



Open Access to Research

Changing Researcher Behaviour Through University and Funder Mandates

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Abstract: *The primary target of the worldwide Open Access initiative is the 2.5 million articles published every year in the planet's 25,000 peer-reviewed research journals across all scholarly and scientific fields. Without exception, every one of these articles is an author give-away, written, not for royalty income, but solely to be used, applied and built upon by other researchers. The optimal and inevitable solution for this give-away research is that it should be made freely accessible to all its would-be users online and not only to those whose institutions can afford subscription access to the journal in which it happens to be published. Yet this optimal and inevitable solution, already fully within the reach of the global research community for at least two decades, has been taking a remarkably long time to be grasped. The problem is not particularly an instance of "eDemocracy" one way or the other; it is an instance of inaction because of widespread misconceptions (reminiscent of Zeno's Paradox). The solution is for the world's research institutions and funders to (I) extend their existing "publish or perish" mandates so as to (II) require their employees and fundees to maximise the usage and impact of the research they are employed and funded to conduct and publish by (III) depositing their final drafts in their Open Access (OA) Institutional Repositories immediately upon acceptance for publication in order to (IV) make their findings freely accessible to all their potential users worldwide. OA metrics can then be used to measure and reward research progress and impact; and multiple layers of links, tags, commentary and discussion can be built upon and integrated with the primary research.*

Keywords: open access, self-archiving, research impact, open access mandates, metrics, citations

Acknowledgement: This paper was prepared with the help of funding from Social Science and Humanities Research Council (SSHRC, Canada) Grant 41020101977

I am going to present a somewhat conservative perspective on "edemocracy" in the area of scholarly and scientific research. This perspective is *radical* on the subject of public access to scholarly and scientific research (especially researcher access), *open* on the subject of public contributions to scholarly and scientific communication (especially researcher contributions), and *traditional* on the subject of peer review and peer-reviewed publication (Harnad 1998).

1. Scholarly and Scientific Research

1.1. Open Access to What? Peer-Reviewed Research

First, the target content: This paper is focused exclusively on the c. 2.5 million articles that are being published each year in our planet's c. 25,000 peer-reviewed journals (and conference proceedings), across all scholarly and scientific disciplines (ULRICHS).

This special literature is written primarily *by* specialists *for* specialists. If it were already accessible to all of its intended users, the major obstacle would be out of the way and we could focus on making its public usage broader and more "democratic." But these papers are not yet accessible to all their primary intended users, and the reason underlying this access shortfall is paradoxical and perhaps instructive, concerning more general questions of edemocracy: For the fact is that these special papers are all, without exception, written by researchers solely to be used, applied and built upon by other researchers; they are not written for royalty revenue; the authors' careers depend on their papers' uptake and impact; subscription barriers are preventing many of

this work's potential users from being able to access and use it; and yet only about 15% of these special authors are making their papers freely accessible ("open access," OA) online (Björk et al., 2009; Gargouri et al., 2010), even though it has been not only technically possible but easy to do so for at least two decades now (Harnad 1990, 1995).

1.2. Why Is All Peer Reviewed Research Not Yet Open Access?

It might accordingly be useful to look more closely at why so much of this special content, written solely for impact rather than income, is not yet spontaneously being made OA by its authors today, despite the fact that it is strongly in their interests to do so. We will not consider books for now, because books are not yet writings that are, without exception, written by researchers solely to be used, applied and built upon by other researchers: Most books still seek the prestige of a print edition, for which the publisher must make ends meet; and many books are still written in the (slender) hope of some royalty income (Harnad et al., 2000). It is likely, however, that the problems — and their solutions — in the special case of journal articles will put into context the stakes and prospects for other kinds of content too (not just books, but data, software, music, video and multimedia content).

1.3. Publish Or Perish

Scientists and scholars, when they are doing their professional work, are not anonymous wikipedia-authors, self-publishing bloggers or discussion-list debaters (although they may do all those things too, when wearing other hats). They have academic careers and research agendas for which their research publications are the crucial currency for advancement. What "counts" in an academic curriculum vitae, in academic performance review and in the prospects for research funding is peer-reviewed journal articles. This is "publish or perish." And what matters is not only, or primarily, (I) how many articles an author publishes but (II) how high the quality standards of the journal in which it is published rank in the quality hierarchy of journals in the field as well as (III) how much each individual article is taken up and used to generate further research progress. Each of an author's articles is ranked by both its own individual citation count and the average citation count of the journal in which it was published (Bollen et al., 2009; Harnad 2009).

1.4. Open Access Increases Research Usage and Impact Metrics

Citation counts are not the only indicators of article quality and importance; soon they will be supplemented by batteries of rich new online metrics of research impact, including download counts, usage and citation growth/decay metrics, tags and comments (Bollen et al., 2009; Brody et al., 2007; Harnad 2008, 2009). But a journal's citation impact is correlated with other correlates of research quality, such as peer rankings. Nor is that a surprise, since a journal's quality depends largely on its quality-control standards, and those, in turn, are based on peer review (Harnad 2004). It has repeatedly been confirmed now, in every discipline where it has been tested, that making peer-reviewed journal articles OA significantly increases their download counts as well as their citation counts (on average, but especially for higher-quality, hence more citeable articles) (Gargouri et al. 2010; Hitchcock 2011; Swan 2010).

2. Current Paradoxes of Open Access

2.1. Only 15% Open Access Despite Evidence OA Increases Impact

The first of the paradoxes of OA is accordingly the fact that only 15% of authors are spontaneously making their published articles OA — by making them freely accessible on the web — despite the evidence that OA can increase citations (from 25% to over 250%) (Brody & Harnad 2004). It is not at all surprising that authors continue to seek to publish their papers in the highest-quality journals whose peer-review standards they can meet, but it is paradoxical that all or most

authors are not yet seeking to top up those papers' usage and impact metrics by going on to make them OA.

2.2. Most Universities Have Repositories and Most Journals Endorse Deposit

The reason most authors are not yet making their articles OA is not that their institutions lack institutional repositories (IRs) in which to deposit their papers, for there is now free software for institutions to create IRs (Tansley & Harnad 2000), and at least 2000 universities (including most of the top ones) already have IRs (ROAR) – but almost all of them languish at the 15% deposit level or below. Nor is the reason IRs are 85% empty that most journals oppose OA: Over 90% of journals already officially endorse making the author's draft OA in some form, with 63% (including almost all the top journals in most fields) endorsing immediate OA for the final, peer-reviewed, accepted draft. The second paradox of OA is hence that even worries about journal copyright restrictions cannot explain why only 15%, rather than at least 63% of papers are not already being made OA by their authors today (ROMEIO).

2.3. “Fair Use” Button

IRs even have a “fair use” button, that makes it possible for any authors who have copyright worries to deposit their papers as “Closed Access” (CA) instead of OA (Sale et al., 2010): This means that only the metadata of the deposits, not their full texts, are accessible to all. If an individual user reaches a paper that has been deposited as CA instead of OA, they can insert their email address and click the button to send an automated email request to the author to request one copy of the final draft, for research purposes; the author can then authorize a single automated emailing of the full text to the user with one click (Carr & Harnad 2005). That would effectively cover the remaining 37% of papers, with “Almost OA” – yet still only 15% are being deposited.

2.4. Other Inducements to Deposit

Nor do requests, encouragement, incentives, information, assistance or even cash rewards to authors from either their institutions or their funders have much effect: Arthur Sale's studies have shown that at most these extra inducements only increase the deposit rate to about 30% (Sale 2006).

3. Open Access Mandates: The Cure for “Zeno’s Paralysis”

3.1. Mandates Work

The only thing that really works is deposit mandates: In several international author surveys conducted by Alma Swan, across all disciplines, authors have reported that they are in favour of OA, but that they would only make their articles OA if deposit were made mandatory by their institutions or funders: If OA were mandated, 95% of authors say they would comply (81% willingly, 14% reluctantly) (Swan 2006) and the outcome studies have confirmed that when OA is actually mandated, authors do as they report they would do, with deposit rates of well over 60% within 2 years of adoption of the mandate and well on the road toward 100% (Sale et al. 2010). (If the deposit in the IR is linked to performance evaluation, deposits grow even faster (Rentier 2007).)

3.2. Mandates Change Behaviour

So in the case of providing OA to peer-reviewed research, it has turned out that the way to “change behaviour” is to mandate it. Why are formal mandates needed, if the new behaviour is already palpably in authors' own interests? At least 36 reasons have been identified so far, all summarised in a continuously updated series of FAQs that have been compiled across the years (BOAI); the condition has been dubbed “Zeno's Paralysis” (after the philosopher who thought that one could not walk across a room, because before walking the whole distance one must first walk

half the distance, and before that, half the half-distance, etc., hence one could not even get started at all; Salmon 2001) (Harnad 2006). Foremost among these (groundless) worries underlying Zeno's Paralysis, however, are four: that OA (I) might violate copyright, (II) might bypass peer review, (III) might destroy journal publishing, or (IV) might take a lot of time and effort.

3.3. Copyright Is Not An Obstacle (I)

We have already described above how OA (or "Almost OA" with the help of the "fair use" button) can be provided for 100% of articles without violating copyright.

3.4. Peer Review Is Not At Risk (II)

The papers that are being deposited in IRs are the peer-reviewed, revised, accepted final drafts, so they do not bypass peer review.

3.5. Journal Publishing Is Not At Risk: "Green" and "Gold" Open Access (III)

There are a few exceptional fields (such as High Energy Physics) where OA already reached 100% years ago. The journals in those fields report that *they can detect no subscription decline as a result of this OA* (Berners-Lee et al. 2005; Swan 2005). But even if OA reaches 100% across all fields, and even if that in turn eventually makes subscriptions unsustainable, there exists an alternative cost-recovery model — the OA pay-to-publish model — which is already being implemented by some journals in which, instead of covering publication costs by charging institutions an annual *subscription fee*, per incoming journal, for access, publishers charge institutions a *publication fee*, per outgoing article, for peer review. Paying this OA publication fee today is a burden on institutions because they are still paying hefty journal subscription fees. But if and when journal subscriptions become unsustainable because author-provided OA (now called "Green OA" self-archiving; Harnad et al., 2004) causes institutions to cancel their annual incoming journal subscription fees, then those same annual windfall savings provide institutions with the funds to pay for their individual outgoing article publication fees (this is also called "Gold OA" publishing; Harnad et al., 2004; Harnad 2010, 2011). Hence universal Green OA will not destroy journal publishing: It may merely induce an eventual transition to Gold OA publishing (Houghton & Oppenheim 2009).

3.6. Depositing Is Quick and Easy (IV)

The years of experience of the 15% of authors who have been providing Green OA spontaneously, unmandated, as well as the weblog analyses done on the timing and the number of keystrokes involved in actual deposits show that IR deposit time is about 6-10 minutes per paper (Carr & Harnad 2005). Even considered on its own (rather than as the minuscule fraction it comprises out of the total time and keystrokes that go into doing the research and writing and revising the paper), and even without considering the sizeable benefit/cost ratio (in terms of enhanced accessibility, uptake, usage and impact potential that results from doing the 6-10 minutes worth of keystrokes per paper (which for most authors means less than an hour per year, and even less for multi-authored papers), it is clear that the only ones who can imagine that providing Green OA takes a lot of time and effort are those who have never actually done it.

3.7. Optimising Institutions' and Funders' OA Mandates:

So in the special case of OA, the formula for change, and the cure for Zeno's Paralysis, has turned out to be for researchers' institutions and funders to mandate Green OA self-archiving, as over 150 institutions (including Harvard, MIT, University College London, ETH Zurich) and over 40 funders (including NIH, RCUK, EU, FWF) have already done (ROARMAP) — although some very important details need to be clearly understood in order to optimize the OA mandates: (a) Deposit itself should be immediate and without exception. (b) Embargoes should only be permitted on when

access to the deposit is made OA (vs. CA), not on whether or when deposit is done at all. (c) Authors negotiating “author addenda” or CC licenses — formally endorsing the author’s right to provide immediate OA or even further re-use rights — should be encouraged, but not required, because they set the barrier for author compliance needlessly high. (d) Funders and institutions should collaborate, mandating convergent deposit in the author’s own IR; funders should not compete with institutional mandates by insisting on divergent deposit in an institution-external central repository; funders’ central repositories can automatically harvest their content from authors’ IRs and institutions can help monitor and ensure compliance with funder mandates. (e) IR deposit should be adopted as the official means of submitting peer-reviewed publications for institutional performance review and CV generation (Harnad 2008b).

4. The PostGutenberg Revolution: Scholarly Skywriting

4.1. Mandating the Revolution

The apparent need to mandate OA in order to reap its benefits seems in this special case to put a slightly different twist on the edem10 conference’s motto: “A revolution doesn’t happen when a society adopts new tools. It happens when society adopts new behaviours” (Clay Shirky). It appears that when adopting the new tools entails some perceived risk and effort, as it does with providing OA to research, even when the risk and effort are illusory, institutions and funders may first have to adopt new rules to induce people to change their behaviours so as to begin to enjoy the benefits.

4.2. Peer Review Instead of Potluck

And it will indeed only be once worldwide Green OA mandates have raised the global OA level from its current 15% baseline to something much closer to 100% that radically new behaviours (Harnad 1991) will become possible. The entire peer-reviewed research literature will be accessible free of charge, at the fingertips not only of all of its intended primary users — scholars and scientists — but accessible also to students and teachers everywhere, at all levels, to journalists, and to the general public: professionals and amateurs of all ages. On scholarly and scientific topics, no longer will anonymously authored entries in Wikipedia be Google’s top offering, followed by entries that are answerable only to the PageRank algorithm: The “refereed research” tag will restrict searches to the journal article output hosted by the planet’s global network of university and research institute IRs. Teachers will be able to rely on peer review instead of potluck to determine what sort of web content their students consult and use.

4.3. Monitoring Merit With Metrics

Nor will it stop there. Universal OA will make it possible to design, test and validate — field by field — far richer, more diverse, equitable and predictive metrics of research usage and impact (including teaching impact and general public impact) to reward and motivate scholars and scientists for their work and to further justify the investment of public funds in supporting research (Harnad 2008a, 2009). As they begin to realize that books too will generate impact metrics, as well as augmenting them, authors will choose (without the need of mandates!) to make more and more of their books OA too (Harnad 2008). The practice of providing OA and monitoring and rewarding metrics of usage and impact will no doubt also generalise to research data, software, courseware, and multimedia in the Academy (Brody et al. 2007), and some forms of usage monitoring and metrics are even likely to be adapted in such nonacademic fields as news, arts and entertainment.

4.4. Speed of Thought

So far, these knock-on effects of OA — enhanced user access and usage metrics — are all just quantitative changes in behaviour. But the most radical of them is waiting to happen too (Harnad 1990; 1991): Human language evolved in the service of local communication, mostly one on one,

and not for speeches and soliloquies but for dialogue. Speech is interactive, and our brains evolved and have become specialized for the interactive tempo of real-time oral interaction. The speed of speech and the speed of thought are roughly matched. We can read somewhat faster than we can hear or speak, so with the advent of writing, handwritten messages increased the speed of our intake, and the advent of print increased the scope and reach of our written output. But written *dialogue* was always orders of magnitude slower than oral dialogue — hopelessly out of phase with the brain's potential capacity for real-time interaction at the speed of thought: Handwritten and printed messages had to be delivered or distributed, and by the time a reply had been written and delivered, one could hardly call the interaction a dialogue.

4.5. Turn-Around Time

The online medium still has not made it possible for us to type as fast as we can speak; but even if we could, it would remain far more comfortable and natural to just speak! Once reliable automatic dictascript (converting speech to text) is perfected, we will use it to give us a digitised record of our real-time conversations, but we will still prefer conducting the conversation itself orally. So it was not faster typing that was missing. What was too slow was *the turn-around time between messages* — plus the slowness and awkwardness of trying to reply to a long written message bit by successive bit, *as in interrupting a real-time conversation to reply*, and having to do so either by annotating the original text or (even more time-consumingly) rewriting or retyping the quotes in our reply.

4.6. Real-Time Interaction

With the ease and power of online quote/commenting on digital text, one can now “interrupt” the text to reply bit by bit, but the interaction is one-sided: You get to interrupt and comment on the text at will, but the author of the text does not get a chance to reply to you till your interruptions are posted. This problem is irremediable unless the author of the text is available in real time, and, as noted, in that case it makes much more sense to interact orally — and then the author may as well just be reading you his message aloud, rather than writing to you!

4.7. Public Quote/Commentary: Skywriting

But there is another feature of online quote/commenting on digital text that compensates for this one-sidedness: “skywriting” (Harnad 1990). When you receive a written text and the author is offline, you can immediately quote/comment the text, but your comments will not be immediately answered. (Indeed, if the text happens to be written by a long-dead author, your comments will never be answered — by the author.) But your quote/commentary can nevertheless be posted (as soon as you are done), and if it is posted publicly, then not only can the author (if living and willing) begin to reply as soon he sees it, but so can anyone else who is interested, because the reply is written as if in the sky, for all to “sky-read,” and for anyone to skywrite in response. So the compensation for the short-term one-sidedness of having restored the written dialogue to the speed of thought only unilaterally is the fact that your quote/commentary becomes one-to-many as soon as it is sky-written. If, as prepared biologically by the evolution of our brains and thought, active participation in an oral dialogue engenders more real-time thought than just passively listening to an oral monologue (where you must resort to taking notes) or passively reading an inert text (where you must scrawl annotations), quote/commentary engenders even more thought because, as in a live oral symposium, you are addressing many potential interlocutors. And yet it is all being done in writing, with no time limit either on how quickly or slowly you respond, how short or long your response is, or how many times you revise it before you post it.

4.8. Distributed Cognition

In short, skywriting is an unprecedented new form of intellectual interaction: It became possible only with the advent of the online medium, out of a combination of email quote/commentary, email discussion lists, and public posting on the web. It restores the potential speed of verbal interaction to the real-time speed of thought in dialogue — and even when not posted immediately, and without the expectation of an immediate response, it engages the human brain in a unique way through a real-time interaction with what would otherwise be inert text, mobilizing the brain's ancient biological adaptation to oral dialogue in a powerful and radically new and fertile way (Harnad 2004). Scholarly Skywriting will graft onto the primary peer-reviewed corpus, seamlessly, an expanding layer of both peer and public commentary and response, accelerating and expanding human inquiry by an order of magnitude. The Open Access Research Web will become the locus of “distributed cognition,” our (e-democratized?) Cognitive Commons (Shadbolt et al. 2006; Poynder & Harnad 2007; Dror & Harnad 2009).

5. Perils of Prophecy

5.1. Reluctant Revolution

Having said this, however, I must immediately confess to two abject failures in prophecy: Having umpired a Gutenberg-era form of open peer commentary for over a decade (Harnad 1978, 2003), I had predicted in 1990 (Harnad 1990) that “scholarly skywriting” would soon prevail, in virtue of the evident potential of the online medium alone. Failing that, in 1995 (Harnad 1995) I predicted that (what would eventually come to be called) “Green OA self-archiving” would soon prevail, with the resultant peer-reviewed OA content inspiring scholars and scientists to skywrite (as the non-scholarly, non-peer-reviewed content on the web had failed to do); I also set a lot of store by my own capacity to persuade and inspire scholars and scientist, via sky-written quote/commentary (Harnad 1998a) to provide Green OA as well as to skywrite.

5.2. Solo Sport

My 1990 and 1995 prophecies, even given two decades and a decade half, respectively, to be fulfilled, have still failed to come to pass, to this day; and not only has my own skywriting been unavailing in hastening the day, but it is my impression that my skywriting is being largely ignored, whether it is on the topic of OA or on the topics of my own scholarly and scientific research. I had thought of myself as something of a virtuoso in this revolutionary new form of interaction, but so far it appears to be a sport in which only I have any interest, let alone excel.

5.3. Eppur...

But it's not over yet. Mandates may still save the day. If in the case of emailing, discussion lists, web-page-making, blogging, tagging and social networking all it took was to lead the general public (including scholars and scientists, when not wearing their peer-reviewed research hats) to the new technology, in order to induce them, like horses led to water, to drink, it may be that because of the complications described above (Zeno's Paralysis), scholars and scientists needed the further inducement of mandates from their institutions and funders before they could discover for themselves the potential pleasures and rewards of OA and skywriting. I'm still hoping that if this is indeed destined to come to pass, it will happen while I am still *compos mentis*, because the pleasures and rewards cannot be partaken of posthumously.

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Stevan Harnad was born in Budapest, Hungary. He did his undergraduate work at McGill University and his graduate work at Princeton University's Department of Psychology. He is currently Canada Research Chair in Cognitive Science at Université du Québec à Montréal (UQAM) and Professor of Cognitive Science at the University of Southampton. He is also an External Member of the Hungarian Academy of Sciences. His research is on categorisation, communication, cognition and consciousness. Harnad was also the founder (1978) and editor (until 2002) of *Behavioral and Brain Sciences*, a journal published by Cambridge University Press, *Psychology*, an electronic journal sponsored by the American Psychological Association, *CogPrints*, an electronic eprint archive in the cognitive sciences hosted by University of Southampton, and the *American Scientist Open Access Forum* (since 1998) and is an active promoter of Open Access (EPrints) Enabling Open Scholarship (EOS), Open Access Scholarly Information Sourcebook (OASIS), SPARC Campus Open Access