 2017, Sci-Hub was providing a huge number of readers and researchers with another mechanism of accessing all of the world's scholarly papers (mainly articles, but some other content as well) that are currently behind paywalls and restricted to subscribers by their publishers. Not as concerned with providing a complete repository of all scholarship (including open access), Sci-Hub has as its focus making available all recent papers that are behind paywalls. The service is monetized through donations, especially via Bitcoin. Sci-Hub makes available 85.1% of all articles currently available only from toll access journals. Its coverage of Elsevier articles was reported at 96.9%, and more than 90% for the American Chemical Society, Wiley-Blackwell, and Taylor & Francis (all part of a group of eight publishers that have more than a million articles represented). Sci-Hub's coverage of articles in the Psychology category (using Scopus data) was determined to be 1.3 million out of 1.6 million (or 82.9%). Clearly, Sci-Hub is making available most of the peer-reviewed paywalled psychology literature. As a benchmark, the authors compared the University of Pennsylvania's subscription library holdings against the content available from Sci-Hub, and even though Penn had paid 13.13 million dollars USD on its electronic resources, it was determined that "Sci-Hub provided greater access to paywalled articles than a leading research university spending millions of US dollars per year on subscriptions." (Himmelstein et al., 2018, p. 10)

With institutions and their libraries spending millions of dollars on access to journal subscriptions from publishers, this issue is one that will continue to be of major interest to libraries and publishers, especially as they aim to combat continuing infringement activities of sites like Sci-Hub. (Russell & Sanchez, 2016) Facilitating more availability of open access content will be one strategy that can mitigate some of the lengths that researchers need to go to in order to access articles. The research community of psychological science has everything to gain by making sure the products of research are available to every individual that needs or wants access. It is not only access that researchers want, but seamless, convenient, one-click access, which is just the type that Sci-Hub offers and publishers and many academic libraries do not. Sci-Hub appears to be an appealing "one stop shop" for convenient access to content for those that can't get access to scholarly publications, as well as those that could use other methods. It is currently unclear how libraries and publishers will (or won't) prevail against Sci-Hub.

More Public and Social Media Engagement for the Results of Research in Psychology

New audiences outside the expected niches are interested in reading scholarly articles, and this includes many interested members of the public, policy makers and of course in psychology, practitioners. There have been calls for scientists to engage more with the public, and reporting of research results via the news media would be one way that funded research results could be disseminated further to taxpayers and other readers of the popular press. (Begg, 2016; Carrigan, 2016)

There have been many calls for the need to translate psychological science research results, whether in journals, books or other formats to materials that can be used by the wider public. With the capacity to address many societal and medical issues, strategies for translating research results to content that is more useful to the reading public have been put forth. With the added vehicles of open access and the wide reach of the internet and mobile devices, the public has never had so much ability to take advantage of the availability of educational content. (Kaslow, 2015) For psychological science, the advantages of this added accessibility have the potential to educate many readers, to spur innovation and to further research into areas important to the health and well-being of citizens.

Research impact via open access can also happen using publicly accessible vehicles such as Wikipedia. Citations to open access research articles are an integral part of Wikipedia articles and inclusion of links to those freely available articles in Wikipedia references creates major diffusion of research information to readers worldwide. As of 2016, there were 5 million articles in English Wikipedia (and 35 million in the other hundreds of languages). Wikipedia is a first stop for millions of searchers and has become the top choice for those seeking medical information online, for instance. (Lammey, 2016) It is likely that this is the case for psychology as well and as a very heavily used open encyclopedia, Wikipedia serves as a gateway for the dissemination of scholarly information about psychological science. With a lot of public reader traffic going to Wikipedia, there have been repeated calls for all academic authors (and publishers) to contribute content and to add open access links to all articles in the popular online encyclopedia. Many articles in reference lists are paywalled, creating roadblocks for information seekers. One way that the results of scientific research could be surfaced to the public would also be through inclusion of direct links to open access versions of peer reviewed articles in reference lists at the end of Wikipedia articles. Links to open content facilitates access for readers but also serves to increase visibility and resulting research impact for authors:

Controlling for field and impact factor, the odds that an open access journal is referenced on the English Wikipedia are 47% higher compared to paywall journals. These findings provide evidence (is) that a major consequence of open access policies is to significantly amplify the diffusion of science, through an intermediary like Wikipedia, to a broad audience. (Teplitskiy, Lu, & Duede, 2016, p.1)

Adding to the possibilities that the internet provides for enhancing citation effect via open access are the very positive uses of social media for publicizing scholarly work. (Carrigan, 2016) Many scholars may see some of the more popular social media platforms as lacking in scholarly

credibility, but after researchers became aware of the potential of services like Twitter to rapidly send out research results (for instance, by depositors tweeting out from the preprint server arXiv), they may not want to miss such valuable visibility. In some cases, this rapid online communication has greatly increased the wide dissemination of very current research, especially in the case of the timely articles and other outputs available from preprint servers. It has become clear that in order for the widest dissemination of research results, services like Twitter and Facebook, extremely popular among academics, are part of a mix for marketing early articles that also includes more scholarly channels. In fact, it seems many agree that "Twitter isn't the only social media platform around, but it's worth noting that it is a favored channel for a wide-spectrum of those working with scholarly output." (Michael, 2016b)

Scholars now have many means to self-promote and use of social media is becoming commonplace. Brief guides on getting started using Twitter in university research settings are available, and the use of these services does not require a high learning curve or much time spent in composing brief tweets in order to share current articles. (Mollett, Moran, & Dunleavy, 2011) Longer treatments, including entire books have been written on how researchers can use the power of many social media services to market and promote their work, receiving valuable feedback along the way. (Carrigan, 2016) ; (Mollett, Brumley, Gilson, & Williams, 2017) The advent and uptake of social media has been a boon to the wide sharing of research. Open access strategies facilitate this dissemination. Alongside reporting of traditional impact via established metrics, researchers are interested in the "attention" that sharing work widely can bring to published work. Studies of sharing via Twitter, Facebook and Mendeley show at least more attention to openly published articles than those that are published in a closed access manner. (Wang, Fang, & Guo, 2016) Savvy researchers promote and market their scholarly work for greater impact using proven strategies that work with various social media. (Mollett et al., 2017)

In a sense, there are methods that any author can use to market a publication, drawing attention to it. These methods are not time-consuming, but can create visibility and added sharing with other scholars and with the public. Enhanced visibility may lead to invitations to present the work at a conference, may attract media attention, or could drive many more individual readers to the article, whether the article is shared as an early version online (preprint) or whether the final published version is shared in more conventional ways. Psychological scientists Weinstein and Sumeracki (2017) provide an example of the many invitations to speak (and other opportunities received) as a result of engaging on Twitter and publishing a blog. Of course, for the busy academic (especially those on the tenure track) the perennial question is one of time spent on one activity (or one platform) at the expense of more traditional scholarly activities that may be required for promotion and tenure.

Strategies for author marketing of publications are very useful as a complement to the efforts of publishers. Using green or gold open access strategies have a proven track record as far as increasing research impact. Authors of scholarly monographs may also need to focus on marketing to lay audiences. Snijder (2016) concludes that studies of monographs' increasing usage when made freely available may also be tied to increased activity on social media, particularly Twitter:

The results identified very little overlap between Twitter usage and citation behaviour; it seems reasonable to hypothesise that the factors affecting citations of books do not play a significant role in tweets about books. Therefore, the probable reason that open access is a significant influence on book citations does not necessarily apply to Twitter mentions. Nonetheless, it is possible to conclude that making books freely available has some positive impact on the number of tweets. Lowering the access barrier does indeed lead to more attention, in line with the effects for discoverability and online consultation found in the 2009 experiment. (p. 1871)

In terms of the most popular referrers to scholarly articles, Twitter and Facebook, there is some evidence (from one study) that attention in the form of social media referrals toward scholarly articles accumulates quickly in the first week after publication, and then dissipates. This does show that Twitter and Facebook visitors to scholarly articles do result in actual clicks on those publications. (Wang et al., 2016) Wider impact of these practices is not clear at this time. Researchers are analyzing whether the wide dissemination through tweets (by authors or others) and the enhanced visibility that Twitter makes possible does actually affect citation impact, as measured by various new (alternative) metrics.

More metrics are required for assessing impact of social media participation. Outside of traditional citation metrics, alternative metrics, or "altmetrics" have taken on more prominence, at least informally, with many publishers (as well as repositories and preprint servers) adding altmetrics indicators to individual articles. Altmetrics are thought to provide a much more well-rounded picture of the impact of an article, allowing for information to be presented about how readers use and engage with articles, books and other products of scholarship. Services like Plum Analytics aggregate resulting metrics from social media through measures of attention that are demonstrated as "clicks," downloads, "likes," "shares," "captures to citation management services," and more. This information allows an author to create a narrative of alternative types of impact that may tell a more complete story of a particular work's meaning to the discipline as well as to the community and reading public.

Publishers are now also using many new products and strategies to both market articles for visibility as well as provide new visualizations of impact using altmetrics. Utilizing new services for assisting authors in marketing their work online in order to reach more readers and potentially increasing impact, for example, Kudos (https://www.growkudos.com/). Kudos reaches out to authors proactively with information about an article's traction and traffic. On its site, Kudos states in its information targeting authors:

> Wherever you publish or share your work, use Kudos to help achieve 23% higher growth in full-text downloads: Open up your research so new audiences can find and understand it. Track the most effective networks for getting your work read, discussed and cited. Learn where to focus your efforts to make best use of your time. Improve the metrics by which you are evaluated. In its information for publishers, Kudos states: Increase publication performance and strengthen author relationships. Authors are increasingly sharing their work, often within private networks. Publication usage is being fragmented, putting subscriptions at risk, and publishers are being cut out of the picture in terms of

understanding and building on new modes of scholarly communication. Kudos provides tools and intelligence to help you connect with authors after publication, collaborate with them to maximize publication usage and impact, and reclaim lost usage.

It is also becoming commonplace to see visualizations of alternative metrics (altmetrics) data on articles, preprints, and entire journals. Where traditional metrics such as article citation counts or journal impact factor are not appropriate or are unavailable, the ability for authors to see the use of their research around the world has become a desirable aspect of publishing one's work and then depositing it in repositories that offer altmetrics services. Adding altmetrics reporting to publisher services has added value to what publishers offer to their authors and readers. Publishers focus on author services in order to establish better relationships, increase the possibility of more submissions, likely enhancing brand loyalty among the pool of potential authors.

With the development of altmetrics, scholars as well as promotion and tenure committees have seen new ways of demonstrating impact. A narrative about an article's impact can be drawn by looking at the aggregated measures of attention that an individual work is attracting. Whether new metrics showing internet downloads or Twitter followers, for instance, will matter to evaluators in a given university is not yet known. As authors become more savvy about marketing their publications online, those using traditional practices may miss some opportunities to reach a larger readership on a global scale. Many are using scholarly collaboration networks as well as various repository solutions for internet dissemination of their scholarship (and data) and these authors now expect and enjoy using various altmetrics to see uptake in various ways. Of course, many studies have demonstrated that open access increases research impact, and so making one's work open access and then marketing it via popular social media would seem to be a winning strategy for dissemination of scholarly work on a global scale. (SPARC Europe, 2015)

Beyond open access strategies and the use of social media, it is necessary for authors to think of all of the factors that make their work more visible and discoverable. If an article has robust and accurate metadata and a well thought out title, that article is more likely to be discoverable by search engines and indexes. As in the past, choosing the best fit between article and publication is paramount, and there are many factors to consider. Authors have many options and also can also employ a long list of strategies to aid in the discoverability of their publications. Planning for open access is necessary for the article to attain maximum readership following initial discovery. Beyond consideration of readership, open licenses like Creative Commons' CC-BY make works more useful and impactful.

Many new tools are available now to assist authors in matching their draft articles to the most appropriate journal publication outlets. Tools have been developed that are attempting to assist authors in matching papers with appropriate journals, or allowing the comparison between potential publication outlets. One tool that is building the capacity to suggest journal titles based on particular attributes chosen by the author is the Cofactor Journal Selector Tool (Sharman, 2016). In 2010, members of the Association of College and Research Libraries Psychology/Psychiatry Committee combined information from the major tools, Ulrich's

Periodicals Directory, Elsevier's Scopus, and Thomson Reuters Web of Science in an attempt to create a type of "core journal list for psychology." (Paynter, Jackson, & Mullen, 2010)

Commercial publishers are now making tools available where an author can search by keyword, draft title, some selected article text and other factors in attempts to find potential journals across the publishers' lists of thousands of journal titles to which to submit draft articles. Springer Journal Suggester (https://journalsuggester.springer.com/) and Wiley's Find a Journal service (https://authorservices.wiley.com/author-resources/Journal-Authors/find-a-journal/index.html) are two such examples. These tools and others like them also help authors wade through an increasingly lengthy list of journals, whether open access, traditionally published, or those that contain a mix of both subscription and open access articles (hybrid).

Author Submission of Work to Psychology Journals and the "In Person" Conference

Decision-making by authors as to choice of publication outlet of course is key. For early career scholars, learning the traditions of the corpus of literature in the field is key and advice is needed from mentors and advisors, some of whom may not be aware of new methods of marketing work or using open science strategies. It is paramount for psychological science to ensure that researchers are empowered to use all available open science strategies to make the literature more visible to other scholars and the public. Engagement with publishers on open access and other associated issues may be more effective if done by established scholars. Senior scholars with a solid knowledge of new publishing paradigms and new ways of looking at author impact are essential to upending a model that may be somehow stuck in the past. With traditional forces at play in promotion and tenure decisions (like impact factor), there may be little room for early career researchers to create change. Regarding the situation in the U.S., one study of early career researchers (ECRs) shows that:

while not all ECRs knew about the scholarly communication practices of their mentors, advisors and supervisors, their assumption is that the practices of their senior counterparts are much the same as their own, except, possibly, in regard to social media and sharing. (PRC-CIBER, 2016, p.27)

Today, there are many options available for early sharing of drafts of articles, even before (or alongside) first submission to a scholarly journal. It is possible to consider a range of sharing of ideas through a continuum that might include sharing tweets from a conference, sharing ideas in an online forum, participating in blog posting or commenting, presentation of initial results at a conference (in person or virtually), posting a preprint online and getting important feedback from interested scholars across the world, and finally, if appropriate, submitting to a peer reviewed journal in the field. The creation of new knowledge can form a continuum from early idea on social media to published journal article. (Daniels, 2015) The open environment of the internet breaks down barriers and allows discussion by interested people that crosses disciplinary boundaries and invites a wide conversation. Invitations to present at conferences and to submit articles can be the result of this "self-promotion" on social/digital media platforms. Sharing via social media also promotes cross-disciplinary (and transdisciplinary) conversation and can lead to important new collaborations within institutions and with colleagues around the world.

One somewhat surprising element of scientific communication that seems here to stay is the in person annual meeting. Notwithstanding reductions in travel funding and other impediments, the annual meetings of major societies and organizations are still attracting audiences to exhibits, presentations and social events. It appears that in person networking and attending presentations in person is still important in many disciplines. (Mervis, 2013) Even though virtual conferences have sprung up and all sessions can be attended online, there is evidence that, for now, the in person meeting provides opportunities for attendees that don't necessarily translate into the online only environment. Large major conferences in psychological science, such as the annual American Psychological Association (APA) Convention, now having been held for 125 years, continue to be a draw. In recent years, attendance at the APA convention has been holding its own, with no evidence of major drop-off even in this online age. Registration numbers for 2016 are almost identical to those for 2012, and although a bit higher, 2010 and 2014 are almost identical as well, demonstrating that the convention continues to be of interest to its many attendees. (C.Won, personal communication, August 16, 2017) Even as researchers move to online meetings, there are new and exciting in person conferences popping up that continue to attract audiences. For psychological science, there is even a new conference (which started in 2016 and grew in 2017) that focuses on many new aspects of scholarly communication and research practices in the discipline. Known as SIPS (Society for the Improvement of Psychological Science) with its latest meeting described as "SIPS 2018 is an action-oriented meeting, serving our mission to improve psychological science. There will be no symposia or keynote speakers: the meeting will focus on initiating and conducting projects." (https://www.improvingpsych.org/SIPS2018/program/) This innovative meeting utilizes an Open Science Framework wiki at: https://osf.io/ck28s/

This dynamic forward-thinking SIPS conference includes training sessions, hack-a-thons, lightning talks, and unconference sessions that focus on topics such as metascience, improving measurement in research, replication, improving teaching and training, peer review, advancing data sharing and much more. (Center for Open Science, 2017b) This is a conference that, as time goes on could attract even more scientists, librarians, and all of those interested in open science and how it is utilized in psychology.

Another way to establish a scholarly presence and create visibility for one's work is through sharing ideas on a blog. Blogging is now an established part of our digital reading and writing culture, allowing ideas to be shared with interested audiences. Separating out quality scholarly and academic blogs from the deluge of other blogs on the internet can be daunting, and many potential readers stumble upon blogs by searching the content in a hit or miss fashion using Google or Google Scholar. Outside of discovering blogs through professional associations, networking with colleagues, or links from other information sources, at least one discovery service, ACI Scholarly Blog Index (https://aci.info/scholarly-blogs/) is an aggregator of scholarly blogs across all disciplinary areas. All of the blogs included in this service are individually curated by researchers and experts in the disciplinary or topical area. Searching ACI Scholarly Blog Index, via an institutional or personal subscription, surfaces high impact blogs, and is indexed in major library discovery tools such as OCLC WorldCat, ProQuest's Summon, EBSCO Discovery Service, and others. (ACI, 2016) Blog entries by leading scholars and thought leaders

are now an important part of primary source, current awareness scholarship, and are often cited in peer reviewed journal articles. Major libraries are subscribing to this resource, thereby including blogs in the search, discovery and access resources offered to researchers as part of the suite of subscription offerings.

Sustainability of the Societies; Will Open Access Harm the Societies that Serve Psychology?

As the open availability of research materials grows, there have been concerns about the membership benefit of the society journal, and as the call for more openness grows, there is a concern that membership in scholarly societies may decline. For many scholars, the issue of the sustainability of the societies has been a concern. Recent reports analyzing largescale changes in how scholarship is to be monetized admit that there may be a "ripple effect for societies that subsidize other activities via their publishing revenue." (Mellon Foundation, 2016, p.89)   With other disruptions in the system due to changing modes of conference attendance to more virtual, and the lack of as much interest in receiving the society's journal in the mail, or even online, open access is sometimes at issue. For many, the journal subscription may have been available online via the university library, further lessening the incentive of the journal subscription as membership benefit. Adding the move to an article-level discovery environment and the move of many learned society journals to the platforms of the largest commercial publishers, and it is obvious that societies had to view the increased opportunities for more visibility that are inherent in moving their publications to more open models, or to situations with limited (or no) embargoes. Ten years ago, Willinsky explored these issues when writing about the Society for Neuroscience, "that, even if no one disputes the public good represented by the greater circulation of this knowledge, how can a journal be expected to offer free access to its content and remain financially viable?" (Willinsky, 2006, p. 9078) At that time, Willinsky had also called for the societies to collaborate more with each other, and possibly with the large research libraries (many of whom became open access publishers using platforms such as Open Journal Systems) as open access was expected to move forward and journal access would not provide the same levels of sustainability. (Willinsky, 2004) The scholarly journal literature has been intertwined with the mission of the scholarly society, and the whole system is being disrupted as boundaries blur on the internet and journal publishing continues to consolidate toward a few very large publishers. Even large funder initiatives (such as the aforementioned "Plan S" currently emanating from Europe), with its lack of allowance for embargoes or closed access, will put pressure on society publishers. The value of the society will in the end be what its disciplinary community decides. Whereas learned societies and their publications have represented a necessary component of networking, an aspiration for researchers to publish in the society's journals, and a meaningful connection to the discipline, it will be interesting to see whether norms around professional membership connections for faculty, researchers, students and practitioners remain a vital and integral part of the scholarly communication landscape.

The American Psychological Association (APA) is the largest professional membership organization for psychologists as well as the largest nonprofit publisher of psychology abstracting and indexing services (PsycINFO), monographs, journals, and other popular

publications and research tools. The APA had 77,552 full members in 2015, a 4% decline for that year, even as more focus had been put on serious outreach to new and continuing members. (American Psychological Association, 2016a) Membership losses have been reported at APA in recent years. For instance, there was a significant decline of 7.6 percent in membership from 2010-2011. APA is not alone in its membership declines; the American Psychiatric Association, for instance, had a 7% membership decline from 2009-2012. However, the Association for Psychological Science (APS), saw a 16.3 percent overall growth from 2007-2011. This may represent growth in membership of a new generation of researchers in psychological science. (Grohol, 2012)

Clements, taking the example of the restricted subscriber access to articles in British Psychological Society (BPS) outlets, offers arguments for wide public access to research results, and even likely attracting more writers to BPS journals and lessening the subscription burden on libraries. If the public and even practitioners have restricted access, there is also an "ethical imperative of using psychology to help others." (Clements, 2016) The fact the American Psychological Association recently introduced an innovative open access, open data journal, *Archives of Scientific Psychology* is an indication of the organization's commitment to innovation and the wider dissemination of research results.

The Role of Academic Libraries Today in Advancing Research and Scholarly Communication

It is a time of transition and disruption for academic libraries. In this interconnected web of online research content, with all of it seamlessly hyperlinked with reader and researcher access as its goal, questions and challenges have emerged for another provider of current and older research material, the academic research library. The role of the brick and mortar academic library as sometimes gatekeeper, with its collection and preservation space reserved for the vast print journal literature has certainly changed and evolved. Concerns may arise around the continued availability into the future of the curated research level library collections that cover psychology from its historical roots to the present day. Electronic access to subscription literature via the libraries of institutions is today (not necessarily forever) still crucial to researchers, and all access must be remote and seamless from users' homes, via laptops or mobile phones, as well as on site at the university. Formats such as ebooks create disruption in libraries due to sustainability of these books in comparison to the collections of hardcover print titles. Due to digital rights management (DRM) issues, psychology's ebook collections have become less shareable between libraries via interlibrary loan. Academic libraries, stewards of the comprehensive literature of psychology, need to be concerned with the continued availability of an explosion of research literature online, including quality open access materials.

Academic and research libraries struggle with redefining and prioritizing the development of collections, services and new tools to aid researchers in their efforts to pull together a targeted search result. Readers and researchers increasingly seek tools that gather together scholarship in personalized targeted ways. Whether the solution to organizing the literature and making it discoverable falls to libraries or internet search engines, readers need to separate the wheat from the chaff, and researchers (with ever higher bars to jump over for

promotion and tenure) need to publish more often, and often in high impact journal titles. Psychology librarians are finding important new roles as partners in the research process with departmental faculty and university research offices in providing new scholarly communication services around open access, data services, use of research tools, consultation around citation metrics, and much more. Many academic libraries and librarians are providing a suite of new services centered around research data management, digital humanities, open access solutions for university-generated scholarship, open access policymaking, institutional repository and library publishing services, digital scholarship, citation management tools, scholarly networking services, open educational resources and open textbooks, or partnering to teach classes on reproducibility, for instance. Provision of services around increasing open access to scholarship is now an established part of the mission of university libraries, and extends the mission of librarians to connect all readers and researchers with the scholarly literature that they need. Psychology librarians will find a particular role in making sure they are connecting authors with open access services that can extend the reach of psychological science to other researchers and the public. Many librarians provide discipline-based scholarly communication information and consultation to faculty, staff and students. Many libraries have a focus on teaching scholarly communication topics such as open access strategies in their library instruction classes and in individual research consultations, even to undergraduates.

Open access is now part of the library. The corpus of openly available scholarship extends and complements traditional library collections even though it may be more difficult to capture, organize and make available to library users. This open access material must be made available alongside subscription content from the library. The future of the library depends in part on the ability for it to present a relevant, useful, organized, and easily discoverable collection to library users. Items in the collection must be chosen for quality, not whether the business model for a publication is OA or subscription-based. Whether a publication is available from the institution via subscription or allowed to be accessed freely from the internet is not a necessary distinction in terms of readers' need or interest. Open access collection development is still in its infancy and something with which libraries are grappling. For a subject specialist librarian, this leveling of the playing field between freely available scholarship and traditional subscription of purchased materials allows new opportunities to build collections without necessarily always having to pay. The challenge is in bringing *all* of this scholarship together for discovery by the university's readers and researchers. (Mullen, 2011) A new role for librarians building research-level psychology collections is to ensure that traditional as well as credible, quality, vetted scholarly open access materials are organized and made accessible in ways that are most useful to researchers. The library is still able to connect the research materials with the user in a way more effective than a search of the open web. A part of libraries' value for the user will be their ability to present a coherent "collection" of research materials for their constituencies, keeping the user from having to dig through a massive and continually growing corpus of material out on the web. The library can make available a meaningful and useful curated global subset of the available scholarship on the web. Subject specialist librarians also offer consulting services that can convey the most current ways to search, discover, and access targeted content. Changing roles for psychology librarians afford new opportunities for them to work more closely with faculty and students on scholarly communication issues.

Academic and research libraries (and librarians) find a natural fit with a continuing focus on the development of a useful suite of research and open access services. Scholarly communication, broadly defined, has always been within the purview of libraries, but now has come to signify a broad range of research services promulgated by librarians in their daily work as liaisons to departments, individual faculty members and researchers. Librarians are able to synthesize knowledge of a complex basket of metrics, with information on open access and research data management issues. Many librarians work in all of these newer scholarly communication areas while maintaining their focus on traditional reference services using a distinct disciplinary focus where needed. Librarians, especially the subject specialists can contribute to the literature of the field of Library and Information Science (LIS) with scholarly communication-related studies focused on the disciplines served. Collaboration with departmental faculty will allow the conversation to resonate with disciplinary faculty and researchers. Alongside this new focus on openness and scientific communication, libraries and librarians continue their focus on development of relevant collections, using the best strategies to provide discovery and access to the research materials needed by faculty, students and the public. Collection development now does not focus on just what is purchased or subscribed, but instead libraries need to gather all relevant quality scholarly material together and organize it for their constituencies. Traditional services such as interlibrary loan, circulation of books, and in person consultations with subject specialists are still important, but they exist alongside new services where departmental library liaisons now offer subject-specific advice on the use of open access strategies for faculty work and possibly participating in library-led publishing efforts, for example.

Many research libraries work to develop comprehensive institutional repositories (IRs) that ingest and preserve faculty scholarship (including all of the products of scholarship such as data), electronic dissertations, and a wide variety of other digital objects created at the institution. The institutional repository is focused on openness and collaboration with faculty and other libraries, and is crawled by Google and other search engines. An institution's IR serves as a vehicle that enables open science and open access to publications and data, and often is a valued service offered to faculty and students. Academic and research libraries are focused on the creation as well as the dissemination of scholarship. Research data management initiatives in libraries are evolving, and libraries and librarians are finding new and productive collaborations with other university offices such as the research office. Libraries, publishers, and vendors inhabit some of the same spaces and find some challenges and opportunities in collaborating with each other on open access or other important initiatives. (Mullen & Ross, 2016) Some publishers, such as the APA, have had close relationships with psychology subject specialist librarians via groups such as library advisory councils that have convened to work on information sharing and product development. There are some challenges for libraries and publishers in the areas of green and gold open access, which will in some ways be pushed toward solutions through increasing funder and reader/researcher demands for open access to taxpayer-funded research. Increasing discovery of articles via inclusion of more and more articles in Google Scholar and other search engines creates a demand for individual articles. Enhanced discovery fuels demand. All of the new publisher and library services play out against a backdrop that includes pirate sites like Sci-Hub, which shows no intention of slowing down as it

provides millions of users with access to proprietary subscription content worth millions of dollars. This access reportedly works in a way more seamless and simple than many university libraries' web scale discovery services (and database access) currently provides.

As library expenditures continue to be stressed by the costs of keeping up with commercial publisher bundles, and many potential former library users begin their research with Google Scholar or elsewhere on the open web, academic librarians seek closer relationships with their faculty, student and community constituencies, wanting to ensure that research services can be customized and targeted. Psychology librarians network nationally as members of the Association of College & Research Libraries' Education and Behavioral Science Section's (EBSS) Psychology Committee. Psychology/Behavioral sciences librarians interface with faculty, students, administrators, research office staff, publishers, vendors and others in order to ensure that psychology researchers have access to the most relevant and useful psychological science collections and services. Dolan's (2018) book "*A Research Guide to Psychology: Print and Electronic Sources"* provides a comprehensive treatment of the research literature of the discipline likely found in libraries with research-level psychology collections. Libraries can use this resource to ensure they are providing excellent library collections in psychology. Today, psychology librarians' roles often also expand from ensuring that the library is providing the research literature of the discipline to also include new services such as consulting on open access publication strategies, helping faculty to identify strategies for paying APCs (or BPCs), providing information on funder requirements, assisting faculty with data management planning, working on open journal publishing teams, assisting with systematic reviews or facilitating implementation of institutional open access policies for individual scholars and whole departments or schools. However, there is need for more contributions to the scholarly communication and open access literature that focus on the traditions and evolution of psychological science. Pulling this information on various scholarly communication topics together in an inclusive and accessible manner for all potential readers would create a more cohesive jumping off point for global discussions that could move the literature of psychology forward. There is no "one size fits all" when it comes to how the discipline will move forward with open access, open science, open data, metrics and how they are used for evaluation of scholars and other aspects of the complex landscape of today's scholarly communication environment. Psychology librarians serving research needs in the discipline and its subfields anticipate demand for services and workshops that target the current needs of researchers in scholarly communication and open access areas.

Conclusion

After so many years where there was little change in the way science was communicated, the vast potential of the internet for sharing and learning has opened new opportunities for authors, publishers, funders, and universities seeking maximum impact for the work of its faculty. The issue of open access alone exemplifies the transformation and disruption of scientific communication and scholarly publishing. Often, there will seem two sides when discussing the best way forward. Whereas green open access seemed to have its beginnings as a more grass roots movement of sorts, with making their work open access left to the authors

themselves (with allowances from publishers in some cases), or Harvard-style open access institutional policies stating right up front that scholars' works need to be made open to the world of potential readers, it remains only one strategy in place to increase the corpus of freely available online peer reviewed material. With gold open access, a more grass roots approach to publishing journals could be seen in university library publishing of journals using one of many open source services such as Open Journal Systems, allowing journal publishing to emanate directly from academia, not just from commercial and other traditional publishers. Currently, the commercial journal publishers are sitting right in the middle of the aforementioned "flip" of the system, offering paid open access options, with article processing charges far from standardized and all over the map, from zero to more than 5000 dollars US. The "hybrid" model also exemplifies in some ways where the system is now, with cash-strapped research libraries still negotiating complex subscription deals with commercial publishers while at the same time working to ensure that the work that their authors produce is widely disseminated. Authors at subscriber institutions are paying APCs to those same publishers, providing another revenue stream that is outside of the subscription outlay but adds to institutional costs. Megajournals have changed the landscape, where, even in psychology, many authors choose the more rapid and cross-disciplinary solutions of journals like *PLOS ONE,* or Springer Nature's *Scientific Reports*, which has taken over the top spot as "largest journal' with thousands of articles published in one annual issue. These megajournals help to subsidize the other high impact offerings of their publishers, and are able to offer to publish at what may be called a "reasonable" APC.

Complicating matters in the complex OA publishing landscape are the different approaches taken by various nations and funders and instead of one size fits all, the situation becomes almost dizzyingly complex. All in all, a pervasive audit culture is taking over at universities in many countries, leading to "publish or perish" scenarios and a need to maintain established high impact publication outlets, no matter the cost. At this point in time, there seems to be no sure way forward. There is talk of a "flip" of the entire system from subscription to open access, but there are still many concerns around issues like sustainability or inclusion of researchers from the Global South in this new system largely based around APCs. Too many researchers are shut out of the current system due to issues of language, resources, and other roadblocks. The library community as well as publishers and other stakeholders are currently discussing very intentionally how to increase diversity, equity and inclusion in many aspects of scholarly communication. There is a long way to go in addressing these concerns.

The licensing issues get increasingly sticky, and may be confusing to many authors and others who want to legally reuse work. Copyright remains a challenging part of the system for authors of scholarly works who sign away their works to publishers without expectation of payment. Authors are unsure of their rights to share as they publish their work. The complex rules surrounding copyright are not fully understood, or are not of interest to many academic researchers. Many working on open access solutions recognize the need for liberal reuse licensing, specifically the use of CC-BY, a Creative Commons license that allows any reuse of the content (with attribution) in order to spur innovation by maximal reuse and rebuilding of published text and data. This is another vital part of the open access conversation and academic libraries and their copyright and licensing specialists may be a vital piece of moving what many

view as "real" open access out to a research community that needs the ability to do text and data mining of more of the research corpus.

Finally, there seems a dearth of information on how psychological scientists are using and participating in all of the newer scientific or scholarly communication tools, resources and practices. At this point, there is much speculation as to how psychology faculty, authors, researchers and graduate students are using these all of the internet-enabled scholarly networks/academic social networks. There must be a call for more studies on scholarly communication behavior based around both existing disciplinary norms as well as newly emerging practices that speak to interdisciplinary areas of interest to psychological science. At present, psychology does not jump out as a disciplinary area that has fully embraced or even become a trailblazer in any areas of scholarly communication, such as open access (of all types). Certainly, the opportunity is there. Large scale qualitative or quantitative studies would be needed to tease out the behavior of psychological scientists at the disciplinary and subfield level. This type of research would serve to inform researchers, funders, librarians and publishers toward enhancing the scholarly and research environment that currently exists and could be enhanced to a greater degree for psychology.

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