

The Need to Humanize Open Science

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Introduction

The “open science” movement has reached a turning point. After years of advocacy, governments and major granting foundations have embraced many elements of its reform agenda. However, despite recent successes in open science entering the mainstream, the outlook for enacting meaningful improvements in the practice of science (and scholarship more generally) remains far from certain.

The open science movement needs to widen the scope of its reform agenda. Traditional publishing practices and modes of conduct have their roots in institutions and ideologies that see

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little critique among proponents of open access and open data. A focus solely on the symptoms of dysfunction in research, rather than the underlying causes, will fail to deliver meaningful positive change. Worse, we run the risk of seeing the cause of “openness” subverted to further entrench damaging institutional structures and ideologies. This chapter looks at the need to consider openness beyond narrow technical and licensing interoperability issues and explore the institutional structures that organize and govern research.

Background

I am writing this contribution from the perspective of someone actively working to reform scholarly communications. I lead development of Open Context, an open data publishing venue for archaeology and related fields.¹ Like many such efforts, most of Open Context’s funding comes from grants. Much of my time and energy necessarily goes toward raising the money needed to cover staffing and development costs associated with giving other people’s data away for free. My struggles in promoting and sustaining open data inform the following discussion about the institutional context of the open science movement.

My own academic training (doctorate in archaeology) straddles multiple disciplinary domains. Few universities in the United States have departments of “archaeology.” Instead, archaeology is taught in departments of anthropology (as in my case), classics, East Asian studies, Near Eastern studies, and other programs of humanities “area studies.” Within archaeology itself, many researchers see themselves first and foremost as scientists

¹ <http://opencontext.org>

attempting to document and explain economic, ecological, and evolutionary changes in human prehistory, while others orient themselves more toward the humanities, exploring arts, ideologies, identity (gender, ethnicity, class, etc.), spirituality, and other aspects of the lived experience of ancient peoples. Most archaeological field research, whether it emphasizes “scientific” or “humanistic” research questions, involves inputs from a host of specializations from many different fields. Archaeologists routinely need to synthesize results from a vast range of disciplines, such as geological sciences, material science and chemistry, zoology, botany, human physiology, economics, sociology, anthropology, epigraphy, and art history.

Humanities and Open Science

The wide interdisciplinary perspective of my background in archaeology makes me uncomfortable with some of the rhetoric of open science. From the perspective of an archaeologist, the “science” part of open science is not only vague, but seems to privilege only one aspect of our research world. The divide between what is and what is not considered to be science harkens back to historical contingency and institutional and political structures that allocate prestige and finances. In the US, science involves research activities funded by the National Institutes for Health (NIH) and the National Science Foundation (NSF). Other research interests lie at the margins and receive significantly less public support. Vested interests give these institutional structures a great deal of inertia and make them hard to change.

Digital technologies, data, data visualization, statistical analyses, and sophisticated semantic modeling now lie at the heart of many areas of humanistic study, often lumped together as

the “digital humanities.” Digital humanities research, like many areas of scientific research, also increasingly emphasizes access, reduction of intellectual property barriers, reproducibility, transparent algorithms, wide collaboration, and other hallmarks of open science. In other words, humanists and digital humanists often care as deeply about issues of intellectual rigor, application of appropriate theoretical models, and the quality of evidence as their lab-coat-wearing colleagues. Indeed, two (William Noel and myself) of the ten “Champions of Change” recognized by the White House in 2013 for contributions in open science were primarily funded by the National Endowment for the Humanities Office of Digital Humanities (NEH-ODH).² This is a remarkable achievement for the digital humanities community, considering that the entire NEH only sees a budget of US\$140 million per year—orders of magnitude less than both the NIH (US\$20 billion per year) and the NSF (US\$2 billion per year).

It is very difficult and arguably damaging to draw sharp boundaries in research so as to define science in opposition to other areas of inquiry. Archaeology is just one area where such boundaries routinely blur. The rise of the Digital Humanities does not necessarily mean an encroachment of scientific perspectives and methods into rather more interpretive and mathematics-shy areas of cultural study. Some of the discussion surrounding “Culturomics,” a term coined by Erez Aiden and Jean-Baptiste Michel to give their analyses of Google Books data (Michel et al. 2011) the same sort of scientific cachet as “genomics” or “proteomics,” implies a sort of triumph of statistically powered empiricism over

² See: <http://www.neh.gov/divisions/odh/featured-project/neh-grantees-honored-white-house-open-science-champions-change>

the pejoratively fuzzy, subjective, and obtuse humanities (see a fascinating discussion of this in Albro 2012).

The fact that we now have large datasets documenting cultural phenomena will not automatically transform humanistic research into just another application area of Data Science. A key research focus of the humanities (and many social sciences) centers on critique and analysis of otherwise tacit assumptions and *a priori* understandings. Like any area of intellectual inquiry, critique can be done badly, and there are plenty of examples of humanistic critique that read like self-parody. Nevertheless, humanities and social sciences perspectives can offer powerful insights into science's institutional and ideological blind spots, including the blind spots of open science.

With these issues in mind, I will continue to use the phrase “open science” in this discussion. However, the “science” I discuss refers to a wider universe of systematic study than often considered in contemporary university or policy-making bureaucracies. My use relates more to the Latin root of the term, *scientia*, referring to knowledge, or the German word *Wissenschaft*, signifying scholarship involving systematic research or teaching.³ I am adhering to the language of open science to help make sure the humanities, including the digital humanities, are part of the conversation on how we work to reform research more generally.

Open Science and “Conservatism”

Many academic researchers, at least in archaeology, the field I know best, are still largely oriented toward publication expectations

³ Thanks to @openscience for helping me explore these issues. I am very gratified by the commitment of @openscience toward all areas of research, including the humanities and social sciences.

rooted in mid-20th or even 19th century practice. But that orientation does not reflect our current information context. The World Wide Web has radically transformed virtually every sphere of life, including our social lives, commerce, government, and, of course, news, entertainment, and other media.

The Web itself grew out of academia, as a means for researchers at CERN and other university laboratories to efficiently share documents. Ironically, academia has been remarkably reluctant to fully embrace the Web as a medium for dissemination. The humanities and social sciences, including archaeology, are notable in how little social and intellectual capital we invest in web-based forms of communication.

The reluctance of many academics to experiment with new forms of scholarly communication stands as one of the central challenges in my own work with promoting data sharing in archaeology. One would naively think that data sharing should be an uncontroversial “no-brainer” in archaeology. After all, archaeological research methods, particularly excavation, are often destructive. Primary field data documenting excavations represent the only way excavated (i.e. destroyed) areas can ever be understood. One would think this would make the dissemination and archiving of primary field data a high priority, particularly for a discipline that emphasizes preservation ethics and cultural heritage stewardship (Kansa 2012).

Despite these imperatives, archaeologists often resist or avoid investing effort in data stewardship. It may be tempting to cite academic conservatism as a rationale for this reluctance, but this has little explanatory power. Archaeologists are, if anything, very selective in their “conservatism.” Many are highly engaged with new technologies. Photogrammetry (sophisticated digital image processing), X-ray diffraction (instruments

to study chemical compositions), geographic information systems, remote sensing (satellite and other reconnaissance data), various geophysical methods (ground penetrating radar, magnetometry), three-dimensional modeling, and even drones see rapid adoption in the discipline. Archaeologists also have professional incentives to distinguish themselves among their peers and do so through publishing innovative approaches in archaeological methods, theories, or interpretations. However, while archaeologists strive to innovate in many areas of their professional lives, publication practices remain highly resistant to change. To explore why, we need to look at the larger institutional and professional context in which academic archaeologists work. This context is broadly similar to many other areas of research and can help illuminate issues faced in promoting open science.

Open Context, Open Data, and Publication

Publication lies at the heart of most fields of academic inquiry. It plays an integral role in our success in finding grants and employment, and it helps structure our identities as researchers. The economics, expectations, and constraints of publishing practices help shape what we know and communicate in all fields of research. In the case of archaeology, the communication and preservation of primary field data and documentation fits poorly into normative publishing practices. This leads directly to the hoarding, neglect, and loss of archaeological data.

Many of our colleagues prioritize publication goals over virtually every other professional goal. We have to understand and negotiate this reality in our efforts to promote data sharing in archaeology. To this end, Open Context, the data sharing system

I direct, has adopted a model of “data sharing as publication.” Open Context publishes a wide variety of archaeological data, ranging from archaeological survey datasets to excavation documentation, artifact analyses, chemical analyses of artifacts, and detailed descriptions of bones and other biological remains found in archaeological contexts. The datasets comprise rich media collections, including tens of thousands of drawings, plans, and photos of artifacts, archaeological deposits, and ancient architectural features. The range, scale, and diversity of these data require dedicated expertise in data modeling and a sustained commitment to continual development and iterative problem solving. Most content in Open Context carries a Creative Commons Attribution License and can be retrieved in a variety of machine-readable formats (XML, CSV, JSON, RDF).

We use “data sharing as publishing” to help encapsulate and communicate the investment and skills needed for sharing reusable data. A publishing metaphor can help put that effort into a context that is readily recognized by the research community (i.e. data publishing implies efforts and outcomes similar to conventional publishing). We hope offering a more formalized approach to data sharing will promote professional recognition (as noted by Harley et al 2010), which would motivate better data creation practices at the outset. Ideally, “data sharing as publishing” can help create the reward structures that make data reuse less costly and more scientifically rewarding (Kansa & Kansa 2013). Open Context uses the EZID system to mint persistent identifiers (digital object identifiers (DOIs) and archival resource keys (ARKs), and archives data with the University of California’s California Digital Library, a unit that runs a major digital repository called Merritt. Archiving and persistent identifiers provide a stable foundation for the citation of data, an important issue to

consider in situating data sharing within the Academy's conventions and traditions (see also Costello 2009).

At the same time, we recognize some of the limits of using “publication” as a metaphor for data sharing. In our experience publishing data, some problems in data recording and documentation only became evident after researchers actually tried to reuse and analyze each others' datasets (Atici et al. 2013; Kansa, Whitcher Kansa & Arbuckle 2014). In other words, problems in a dataset may go undetected even after cycles of editorial review and revision, only to be discovered long after publication. Even using the term publication with data can carry the unfortunate baggage of implying finality or fixity.

Open Context's datasets are not fixed as static products, despite our use of the term “publication”. For instance, we need to revise datasets periodically to fix errors or to annotate with new controlled vocabularies and ontologies through linked open data methods. In many respects, then, Open Context treats datasets as software source code. Like source code, the data are expressed as structured text and new versions are “pushed” to the community of users. The use of version control systems (such as GitHub, in the case of Open Context) can improve the management, professionalism, and documentation associated with ongoing and collaborative revision of datasets (for a thoughtful discussion see Kratz and Strasser 2014).⁴

Open Context now publishes key datasets in a number of specializations covering topics as diverse as the development of early agricultural economies to the comprehensive settlement history

⁴ A recent paper details a case study for how Open Context's editorial, annotation, publishing, and version control practices assisted in the analysis and interpretation of multiple datasets submitted by 34 archaeologists studying early agriculture in Turkey (Kansa et al. 2014).

of large portions of North America.⁵ Despite these developments, data sharing and data publication are still not expected aspects of archaeological scholarship. Though data management sees growing recognition in the archaeological community, few archaeologists feel free to commit to the effort required to improve data quality and documentation. This hesitation stems from relentless professional pressures that make any deviation from established norms almost unthinkable.

A Context of Neoliberalism

Why is it so difficult for many researchers to deviate from established modes of publication? This question lies at the heart of many discussions about open science and scholarly communications. And while most open science advocates acknowledge the challenge of overcoming professional incentives that inhibit reform, there has not been enough discussion of the institutional basis of those (dysfunctional) professional incentives.

In much of the wealthy, industrialized world, the past three decades have witnessed an accelerating consolidation of “neoliberalism,” a loosely-associated set of ideologies, economic policies, and institutional practices. Using a vaguely defined term like neoliberalism can be problematic especially when applied too broadly (Kingfisher & Maskovsky 2008). However, this discussion focuses on policy and governance issues in academic institutions, and in

⁵ The Digital Index of North American Archaeology (DINAA project, led by David G. Anderson and Joshua Wells) publishes “site files” compiled by state government officials that inventory and document archaeological and historical sites identified by archaeologists. Identification of most of these archaeological sites resulted from contracted studies (“cultural resource management”) to comply with federal historical protection laws. See: <http://ux.opencontext.org/blog/archaeology-site-data/>

this context, neoliberalism offers a useful shorthand for discussing a variety of loosely related ideologies and practices (Lorenz 2012; Feller 2008). Very broadly, neoliberalism refers to policies of economic liberalization (deregulation), imposition of “market-based” dynamics (as opposed to central planning or public support and financing), and corporate management methodologies, especially workplace monitoring and performance incentives.

What does neoliberalism have to do with academic publishing? As it turns out, virtually everything about scholarly publishing in one way or another relates back to neoliberal policy making. Over the past few decades, consolidation in academia’s commercial publishers has helped fuel dramatic price increases, averaging 7.6% per year for the past two decades and amounting to 302% cost increases between 1985 and 2005 (McGuigan et al. 2008). Ideologies and policies favoring market deregulation permit such commercial consolidation. At the same time, escalating subscription costs give commercial publishers consistently high profit margins—35% in the case of Elsevier (Mobbiot 2011). These price increases further exacerbate other outcomes of neoliberal policies. While publication costs skyrocket, academic libraries witness declining budgets as higher education institutions struggle in a climate of fiscal austerity.

The escalating cost of higher education, or, rather, the increasing co-option of research and educational funding streams toward corporate interests, inevitably means that academic institutions pass the costs of neoliberal policies on to core constituents, namely faculty and students. Researchers see reduced salaries, smaller research budgets, and cut-throat competition for fewer faculty positions. Academic labor has become increasingly contingent, as part-time and short-term adjunct faculty contracts have become the norm. The pay and working conditions of this

contingent class of scholars requires many of them to supplement their income with public welfare assistance to pay for basic necessities such as food and shelter (Patton 2012). At the same time, students see explosive growth in tuition, and in the US, this has fed a mind-boggling US\$1.2 trillion level of student debt (Denhard 2013).

Neoliberal pressures on archaeological publication extend beyond cost increases and reduced public financing. Neoliberal ideologies also emphasize “instrumentalism” in research and education (Hamilakis 2004). Policy makers increasingly expect direct and immediate financial returns for investment in education and research. Research, instructional, and other scholarly activities increasingly need to “pay for themselves.” This driver makes it extraordinarily difficult to finance open data, especially in a long-term and sustainable manner (see below).

Instrumentalism creates pressure to align scholarship toward easily commercialized ends. Students, under pressure to justify high levels of debt, feel compelled to focus on subjects thought to give high financial returns. Archaeologists often need to justify their course offerings in how they give students “transferrable skills” that can be applied in more practical domains. University administrators also increasingly use instrumentalist rhetoric to argue against further erosion of public financial support. Because most public financing of research goes toward medical, engineering, or scientific domains critical for economic competitiveness (another neoliberal trope), university administrations prioritize these easily monetized domains in new hires, facilities, and other supports. For the humanities and social sciences, including archaeology, this has exacerbated the bite of publication cost escalations. The worst publication cost escalations have focused on science, technology, engineering, and medicine (STEM) journals,

yet those are the journals prioritized in library budgets because of their strategic importance to universities. This leaves even less money for books and journals in the humanities and social sciences (Steele 2008; Davidson 2013).

Academic publication is not just about communicating with one's peers. It involves a selection of venues, choice of language and style, and other signals that communicate one's claims to a certain professional identity. Many of us who have taught undergraduate and graduate students have personally observed and mentored student learning in how to communicate like one of us. It is a central aspect of the reproduction of academic culture. The mastery of publication practices can make or break a career, because publication is so heavily invested with prestige and social capital. Journals can have very competitive review processes and rejection rates. A citation or a positive review from an elite scholar has implications for employment. The adage "publish or perish" captures these high stakes.

The Public Library of Science (PLOS) achieved remarkable early success in drawing social capital to its titles. Sadly, the success of PLOS has been slow to replicate in many other disciplines. It is very difficult to promote new and unfamiliar forms of scholarly contribution with uncertain rewards when many in the research community feel increasing pressure to perform in clearly recognized ways. Diane Harley and colleagues (2010) led the largest and most comprehensive investigation of scholarly communications practices to date. Part of their study focused on archaeology. Unsurprisingly, they noted how professional incentives and rewards deter many faculty from participating in digital publishing. Faculty often feel wary of committing effort toward digital projects when mainstream publication offers much more clear and certain rewards.

Counting Publication with Performance Metrics

It is ironic that even though many researchers are reluctant to share data, most common publication incentive structures *treat their papers as data*. In many institutions, hires, promotion, and tenure all center on numeric assessments of a given researcher's publication record.

The growing importance of performance metrics further fuels the competitive fire of academic publishing. The rise of performance metrics represents an important change in academic administration and is often seen as another manifestation of neoliberalism (see overview by Feller 2008). Performance metrics have assumed greater importance in administration and governance because of their apparent objectivity in assessment. Administrative bureaucracies tend to promote metrics because they promote “accountability” by giving clear and quantified outcomes of work these bureaucracies manage and finance. The apparent objectivity of quantification further legitimizes allocation of resources based on metrics. Metrics, unlike more qualitative assessments, seem (at first glance) less susceptible to biasing by age, class, gender, race, or other social and political factors that may color judgments about performance.

Thus, performance metrics are integral aspects of rational meritocracies including, especially, the Academy. One does not need to look hard for examples of how performance metrics help shape academic practice. The UK and Australia have enacted two of the most prominent and ambitious programs of academic performance monitoring with, respectively, the Research Excellence Framework (REF) and the Excellence in Research for Australia (ERA). While the US has a far more decentralized institutional context for universities and has no equivalent to the REF or ERA

systems, various performance metrics also feature prominently in allocating resources, at both the institutional and researcher levels (Feller 2008).

In describing metrics, I use the phrase “apparent objectivity” quite deliberately. We live in a vastly complex social world. This complex reality offers many phenomena that we can potentially choose to count and measure. However, even in an era where data collection is cheaper and easier than ever, we select only tiny slices of our overall social reality to quantify. Our models of how people and organizations perform, practical and legal issues, as well as institutional and ideological factors, all shape which social phenomena we choose to measure. These factors come together to make the quantification of a complex social process like research less objective than it can initially seem.

When metrics become significant factors in attracting or allocating financial resources, the choices involved in selecting metrics necessarily become political choices. Metrics measure what certain institutions value, and those measurements can become increasingly valued by institutions. In these circumstances, feedback loops can entrench certain metrics into becoming significant institutional or organizational goals unto themselves. As already discussed, neoliberal policies ratchet up competition for jobs and funding. In this relentlessly competitive context, various institutional and individual performance metrics can become potent motivators toward certain kinds of behavior.

The role of metrics in shaping publication practices has received a great deal of attention. The often criticized Impact Factor started out as a way for librarians to make more informed choices about journal subscriptions (at least according to Curry 2012). In that context, the Impact Factor was relatively benign (see Garfield 2005). However, according to many scientists and other

observers (see below), the Impact Factor evolved into a proxy for assessing the quality of individual research contributions. In other words, it became a tool for Taylorism. Taylorism refers to Fredrick Taylor, the originator of “scientific management,” a highly influential approach to workplace administration that emphasizes achievement of discreet, quantified goals to promote productivity. It carries negative connotations of coercive monitoring and dysfunctional misalignments between meaningful but abstract goals and the actual behaviors being measured. Above all, Taylorism implies reduced workplace autonomy, diminished creativity, and the dreary mass-production of standardized, readily quantified products. These are precisely the criticisms levied against university bureaucracies that draw on the Impact Factor for hiring and promotion decisions.

Given the potent role played by publication metrics and the difficulty inherent in distilling complex social realities into simple measurements, metrics are hotly debated. In 2013, the San Francisco Declaration on Research Assessment (DORA) was signed by several journal publishers and editors, hundreds of organizations, and, more notably, more than 10,400 members of the scientific community.⁶ DORA represents one of the most visible acts of protest against the use of Impact Factors in measuring the quality of an individual’s research.

Further demonstrating dissatisfaction with conventional citation metrics, ImpactStory.org recently launched (with major funding from the Alfred P. Sloan Foundation) an effort to provide alternative measurements of research outputs better aligned with Web-based modes of communication. Conventional citation metrics only count papers published in traditional

⁶ See: <http://am.ascb.org/dora/>

peer-reviewed journals. Any form of scholarly contribution that falls outside of these venues, such as software, computational models, data, or blog posts literally do not “count.” Researchers and institutions that value such alternative forms of scholarship often want their Web-native forms of contributions to count, provoking widespread enthusiasm among reform activists for the type of “altmetrics” (alternative metrics) being developed by ImpactStory.org.

Should We Count on Better Metrics to Make Science Open?

I do not have the expertise to more fully explore issues in bibliometrics (the studies involving the quantification of research publications), nor to discuss the relative merits of different forms of citation analysis and impact rankings. I also do not want to dismiss the field of bibliometrics (or even the Impact Factor itself) as nothing more than a dystopian tool of neoliberalism and Taylorist surveillance. Bibliometrics can be useful and powerful tools in library and information science to promote information discovery, identify linkages between concepts, and other important (from a research perspective) ends. Thus, there is nothing inherently wrong with exploring and refining new types of citation metrics and altmetrics. In fact, this is an important area of research deserving attention and support.

The problem with metrics lies not in quantifying research outputs *per se*, but rather how institutions use metrics to shape behaviors. The clearest problem I see in relying on metrics as a tool for reform centers on the inertia behind the institutionalization of a particular metric. Data sharing advocates often talk about how data should be rewarded just like other forms of publication. Data

should “count” with measurable impacts. If we convince universities to monitor data citation metrics, they can incentivize more data sharing. We can also collect a host of altmetrics to incentivize other forms of Web-based collaboration and open source projects.

Unfortunately, it takes a great deal of time to convince university bureaucracies and granting foundations to adopt a new system of metrics. Entrenched constituencies inevitably have vested interests in already established means of assessment. Introducing new metrics that may disrupt an established *status quo* will be a slow and sometimes painful process. By the time a given metric becomes incorporated into administrative structures, the behaviors it tries to measure will not necessarily be innovative anymore. Worse, even the most forward-looking current altmetrics cannot anticipate (or, thus, accommodate) future innovative approaches to scholarly communication. Thus, unanticipated innovations in the future *still* will not count.

Using metrics implies that the objects being measured are commensurate and this may undermine the value of scholarship. For example, a certain dataset may uniquely and irreplaceably document a key epigraphic corpus of a long-dead civilization whose written language is only understood by a dozen scholars worldwide. This dataset may count for next to nothing using conventional impact metrics or even altmetrics. Yet, it would be measured in the same way as a paper describing a new readily commercialized nano-material or a dataset documenting social networks among corporate board members. These different forms of scholarly contribution each have great value in their own right, but their significance is highly context-dependent. It is very difficult to compare their relative worth, and indeed such comparison may cheapen their value in unforeseen ways.

If we see all forms of scholarship as assessable through a common set of metrics, we risk ignoring key contextual associations that differentiate meaningful “knowledge” from mere “data.” Ignoring context can mean any given metric will be as arbitrary and meaningless in a given situation as a measure of file size or a paper’s alphabetical ranking by title. In other words, there is a danger institutions may use metrics to treat research outputs and data as somehow “fungible” (functionally interchangeable) and in the process devalue or diminish scholarly context.

Both conventional metrics and altmetrics attempt to measure “impact.” The website RetractionWatch.com, a venue for tracking increasing levels of publication retraction, notes how an incentive structure favoring quantity and “splashy” findings encourages shoddy research and sometimes outright fraud (see also Fang and Casadevall 2014 noting a strong positive correlation between journal Impact Factor and retraction rates).⁷ It is possible there may be even more insidious issues in emphasizing performance metrics and altmetrics that measure impact. Do impact metrics exacerbate “hype-cycles” and band-wagon effects of chasing short-term popularity at the expense of long-term (possibly more meaningful) research programs (Field 2013)? Many forms of impact can be diffuse and difficult to observe, especially when they relate to policy making. I have helped set data sharing agendas for professional societies and granting foundations and none of those activities would count in any conceivable metric or altmetric. I raise these issues because I suspect that we take far too much for granted when we discuss and attempt to measure impact.

⁷ See this fascinating discussion thread: <http://retractionwatch.com/2014/04/07/pain-study-retracted-for-bogus-data-is-second-withdrawal-for-university-of-calgary-group/#comment-90374>

Impact is only one of a wide array of possible ways to quantify research. Tim McCormick started a provocative thread on Twitter (McCormick 2014) under the #allmetrics hash-tag, making a clear reference and unique twist to the #altmetrics hash-tag. In the thread, McCormick asks if there are other valences and dimensions to scholarship that can and should be counted than those that measure exposure and attention, as is the case with conventional citation metrics and altmetrics. His comments point to the political processes and ideological assumptions inherent in how certain metrics gain institutional power. One can imagine a whole host of metrics aimed at measuring labor conditions and hiring equity of laboratories publishing biomedical research, or metrics counting investments in mentorship associated with faculty and student field work and data collection. These examples seem almost comical because it is difficult to imagine contemporary universities caring about such issues sufficiently to actually develop policies based on such radically different metrics.

The problems we encounter in encouraging more open, transparent, and collaborative forms of research stem not merely from the reign of certain bad legacy metrics, but from institutional structures that promote profound power inequalities. Those power relationships make metrics far too influential in shaping research agendas, outcomes, and careers. It is the obsession with performance metrics itself, not the choice of metrics, which stifles academic freedom. Researchers need the space and autonomy to experiment, creatively play, take risks, and occasionally fail. The constant pressure to maximize measurable performance inhibits precisely those aspects of science and research we should most value.

Institutional hierarchies are partially defined by who measures and monitors whom, and according to what metric. In other words, establishing and enforcing metrics can be political tools

to discipline members of a community. Neoliberal policy seems to care little about the human costs and creativity loss associated with maximizing research productivity as narrowly defined by a given metric. So while altmetrics that incentivize behaviors like data sharing can conceivably gain some traction (after much struggle) in current institutional settings, other more radical forms of “allmetrics” that measure such issues as labor conditions in research are probably nonstarters.

This last point raises an important issue. An open science reform agenda needs to extend beyond a focus on copyright licenses, access to research data, and collaboration on GitHub. Institution-izing meaningful open science reforms probably also requires reform and reconfiguration of the institutions in which researchers work. Homogeneous career options, institutional structures, and performance metrics will continue to promote homogenous researchers and research outputs. If we want to encourage more innovation and diversity in the conduct of research, we should encourage and reward more diversity in career paths and institutional structures. Innovation in open science will require investing in new institutional forms that better recognize and reward collaboration and communication of the research *process*, not just the finished product.

Though the above discussion highlights my skepticism of using better metrics to “count” our way to open science, recognizing such issues helps us seek alternative approaches. Efforts like ImpactStory.org are important and relevant because they start a much needed conversation about how to encourage higher quality, more collaborative, and more ethical conduct. Yet we should remember that altmetrics need to be the start of the conversation, not the end. The need for reform goes far deeper than selecting the right impact measurements.

Open Science, Public Goods, and Communities

The largest and most entrenched policy barrier to promoting open science centers on the current neoliberal climate of relentless competition. Open science seeks to improve research practice by making the process of research as evident and open for collaboration, scrutiny, reuse, and improvement as the final products of research. Exposing the research process to a wider community requires a high level of collegiality and trust. Cynically, I suspect that collegiality and trust are precisely the personality traits and inclinations that are most at odds with career success in many academic departments.

Any research career now involves tremendous risks ranging from dismal serfdom as an adjunct to complete ejection from academia. Most researchers (save for an exceptionally brave or foolhardy few) are loath to expose themselves to even more risk by adopting novel open science modes of practice. If research remains a hyper-competitive, zero-sum game, no amount of data citation or altmetrics will lead to trust or collaboration. Worse, we could face a situation where counts of datasets and GitHub updates succeed in “open washing,” a system whose fundamentals breed anxiety, suspicion, and escalating pressures to cut corners.⁸

The risks of open washing are real. In our efforts to promote open data and open science more generally, we often use neoliberal policy arguments. We emphasize how open data and open science will reduce overall costs and introduce new commercial opportunities for entrepreneurs and their investors. After all,

⁸ “Open washing” borrows from the phrase “green washing.” Green washing describes superficial measures to give the appearance of environmental sound and sustainable practices. Open washing similarly describes superficial and insubstantial measures that signal openness.

canonical definitions of open data require data to be freely available for commercial use without restriction. Awkwardly, someone still needs to finance the creation and maintenance of the open data that can have such wonderful commercial utility. Where will that money come from? On this issue, open science clearly clashes with neoliberalism. It is very difficult to get open data to pay for itself because open data is an almost perfect example of a public good, a type of resource markets almost invariably fail at supplying. And yet, despite public policy interest in open research data, nobody seems to know how to finance it, even at the level of the White House.⁹

While a free and open research data commons can indeed spark entrepreneurial commercial development, we enter dangerous territory by limiting our arguments to such narrow instrumentalism. Some forms of research data may have very little direct commercial interest, and may be valuable only when understood in an appropriate context. Unfortunately, neoliberal ideologies and policy making have very little time for contextualizing knowledge and knowledge creation. The *ne plus ultra* example of a neoliberal metric is the final financial return on an investment.

Let me give an example of why this hurts the cause of open science. Take a resource like the Sloan Digital Sky survey.¹⁰ Though it lacks clear commercial potential, at least in the short term, it represents an invaluable resource for exploring basic questions in astronomy and cosmology. Such basic research, through many twists and turns, may lead to applied science and

⁹ Federal agencies supporting research are not likely to receive additional funding to support open data services, despite the Office of Science and Technology Policy memorandum calling for open data dissemination of federally funded research (Holdren 2013).

¹⁰ <http://www.sdss.org/>

engineering that can see eventual commercialization. But even more importantly, the basic research activity itself has an (admittedly diffuse and hard to measure) intrinsic value. It provides a fertile domain of fascinating questions that sharpen minds, promote analytical thinking, and spark curiosity and wonder at the world. Research in other “useless” fields like archaeology or the humanities and social sciences has a similar intrinsic value. Unfortunately, activities and outcomes that are difficult to quantify or involve wide and diffuse externalities struggle to gain recognition in neoliberal settings.

For open science to really succeed, reform advocacy needs to dismantle a powerful and entrenched set of neoliberal ideologies and policies. Some of the key benefits of open science center on diffuse and hard-to-quantify externalities, namely trust and collaboration. Trust and collaboration are key enablers in any social enterprise, including research. We erode trust at our own peril, and making up for a loss of trust through more intrusive surveillance (or metrics) exacerbates costs and dysfunctions. If we want open science to truly succeed, we need, first and foremost, to establish institutional and policy frameworks that are humane and help to cultivate community.

Conclusions

Most of this paper has focused on the underlying policy and ideological challenges that make open science difficult to institutionalize. Tinkering at the edges of a fundamentally flawed and abusive research system will do little to promote meaningful reform. Real change will require a policy and ideological commitment to making the research process more humane—not simply more productive or high-impact. That change will only

come through renewed public support and financing for basic research so that competitive pressures do not kill collegiality. Meaningful reform will also require a renewed commitment to basic notions of academic freedom and autonomy so that metrics and altmetrics serve researchers, and not the other way around.

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