Preprint of a chapter on researchers' responsibilities for increasing access in book e-Research: Transformations in Scholarly Practice, Ed. Nick Jankowski (London: Routledge).

Open Access to E-Research
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In its soaring introduction, the National Science Foundation's *Atkins Report* hails the progress made in scientific research since the digital revolution and declares:

> Advances in computational technology continue to transform scientific and engineering research, practice, and allied education. Recently, multiple accelerating trends are converging and crossing thresholds in ways that show extraordinary promise for an even more profound and rapid transformation—indeed a further revolution—in how we create, disseminate, and preserve scientific and engineering knowledge. (Atkins, 2003, p. 4)

The report has come to be seen as a seminal document of e-science and e-research (and, as it is called in the report and known in the United States, *cyberinfrastructure*), but the ambition expressed in these sentences has thus far been realized only incompletely. E-science has done much to advance techniques for knowledge *creation*, such as grid computing and remote research collaboration, but its engagement with issues of *dissemination* has been more limited. Some admirable strides have been made in the area of data sharing, but less attention has been paid to distributing knowledge within the academy and less still to the public circulation of published research. We hold that the responsibilities of the researcher extend beyond the immediate design, conduct, and supervision of the research. Those additional responsibilities have both epistemological and ethical implications for what it means to do work that goes by the name of research, and those implications have to do with how the research is circulated and shared.

Our theme with this chapter, then, is that the research is not complete until it has been made available to others, and how it is made available carries with it a new set of epistemological and ethical responsibilities that are the result of changes in how scholarly work is now being published. Research worthy of the name has always had to appear in some publicly accessible form. It may be filed in a university library as a dissertation, submitted to a client as a report, read at the annual meeting of a local society, or published in a journal or book. When it comes to talking about the contribution that research makes to the common stock of knowledge, the way in which the work has been circulated and the way in which it is open to review serve to warrant its claims to be *research*. Just how much of the research is made public is critical to its claims. The research must identify the sources in great detail on which it has drawn; it must justify the design and method deployed; it must share some portion of the data; it must demonstrate how the conclusions were arrived at, while accounting for counter-examples; and finally, it must situate the findings within the larger picture, in ways that speak to immediate implications and future directions.

The critical elements of the well-formed research article have emerged out of a publishing tradition that goes back to the very public scrutiny of Isaac Newton's one and only published article, which was on optics, in the January 3, 1671 edition of the *Philosophical Transactions*, during the first decade of the new genre that has come to be known as the scientific journal (Willinsky, 2006, pp. 234-44). The critical questions raised by readers of this article in letters to the *Transactions* forced Newton to further clarify his research design and method, as well as the scope of his results. The back and forth between Newton and his critics in the pages of the *Transactions* until, after four years, Newton said, "No more," to the journal's earnest editor, Henry Oldenburg, amounted to the setting of a standard for making research public, a standard that placed the reader in a position not only to replicate the experiment, but to check the sources, scrutinize the analysis, and challenge the conclusions (Kuhn, 1978).

Which is only to say that the researcher's responsibilities for opening a work to the widest possible public scrutiny are no less important to its standing as research than all of the thought and care that she originally invested in the designing and carrying out of the research. In terms of epistemology, we would say that one requisite for believing that a study's conclusions are true, and not mistaken or misguided, is that the study has been subject to critical scrutiny. Sometimes we make that call ourselves, but more often we leave it up to the editorial and peer-review process, which represents the great contribution of the journal system for scholarly publication. Here, the normally opposed reprobate postmodernist and recalcitrant positivist share a point of common understanding: If you will not allow us to see your work, your claims to having done research on a topic is just so much cant. This is otherwise known as, "put up or shut up."

Yet if that is the epistemological side of the coin we would forge in the act of completing the research study, then there is also the ethical side of going public to consider. Most recent treatments of research ethics focus on respecting the rights of individuals who participate in research. They do not, for example, acknowledge a corresponding right among the public to consult the resulting knowledge. Obtaining the *informed consent* of the research subject seems t us only half the story, given the assumption that the research being conducted will constitute a public good held to be of interest to the welfare of the larger society. What then of the researcher's responsibilities, or rather the research community's responsibilities, to establish public norms that support *informed participation* in this democracy not just among the immediate participants, but also among the larger community? That the research must be disclosed to professional scrutiny is a safeguard or check on its quality. To see that it is open to wide circulation and easy access is what ensures that the research falls within a democratically informed public sphere.

A recent instance of the ethics at stake in publishing is found in the tendency of certain corporate sponsors of clinical trials research in the life sciences to leave unpublished or suppress the publication of studies that conclude a given treatment is not helpful, or worse. The situation had become so alarming that the International Committee of Medical Journal Editors recently declared that it would only publish studies that had been previously registered "at or before the onset of patient enrollment" with that registration taking place at a publicly accessible site, such as Clinicaltrials.gov run by the U.S. National Library of Medicine (De Angelis et al., 2004).[1] This meant that no study could escape scrutiny, unless its corporate sponsors wanted to risk not being able to publish the results at all.

The more general ethical principle at stake with the publishing of research has to do with conceptions of public trust and public good. The warrant for conducting research is that such

work will contribute to knowledge, which is regarded as a matter of public good. The support of salaries, grants and facilities, especially as these involve public or non-profit institutions, only adds to the weight of public trust at issue in doing research. Thus, the ethical compulsion to do the research well, and to make the resulting knowledge publicly available, ideally through some form of publication that, through its review process, ensures that the work has some initial claim to being research, notwithstanding the further scrutiny it will undergo as a public document.

That is all well and good, you might interrupt at this point, but surely the importance of publishing research goes without saying. The reason for that, we would counter, is largely because publication is about other things besides epistemology and ethics. Publishing well is a necessary aspect to being recognized as a researcher and a scholar. The very right to continue conducting research depends on the publication of previous work, even as the blind review process ensures that attention is paid to the merits of the current piece of research, rather than judging it on the author's established reputation. Yet the current and intense focus on publishing turns out to have little to do with the open circulation of the work. Getting research into a peer-reviewed journal or an edited book becomes an end in itself for the majority of scholars. There is a small group of academic stars whose work thrives on widespread readership and citation, but for most, publish and perish has become the mark of an academic life.

However, a historic moment may well be upon us, one that gives new meaning to the epistemological and ethical issues entailed in the circulation of research. In the course of little more than a decade, the Internet has proven itself a powerful, global publishing medium for research and scholarship, especially at the level of the article. The researcher has now to reconsider what it takes to do research in a responsible manner, when the public presence of that work has the potential to be – and in many cases has already been – radically expanded. It may look like business as usual within the journal system that dominates scholarly publishing. The vast majority of journals simply moved online without changing how they look or publish (much as Gutenberg's printing of the Bible, with its cursive font and illuminated first letters, created a book that resembled the medieval manuscripts, which the printing press was about to put an end to as a publishing form). Yet the Internet has opened a new world of access to the forms of knowledge that are recorded in journals, if far less so with scholarly books at this point.

You can now walk into a public library or a high school, sit down at a computer station, and tap into a small, but substantial portion of the scholarly work and scientific research that is being currently published; you can explore historical documents and archives, as well as vast sets of data, including the human genome.[2] This work has not just been published within a limited community of subscribing institutions, but has also been made open to readers wherever there is Internet access. This access represents a great increase in the ability to tap into the storehouses of knowledge, but when it comes to the scholarly literature, a very small proportion, perhaps amounting to 15-20 percent of the annual output, is made freely available to readers. This public access has been afforded by a new breed of scholarly journal (some having grown out of long-standing print titles, such as the *New England Journal of Medicine*) which makes their contents freely available to readers online, whether immediately on publication or some months after the issue is released (to give subscribers an incentive to keep subscribing). Yet while journals that offer open access provide one important source of a new global access, a greater part of that 15-20 percent of scholarly work that is now open comes from those authors who, having published in a journal that is restricted to subscribers, have taken advantage of that journal's self-archiving policy to post their published work to an open access institutional repository run by their library or to their own website.[3] This is not just a hypothetical increase in access, as there are now a

good number of studies that make it clear that studies which are made available through open access journals or institutional repositories are read and cited by more people than those that are not.[4]

Suddenly, these developments raise a new set of responsibilities for how that research is allowed to circulate, given that there are a whole new range of options for opening it to critical scrutiny and having it enter the public sphere. When print was the only means of publication, the idea of printing a limited number of copies of a journal – determined by the number of subscribers who covered the costs and to whom it was then exclusively delivered – made perfect sense, with a little photocopying and off-print circulation on the side. This is the time, we are proposing, for reviewing the researcher's epistemological and ethical responsibilities in light of the *open access* option, an option which some journals are actively pursuing, and which most journals not going this way have at least recognized as falling within the rights of their authors (as they permit authors to self-archive the work the journal has published).

As Willinsky has argued elsewhere (2006), the final step in any research project should be about ensuring the circulation and exchange of knowledge in as wide a fashion as is feasible. We use the word *feasible* because we recognize that there is a whole range of limits to the circulation of knowledge, from economic to educational. However, it also needs to be noted that the possible global and public scope for the circulation of research has recently and rather radically changed with the introduction of new information technologies in relation to the Internet. The overwhelming majority of scientific journals have moved to the Internet over the last ten years. This enables a level of global and public distribution of knowledge that far exceeds what was possible with print technologies. What researchers then need to consider, in the midst of this great migration, is how this new publishing medium can be used to improve both the scientific and public value and impact of research, not just as a source of scientific information, but as a source of public knowledge. The viability of this greater distribution and greater integration of research into public life has been demonstrated by a small but important number of journals that are offering their contents free to the reader.

In our own field of education, for example, there are close to 200 journals that make all or some portion of their content free to read online.[5] This manner of "open access" publishing is being implemented through a number of different economic models that include charging author fees (largely used in well-funded areas of the sciences, such as biomedical research), relying on subsidies, providing open access after a period of subscription-only access, or offering open access to developing countries. Part of our contribution to these open access developments has been through the Public Knowledge Project (PKP), which Willinsky has directing since 1998 (http://pkp.sfu.ca). In addition to conducting research on various aspects of open access and its impact on both scholarship and the public, PKP developed open source (free) software to facilitate open access by reducing publishing costs. Its most notable offering is Open Journal Systems—for managing scholarly journals and publishing them to the web – which is currently available in 13 languages and is being used by more than 1,200 journals on six continents to make journals across the disciplines open access.

As a further means of achieving open access to research, a number of the major publishers, such as Elsevier, Springer, Wiley, Sage, Blackwell, and Taylor and Francis, have author self-archiving policies in place that permit authors to post the final drafts of the work published in their journals to a personal website or a libraries' institutional repositories.[6] Some funding agencies are now mandating this archiving of work they underwrite, most notably, the U.S. National Institutes of Health, with an annual budget of $28 billion, leading to roughly

80,000 articles, now requires any work published as a result of its funding to be made publicly available in PubMed Central 12 months after it appears in a journal (http://publicaccess.nih.gov/index.htm).

A related movement, to which e-science has made strong contributions, calls for open access to the data sets that underlie published research. Jean-Claude Bradley, who coined the phrase "Open Notebook Science" to describe this phenomenon, makes the epistemological case, writing, "[I]t is essential that all of the information available to the researchers to make their conclusions is equally available to the rest of the world. Basically, no insider information." (Bradley, 2006, September 26) Cambridge chemist Peter Murray-Rust, a participant in e-science and advocate of open data, adds that the data currently being collected is vastly under-analyzed, and "contains huge amounts of undiscovered science" that could be unlocked through coordinated data sharing (2007, April 10).

The CODATA committee of the International Council for Science has spent decades advocating for improved data quality and access, but in the past few years, the movement has gathered real momentum. On December 16, 2007, Science Commons, an offshoot of the copyright reform group Creative Commons, released a legal framework for open data, the "Protocol for Implementing Open Access Data" (http://sciencecommons.org/projects/publishing/open-access-data-protocol/). Four days later, Harvard's Dataverse Network Project released version 1.0 of its open source software for archiving and publishing data sets (http://thedata.org/). The Open Data Commons project is expected to release a public domain dedication for data in early 2008 and has declared this the "year of open data" (Hatcher, 2008, January 3).

However, the road that scholarly publishing had been heading down, prior to this open access movement, and continues to head down in the face of these promising new developments, is one of increasing corporate concentration, with publisher mergers and acquisitions (as well as the corporate acquisition of scholarly society journals). The resulting price increases driven by opportunity as much as anything has been leading over the last two decades to a declining state of access to research, judging by the journal cancellations that have trimmed collections at the best university libraries, while decimating those of less privileged institutions (ARL 2002). The introduction of open access models through online publishing appears to offer the universities another direction in which to take the circulation of knowledge. Scholarly associations, journal editors and university libraries need to carefully weigh the dissemination of research in terms of this juncture, especially as it bears on the scientific principle of seeking the widest possible circulation, exchange, and scrutiny for knowledge.

Open access publishing serves scholar and public alike, by providing a much wider readership than is afforded by subscription-fee journals (online or on paper). The open access model not only opens the research work to more thorough "professional scrutiny and critique," it also provides greater *accountability* and *visibility* for research. In education, the American Educational Research Association, ERIC, and other organizations have approached this public side of science by providing a form of research digest and "translation" on selected topics.[7] While commendable, such initiatives are obviously costly and can provide at best a limited coverage of the literature. They could be greatly extended, we are suggesting, by integrating much more open access to this literature into the very systems for circulating that knowledge.

We have argued that 'research' should be understood to include both knowledge creation and dissemination, but to this point, e-science and e-research initiatives have focused on the first of these, particularly through grid computing and distributed research teams. The United

Kingdom's National e-Science Centre defines e-Science as "the large scale science that will increasingly be carried out through distributed global collaborations enabled by the Internet" and goes on to describe "very large data collections, very large scale computing resources and high performance visualization," all made possible by the computing architecture of the Grid. (http://www.nesc.ac.uk/nesc/define.html) The British National Centre for e-Social Science defines its charge in nearly identical, Grid-centric terms (http://www.ncess.ac.uk/about_eSS/faq/). Neither makes reference to dissemination of published work.

      As mentioned previously, the NSF's *Atkins Report* demonstrates a good deal more vision regarding access and dissemination. "In the future," the report predicts, "we might expect researchers to…[a]ccess the entire published record of science online" (10). It recognizes potential applications of access in tertiary science and engineering education (26-27), and includes the following paragraph on public circulation of knowledge:

> **Access by the wider public** – By making access to reports raw data and instruments much easier, a far wider audience can be served. Although large teams and major financial investment are required to create comprehensive data repositories and specialized scientific facilities, individuals, even amateurs, working alone or in small groups, given access to such resources, can provide scientific discoveries. A good example is amateur astronomy, which significantly expands the reach of scientific observation. (29)

We applaud the *Atkins Report*'s commitment to expanding access throughout the republic of science. It is worth noting, however, that even here, it is *researchers* who will have access to published work and future researchers and engineers who will benefit from it educationally. Even the report's most ambitious endorsement of wide access, quoted above, is justified solely by the prospect of future knowledge creation by amateur scientists. It fails entirely to address the place of science within the larger republic—the implications of research for democracy.

      Now, in invoking the role of research in a democratic culture, we realize that public access to *what is known* through scholarly inquiry, as well as to the debates and controversies that arise through that inquiry, is but one small aspect of what should contribute to the quality of contemporary democracies.[8] It may be a small aspect, but it is precisely the aspect over which researchers have control. It is the very point of their professional contribution, as scholars and educators.

      It is also fair enough to raise questions about what this new public presence of research may mean for the integrity of research. Certainly, discomfiting instances are to be found of the political and social corruption of scientific practices. Think of the role that anthropology often played in the service of colonial administrations, or the eugenics movement in the early decades of the twentieth century. Today, with the George W. Bush administration in the United States, issues of political interference in research abound.[9] Yet such abuses, while a source of concern and caution for researchers, hardly argue for isolating or insulating scientific culture from public and democratic culture, especially for the many sciences that hold to the importance, as a first principle, of posing *significant* questions. The open and public discussion of those questions seems a critical element in keeping science a principled enterprise in an ethically responsible sense.

We recognize that disciplines vary in their degree of public orientation, but open access should hold interest even for those that operate at greater remove from the issues of the day. Open access ensures global access for scientists, in an age when even the best institutions cannot subscribe to everything and those in developing countries cannot subscribe to more than a handful without OA or programs like HINARI (the Health InterNetwork Access to Research Initiative) or AGORA (Access to Global Online Research in Agriculture). Further, as the *Atkins Report* notes, the public includes dedicated amateurs and teachers in senior high schools and universities, whose participation can only help strengthen the disciplines. And more to the point, the work of many fields *does* hold wide interest. In fact, it is difficult to think of an issue for which science and social science cannot contribute to public discourse. Educational research, for example, has obvious relevance to parents, professionals, policy advocates, and public deliberators from the local level to the international. The public significance should be no less clear for most social and behavioral sciences, the sciences of energy, environment, and agriculture, and the many sciences that bear on medicine, public health, pharmaceuticals, and bioengineering.

Over the past decade, medical research has provided an excellent example of a field making itself part of public culture, with its breakthroughs, controversies, reversals, indeterminate results, and all. The lessons we need to learn from this work concern how the scientific culture of medical research is unmistakably part of the public culture of daily talk and dinner tables, of politicians and media pundits.

The expanded coverage of health information in the media, under the rubric of news-you-can-use, is easy to track in newspapers, on television, and the Internet. In the spring of 2003, the *New York Times Magazine* devoted its entire issue to the theme "Half of What Doctors Know is Wrong" (March 16, 2003). It featured articles with titles such as "Medicine's Progress, One Setback at a Time" and those articles thought nothing of describing the details of sample sizes, risk probabilities, and research design flaws of studies published in the *British Medical Journal* and elsewhere. The magazine makes the dynamics of research present: the tentative search for an answer, the challenges and revisions, the study released last week, the reversed position. True, it is the *Times*, which is not everyone's daily newspaper, but this public exposure of medical research's reversals (hormone therapy) and design flaws (mammograms) has appeared, with less detail, on the television nightly news and the tabloid press. And it has not reduced public support for medical research; it has arguably fed support for it, creating a public appetite and expectation of a right to know as a function of the democratic state to support and make available.

This knowledge is now working as part of a public culture, adding to that culture's democratic, and intellectual, quality. That is, this increase in access to health information has changed the relationship of medical research to the public body, changed it in a way that we are tempted to describe as reducing the tyranny of expertise. From the physicians' perspective, having patients and their families arriving at their office with medical research and other health information in hand has led to a "new method of care," a method which has been encouragingly labeled "shared decision making" (Brownlee, 2003, p. 54). We hardly need add that *shared decision making* sounds a lot like democracy in action, whether one thinks of a doctor's office, a community school, or a nation. This particular form of sharing has only been made possible by increases in medical research's presence in public culture. As one indication of that, we offer the National Institute of Health's estimate that six million Americans go online each day in search of information about health and disease (NIH, 2003) – although only a small percentage may be consulting research – as well as the NIH's commitment to seeing all of the research that it

sponsors publicly available through institutional repositories or open access journals (Suber, 2005).

In an effort to feed this hunger for information, as well as address the right to know, doctors in the state of Georgia are experimenting with a "health information prescription" (Brownlee 2003, p. 54). The prescription will guide patients to reliable sources including the National Library of Medicine's MedlinePlus, which includes a layperson's guide to symptoms, diagnosis, and treatment. MedlinePlus, however, also provides patients with direct access to the latest medical research, through the NLM's PubMed database, although most of the 11 million articles in it are not available to the public beyond their abstracts, because of the small, but growing, proportion of the articles that have been made open access and thus publicly available.

As the conversation between physician and patient takes on this more informed quality, concerned as it is about both risk and quality of life factors, the educational quality of that exchange goes up for both parties. Clearly, physicians are also beneficiaries of this increased access to research. Doctors speak of having the "newest and best in medical research right at our own desks," if only to discover that "leeches, for example, are now used on some patients to treat the pain of arthritis" (Sanders, 2003, p. 29). Patients make informed decisions based on their own value systems: "For me, it's a trade-off," as one woman said in deciding to stay with menopause hormone therapy for the mental agility it provided her against the recently established increased health risks of such therapy (Kolata, 2003).

What has changed with medical research, and what needs greater recognition by e-researchers in other fields, is how productive this new emphasis on public access to research is for professionals. To go a little farther with the medical research access analogy, the perfect example of this democratic and public engagement with research is ClinicalTrials.gov, a website sponsored by the National Institutes of Health, other Federal agencies, and the pharmaceutical industry. The site was launched in February 2000 and as of December 2005 lists 23,500 clinical studies, which are inviting participation from qualified subjects, as well as informing the public about ongoing investigations. The site is global, involving studies in about 120 countries, although most are in the United States and Canada, and it receives approximately 20,000 visitors a day.

The ready ability to connect study to study, to compare results and see ideas challenged and discussed, can only add to the quality of scholarly and public discourse. But more than that, our work through the Public Knowledge Project has demonstrated how the Internet can now support systems of "Reading Tools" that can enable readers of a research article to connect the article they are reading not only to related studies, but just as easily to current newspaper articles and government reports on the same topic, to sites with instructional materials for teaching the topic and to online forums where the topic is informally debated.[10] The promise here is of having greater public access to research, combined with greater connectivity among different orders of knowledge (from research to practice and policy), incorporated into the design of scholarly publishing environments in ways that improve the quality of the peer review process (with access to the original data sets) as well as support public accessibility, for example, by providing access to related materials in the media and other public documents.

As scientists since Newton have demonstrated, what makes work scientific is not simply the validity of its claims. What is scientific is far more about open and free inquiry. Technological advances afford us the opportunity to make scientific inquiry freer and more open than ever before, and to expand that culture beyond its previous bounds. In addition to thinking about disclosing research for the purpose of affording sufficient scrutiny from other researchers,

e-researchers need to consider these new ways of increasing the circulation of this knowledge. Doing research today means testing the potential of new publishing technologies for opening research to greater scrutiny and impact, as well as to greater integration with other forms of knowing. At this moment, as the research literature moves into this new publishing medium, the researcher has indeed assumed a new responsibility, a new level of accountability, over how public access to the research literature can be improved, as both a scientific and design principle that will only serve to strengthen scientific culture within an informed and democratic public realm.

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Notes

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[1] From the statement of the medical journal editors: "Irrespective of their scientific interest, trial results that place financial interests at risk are particularly likely to remain unpublished and hidden from public view. The interests of the sponsor or authors notwithstanding, anyone should be able to learn of any trial's existence and its important characteristics" (De Angelis et al., 2004).

[2] On open access to research data in the sciences, a recent *Nature* editorial (2005) refers to how researchers can retain credit and rights over the data sets they contribute to the "global academy" by making it freely available online through the use of a Creative Commons license (http://creativecommons.org).

[3] See the Sherpa Project (http://www.sherpa.ac.uk/), in which a survey of 127 publishers reveals that 75% grant permission for authors to post some version of their published article in an institutional archive or on a personal Website.

[4] See Steven Hitchcock's (2005) running bibliography of studies on the citation impact of open access articles.

[5] See the American Education Research Association list of open access journals in education maintained by Tirupalavanam Ganesh (http://aera-cr.asu.edu/ejournals/).

[6] See Willinsky (2006) on different types of open access journal publishing, and to check the current self-archiving policies of publishers and journals see the SHERPA project database (http://www.sherpa.ac.uk/romeo.php).

[7] See, for example, AERA's *Research Points* (http://www.aera.net/publications/?id=314).

[8] The more common philosophical formulation of the relation between science and democracy focuses on the democratic regulation of science, as when Helen Longino asks, "What kind of institutional changes are necessary to sustain the credibility, and hence value, of scientific inquiry while maintaining democratic decision making regarding the cognitive and practical choices the sciences make possible and necessary?" (2002, p. 213). Also see Philip Kitcher (2001) for a similar approach. My argument for improved access to research will, of course, bear on the democratic decision making affecting science.

[9] See the Union of Concerned Scientists, who documents the degree to which "an unprecedented level of political interference threatens the integrity of government science" (http://www.ucsusa.org/scientific_integrity/).

[10] See the Public Knowledge Project website for demonstrations of a Reading Tool that is included in the project's journal and conference publishing systems, and is designed to integrate research more fully into other forms of knowledge (http://pkp.sfu.ca/ojs).