
Open access: what comes next?

Introduction

This article is being written in early October 2004, when it is not yet known whether open access (OA) according to either the US NIH model or the UK model will be officially adopted. The details and the speed of implementation are currently unknown. The intention here is to examine what will follow after the decision; delays in starting will affect the timing, but not the nature, of the events that follow. [See Note added in proof below.]

The merits of the various plans are not examined here.¹ Their advantages and defects are not relevant, since the proposed plans have been specified and will be judged based on their political attractiveness, not their merits. This is not an argument about whether to adopt them, but a discussion of what will happen after that.

This article studies the possible effect of OA under different assumptions, and attempts to encompass the widest and most extreme range of consequences. It is recognized that less extreme situations may well happen, but it is hoped that their effects will be clear from the cases given.

It should be noted that the author is a supporter of OA, but also has expressed strong reservations about the advisability of some of the provisions of each country's plan.² This is nonetheless intended to be an objective discussion of the positive and negative consequences of these plans, and examples have been selected yielding very different results.

Background

The model as proposed in both the US and the UK is a variety of 'green' OA where the material is published in a journal, and also in some type of repository. Both plans provide only for the publication of primary research in scientific journals, but not review articles,

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ABSTRACT: This article examines the effects that present decisions about open access (OA) will have over the next ten years. It will be shown that the consequences are affected both by deliberate choices of policy by librarians and publishers, as well as by the adoption of various alternatives by scientific authors. The eventual result could be excellent, or quite otherwise.

books or paid editorial material. Only the minimum discussion will be presented here.³

In both plans, the requirement is that OA be provided, at least, for the author's final version after peer review but before further editing. In the US, the requirement only applies to research sponsored by the NIH, and the OA version is to be placed in the NIH database PubMedCentral. In the UK, it would apply to all government-financed science, and it was proposed that the OA version be placed in institutional repositories at each author's institution. In the US, the copyright holder may postpone OA for up to six months; in the UK, it would be postponed for six months unless the author uses government money to pay for publication, in which case it would be available immediately. These differences between the plans are not large. The only significant one is the subject coverage, and it is generally assumed that if successful, the US plan will be extended to all government-financed sciences. It is anticipated that compliance with the plan will be required only for new grants, not existing ones. It is also expected that philanthropic foundations and other providers of research money will follow the governmental policy of OA.

Both plans are based upon the proposal widely disseminated by Harnad and others associated with the Budapest Open Access Initiative.⁴ It is sometimes known as 'self-archiving'. Quite independently of any mandate, self-archiving can be carried out on a voluntary basis, and that was the original proposal. Many who support OA find the government versions too weak, and object to various elements. Most object to the six-month embargo; some object to the use of the author's final version, instead of the final copy-edited version as published. Some also distrust the stability of any plan depending upon diverse repositories rather than central ones; others insist upon institutional repositories and not central ones.

Both the UK and the US plans would rely on the established scientific journals for providing archiving, copy-editing and the critical quality control function of peer-review. Nonetheless, there is considerable opposition from the publishers. They rely on subscription income for performing these

functions, and they understandably fear that the provision of any free versions of the articles will encourage the discontinuation of subscriptions and lead to the financial collapse of the journals. The six-month embargo, and the required deposit of merely the author's unedited version, are government attempts to protect the publishers' subscription base. These steps may prove adequate, or they may not – each possibility will be shown.

In addition to the proposed government plans, there are at least two other methods that are possible in case the plan as chosen should yield unfortunate results. They are not explicit parts of the government plans, though they are generally recognized as alternatives that could have been adopted.

We could have a system of journals each consisting entirely of OA articles, generally called an open access journal (OAJ) – sometimes called 'gold OA'. Publication generally would be paid for by fees collected 'on behalf of the author' unlike conventional subscriptions that are paid for 'on behalf of the reader'. The BOAI, in compromise, accepted that such journals are at least as good as 'green' OA. Such OAJs have the obvious advantage that they will continue the existing journal system, and the obvious problem that such a transition cannot be rapid, since the manner of payment must be shifted from subscriptions to author/institutional fees. There are already a small number of such titles, some intended to be inexpensive, and some more elaborate.⁵

Alternatively, we could have a system completely independent of journals, in which articles are published in a database. Some near approaches to such databases already exist, although presently almost all of their articles are also published conventionally in journals. The extent to which they presently carry out the conventional peer-review, copy-editing and archival functions of journals is limited. In these respects, they are all inferior to a first-rate journal, but some are already superior to many conventional titles. The term 'article databases' will be used for those that are of equivalent quality.⁶

Article databases have an obvious advantage in their low cost; however, the ability of

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the database to develop the full panoply of quality control and access functions of the journal system is unknown, and such a plan would obviously mean the ending of the present journal system. So-called 'overlay journals' could continue, as a title page with links to selected articles in the article database, peer-reviewed or chosen on other bases. It is also possible that a mixed system might develop, such as OAJs for the major titles of widest interest in each field, and article databases for the lesser ones and the most specialized. The possible stability of mixed systems will not be studied here.

Assumptions [See Note added in proof]

As the basis of this argument, it is assumed that the measures proposed by the US will be adopted by the end of 2004, and will apply to new grants only. There will thus be an extended period of phase-in, as existing grants come up for renewal: I will assume a five-year period. It is further assumed that the US will extend such measures to all government-financed research by the following year, and that philanthropic foundations and other providers of research money will adopt the governmental policy of OA. It will be further assumed that the UK will soon follow, and that the UK/US differences will soon be harmonized. The discussion assumes that the publishers provide OA to the degree the law requires, and only to that degree. As it is possible that some or all will see the wisdom of a more pre-emptively liberal policy, the case is also considered where the publishers in both countries might extend OA immediately to all articles, without embargo periods, using the final published version.

It is clear that the decision for OA in either the US or the UK will inevitably bring about its adoption by the other country. I suggest that the adoption of required OA in any major scientific country, like France or Germany, will also cause the US and UK to conform. The rates of change under such country by country adoption need discussion, but it will not be attempted here. However, the possibility that both government plans are defeated is included as a

special case, to see whether this too might yield satisfactory results.

Library subscription decisions

The key factor determining the overall results is whether or not libraries will maintain their journal subscriptions even after the introduction of OA. Traditionally, libraries subscribe until forced to cancel by rising prices. Publishers' prices have almost always increased faster than library budgets. This is due to positive feedback: publishers' costs increase each year; they know that a comparable price increase will cause a certain number of subscribers to cancel, and therefore they increase the price to cover both. The obvious result is accelerating cancellations in all following years.

The arithmetic conventionally used by libraries in deciding about subscriptions will not be affected by OA. In general, for a library that is a subscriber, the key figure examined during cancellations is the cost per use, however measured or estimated. Under OA, users associated with subscribing libraries will find themselves directed by the various already-existing linking systems to the publishers' official sites. If, as seems increasingly to be the case, they identify their articles on the Web,⁷ they may be initially directed either to the publishers' site or the OA site, but the OA site will contain a link to the official one. Thus the use of the publishers' sites will either remain the same or actually increase. For non-subscribers, systems and links will hopefully direct them to the OA site.

Therefore, library discontinuations of journals will be proactive, and represent decisions about how material can most efficiently be accessed. Research libraries and non-research libraries are in different situations. For non-research libraries, few still subscribe to more than the central titles in each subject, and almost no title is truly indispensable; the cutoff will vary with the budget and the availability of alternatives. Rapid cancellation of many of the titles, especially any remaining expensive ones, would be the rational course for such libraries. Libraries without research needs are expected to consider interlibrary loan or

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article-by-article purchase adequate for the embargo period, or if publishers' versions are required, just as they use it now for un-subscribed titles.

For research libraries, while only a small fraction of material in each journal is available OA, as would be the case during the slow development of voluntary OA, or during the earliest years of the phase-in, only those libraries that have truly marginal need for a journal would discontinue. Once most material in a journal is available as OA, as provided in these mandates, most libraries might also discontinue those titles for which they do not have a demonstrable research need. This is the reason for the provision of the six-month embargo and the limitation of quality to the pre-copyedited version: they are intended to keep research libraries subscribing.

Even for research libraries, not all the titles to which they subscribe are of equal importance to them. Any actual university has subject fields of only peripheral interest to the research programme. In any research field, some journals are of extremely limited value, and probably no library has a truly complete collection of all such journals. For both groups of titles, even a very good library might consider the limited OA access as sufficient.

The embargo will be the first factor to consider: during the initial six months, the suitability of interlibrary loan or article-by-article purchase may extend to the least important titles in research libraries. The acceptability of such substitutes depends on the extent of need, and the speed and cost of these alternatives; the details will not be discussed in this paper. The second factor is the degree to which the users prefer or need to use the official form. If they do, research libraries will retain them to the extent finances permit. If they do not, there will be very little reason to retain them. Some libraries will feel the need to maintain an archive of all possible titles, but few will want to do so in all subjects. Some may maintain subscriptions out of tradition as long as funding permits; others may seize the first excuse to cancel. Once some key libraries cancel, others will, especially the lesser ones. Publishers have relied on the

effect of mutual encouragement in consortia to hasten the spread of subscription plans; the same collective effect may also work in the other direction.

Publisher decisions

The commercial publishers, having generally large financial resources and profits that provide a considerable cushion, are characteristically taking the position that while the OA plan is not necessary, or even desirable, they will be well-prepared to comply with it. They normally consider the alternative of OAJs possible, and they have the capital to sustain their titles during the administrative transition.

The academic societies, which publish the great majority of the highest-rank journals, have minimal financial resources. (There are some exceptions.) Thus, they consider themselves unable to switch to OAJs: they already often charge author fees, and they regard further increases as impossible for their authors. They regard any loss of subscriptions as financially perilous: one-third of them already make no profit from their publishing activities.⁸ Their titles are less expensive than corresponding ones from the commercial publishers, and their hope is that the cancellations will fall on the more expensive commercial titles. It is paradoxical that some such societies, especially in biomedicine, themselves already allow full access after an embargo period, while continuing to oppose it as a mandate.

Methods

The projections have been constructed informally, assuming likely rates of change by the various components. Publishers and libraries do not quickly change in the absence of external constraints, and developments left up to them are assumed to proceed initially in a linearly increasing fashion. Once a new system has been demonstrated as necessary or successful, adoption can sometimes develop quite rapidly, and I assume in those cases an increasingly rapid change, whereby seemingly successful methods become universally adopted within a few years.

Although the results are being presented as graphs, they are not really quantitative. It

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is probably impossible to be more specific in advance, as the key decisions cannot be exactly predicted. We may look forward to proper analysis of the actual results after the fact.

Figures 1–6 present the expected proportionate share of each of the publishing methods. If there is a large overall increase in the amount of publication, we might see an increase in the proportion of informal publication without a corresponding decline in the absolute number of conventional subscriptions; this is not taken into account. Some publishers fear a net decrease in total publishing opportunities (by which they mean decline in the number of journals), but it would be expected that such decline would merely increase non-conventional publishing.

An increase in the total funding for science would benefit publishers as well. This might come from an increasing support from the wealthier nations, or, more likely, a gradual increase from the less wealthy as they develop. This would probably affect non-conventional publishing first: most developing nations subsidize their journals sufficiently so that many are OA.

Cases

I consider six possibilities:

1. The desired favourable case where OA is adopted, but the journals continue to publish. This may be caused by user preference for the official form, by conservative decision-making by the libraries, or by supplemental funding to encourage this result.
2. The undesired unfavourable case where OA is adopted, but many journals do not continue to publish. This may be caused by user lack of demand for the official form, or by greater cost sensitivity by the libraries.
3. A variant of case 2, where the journals as they fail to survive are replaced as rapidly as practicable by OAJs, paid for on behalf of the authors.
4. Another variant of case 2, where the journals as they fail to survive are re-

placed as rapidly as practicable by placing articles in an article database.

5. A variant of case 1, where the journals permit full OA to all their articles immediately in their published form, and survive by achieving lower prices through greater efficiency, or through lower profits, or through fewer journals, or possibly through direct subsidy.
6. The case where mandated OA is not adopted, and 'self-archiving' remains voluntary.

Case 1: required OA; journals continue (Figure 1)

In this case, the subscription years 2005–2008 are accompanied by the phased-in required transition to 'green' OA. OA does not reach quite 100% because there will probably remain a few journals that either publish only articles from privately funded research, or are review journals, and the plans require only primary research articles to be OA. There may possibly be an increasing number of authors who prefer to publish in the repositories only, but this should decrease with the slow development of the superior methods – OAJs and article databases.

The proponents of the official plans claim that this case will certainly prevail, and often do not consider other possibilities. They typically argue that only the true research libraries have kept many of these journals so far, and will not now discontinue them if it can be prevented. It is true that if users and authors insist on the higher quality of the publishers' versions, and funding remains available, the number of core subscribers may remain stable. Proponents claim to consider any less satisfactory result impossible; those less committed are beginning to consider such results openly.⁹

Case 2: required OA; journals fail (Figure 2)

This is the opposite case from the one above. In this case also, the subscription years 2005–2008 are accompanied by the phase-in of the required transition to 'green' OA. The normal pace of journal price increases will cause a decrease in the number

of subscriptions just as it always has; this decrease will surely go more rapidly when there is an alternative in OA, rather than just interlibrary loan. If readers accept a lower-quality alternative, the number of true core libraries may be very small. Libraries, seeing an alternative, will begin to discontinue titles, starting with those less central to their programme and those of least quality and use.

Discontinuing low-quality journals will obviously affect only such titles. However, discontinuing high-quality but out-of-field titles will also affect the better journals. As the process continues, the prices increase, and the number of subscriptions decreases to the point where publication cannot be continued. This will affect low-quality journals initially, and then the ones at successively higher quality levels.

Figure 2 shows 15% of subscription titles still continuing until 2013, as some of the conventional titles may be strong enough to operate even under these conditions. It shows the same slow increase in OAJs and article databases as in the previous cases. The lack of other possibilities results in two-thirds of articles being published only by uncontrolled self-archiving by 2013. The percentage might vary; what would not vary is the corresponding lack of peer review and other journal functions, as the journals previously doing them and paying for them no longer exist. Fortunately, there are two good ways to avoid this dismal situation.

Case 3: required OA; journals fail, but are replaced by OAJ

In this case, the money formerly used to buy journals that now no longer exist is used to fund OAJs. If we show foresight, we will plan this in advance, and begin developing OAJs immediately, without waiting for the collapse of subscription titles. This could be done by publishers converting existing journals, or by the formation of titles that either parallel existing titles or are altogether new.¹⁰ This is shown by an initially slow but accelerating increase in the proportion of publication in such journals; they take some time to start or convert. There will probably be an interim period when the conventional

journals have begun to fail, but not enough OAJs have been started or converted to accommodate the need. This is indicated by a temporary increase in the proportion of articles published by self-archiving only. As before, there remain some subscription journals as review journals or other special cases.

There may be essentially trivial but insurmountable difficulties: the non-commercial publishers could probably not effect such a change without at least temporary financial assistance, and the slow pace of change in academic institutions will greatly handicap the necessary change in financial arrangements. Repeated doubts have been expressed that the 'payments on behalf of the author' could ever be administered fairly.¹¹ If necessary, there is a more radical alternative.

Case 4: required OA; journals fail, but are replaced by article databases

This is the same situation as in the previous case, except that instead of changing to OAJs to fill the gap, authors instead adopt the use of true article databases. These can be established and operated much less expensively than journals, but there will be an inevitable lag in changing the behavior of academic administrators.

Universities presently rely upon the peer review for journal publication to provide the principal criterion for academic appointments and promotions. Appropriate quality control measures could be achieved by an article database – probably taking the form of overlay journals – but the change in the traditional criteria would appear exceedingly slow to those not familiar with academic institutions. Therefore, the figure shows a similar lag period as in the previous case, covered by a temporary increase in the proportion of articles published by self-archiving only. As before, there remain some subscription journals as review journals or other special cases.

The most significant difference between case 3 and case 4 is that the OAJs in case 3 could be operated essentially as journals now are, with the same staff, publishers and titles. On the other hand, there is no real place for academic publishers in the article databases of case 4, except the possible sub-

Figure key

Conv. jls only = % of articles that are published in 'paid-on-behalf-of-the-subscriber' conventional journals. *Jls + "self-arch"* = % of articles that are published according to 'Green' OA, in 'paid-on-behalf-of-the-subscriber' conventional journals, and also in some version available free in institutional or national repositories. *"self-a" only* = % of articles that are published only in repositories, not journals, and where the repositories are uncontrolled self-archiving that do not meet the quality standards of article databases or good journals. *Art. Databases* = % of articles that are published in OA article databases that are similar in standards to good journals. *OA Journals* = % of articles that are published according to 'Gold' OA, in 'paid-on-behalf-of-the-author' OA journals. *total journals* = total % of articles that are published in 'paid-on-behalf-of-the-subscriber' conventional journals, whether or not they are also available in some form as OA. It is the sum of (*Conv. jls only*) + (*Jls + "self-arch"*). *total sub j* = total % of articles that are published in journals of any sort, conventional, 'Green' or OA journals. It is the sum of (*Conv. jls only*) + (*Jls + "self-arch"*) + (*OA Journals*). *Total % OA* = the total % of articles that are published in one or another form of OA, whether OA journal, 'Green' journal, article database, or even uncontrolled 'self-archiving'. It is the sum of lines (*Jls + "self-arch"*) + (*"self-a" only*) + (*Art. Databases*) + *OA Journals*. The area above the blue *Total % OA* line represents the total % of articles that are published without any form of OA. Its area equals the area beneath the line *Conv. jls only* in Figures 1a–6a.

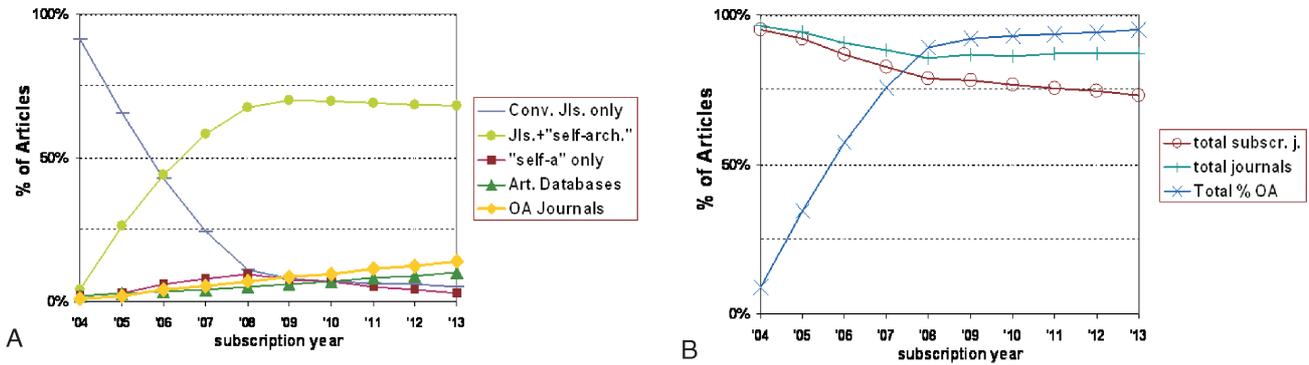


Figure 1 Required OA; journals continue.

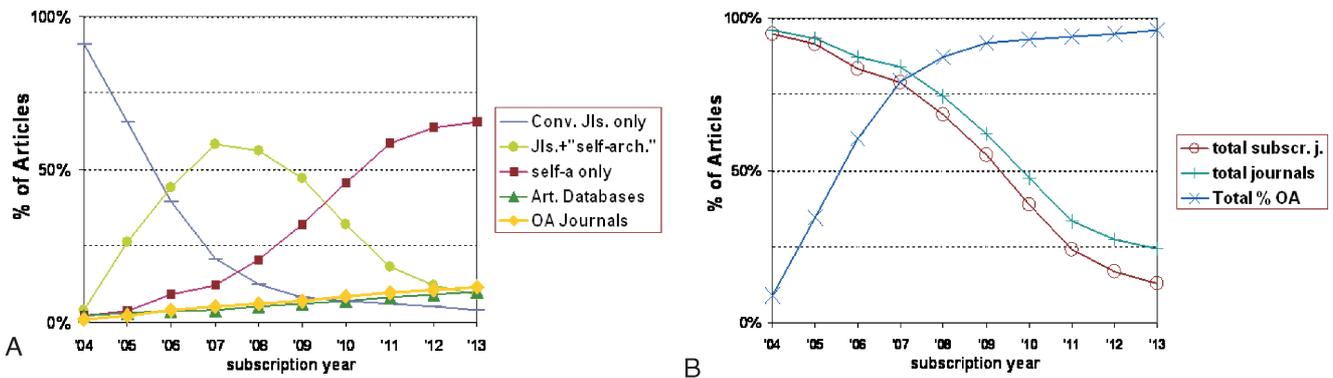


Figure 2 Required OA; journals fail.

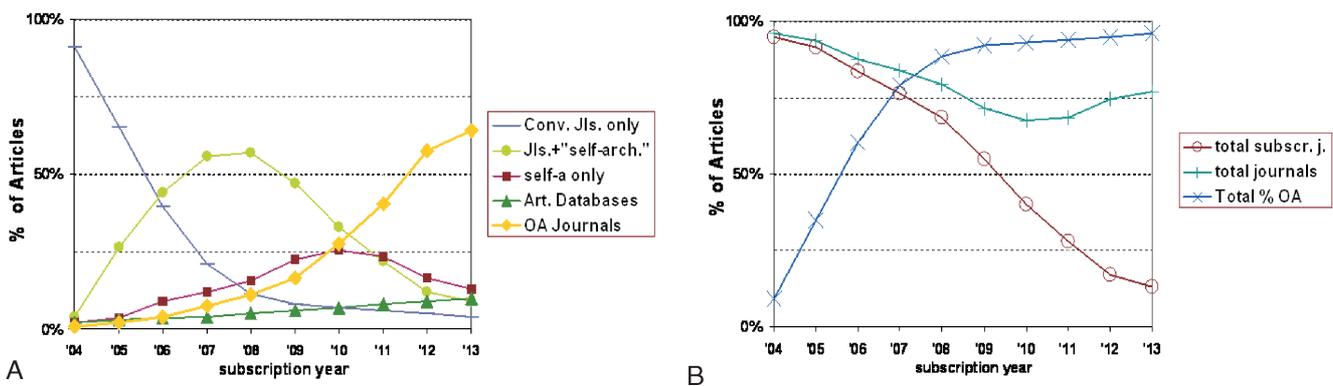


Figure 3 Required OA; journals fail, but are replaced by OAJs.

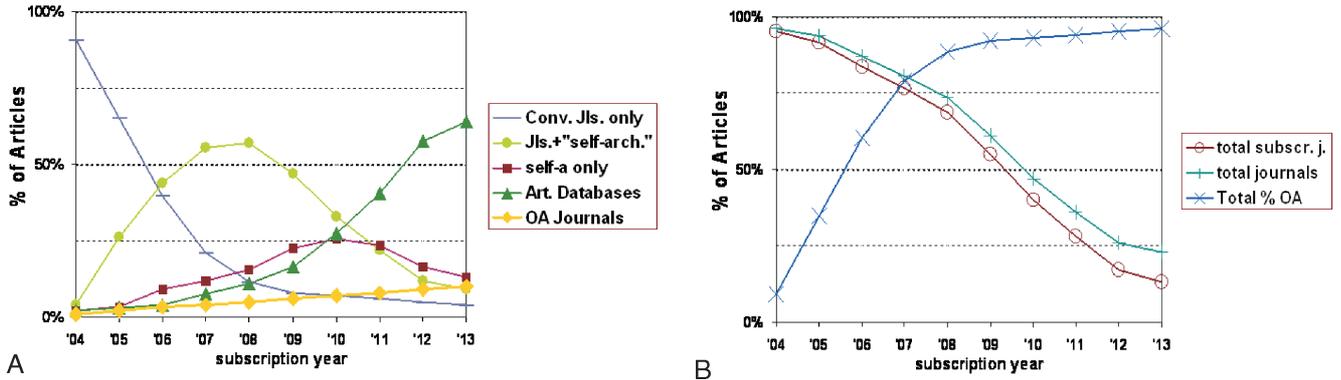


Figure 4 Required OA; journals fail, but are replaced by article databases.

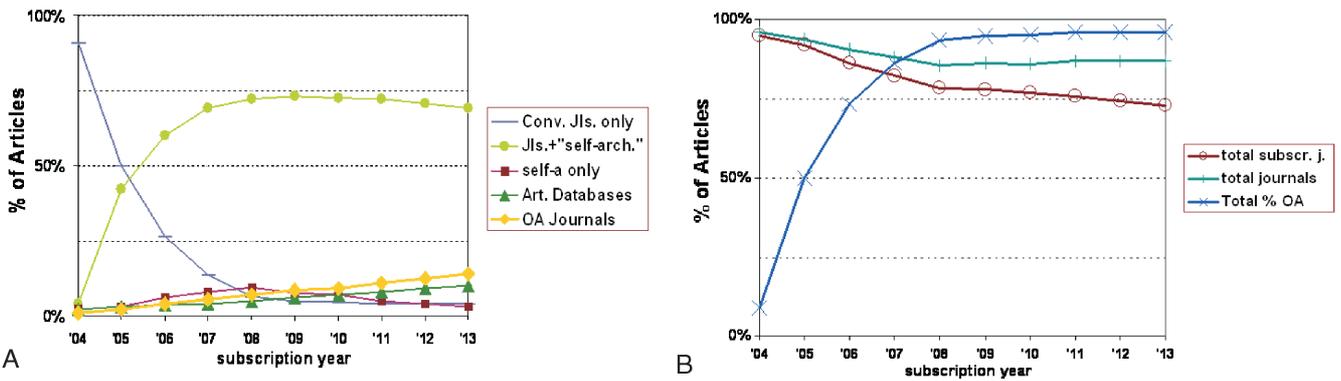


Figure 5 Full OA.

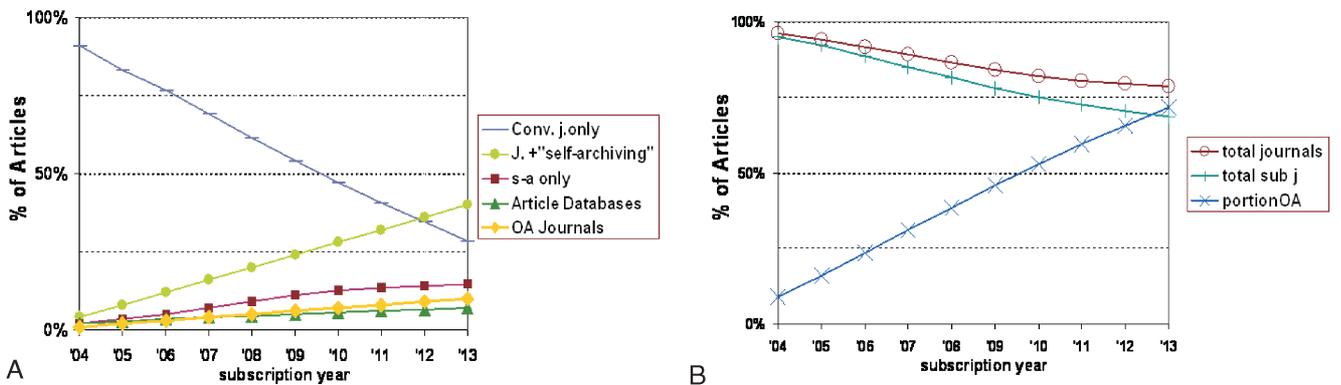


Figure 6 OA measures are not enacted.

Table 1 Time when OA is achieved

Case	50%	90%	95%
1 Mandated OA, journals continue	2006–2007	2009	2013
2 Mandated OA, journals fail	2006–2007	2009	2012
3 OA journals	2006–2007	2009	2012
4 Article databases	2006–2007	2009	2012
5 Full OA	2005	2008	2009
6 Mandates fail	2010	?2015	?2020

sidary vestigial roles of operating services for copy-editing, and structures for peer review. Since the change to article databases can be accomplished by the academic faculty and administrators alone, even over any possible opposition of the publishers, this would appear to give publishers every reason to assist in the rapid achievement of other forms of OA.

Case 5: full OA

This case is an attempt to provide the optimal conditions for 'green OA' – subscription journals supplemented by repositories.

In this case the publishers do not wait for the pace of the regulatory action, but immediately provide OA through institutional or centralized repositories for all articles in all subjects. They further encourage OA by providing the facilities for authors to immediately provide OA to the authentically published form of their articles. They survive by making full use of opportunities for greater efficiency to lower prices,¹² thus operating the positive feedback cycle in the opposite direction: the slightly decreasing prices will encourage institutions not to discontinue the journals and will encourage some to add borderline titles they had previously discontinued. The slightly greater number of subscriptions will permit yet lower prices, and the effect will increase for each succeeding year.

Some titles may have too few potential subscribers, and their articles will instead be published in article databases. Some very strong titles will be able to convert to OA journals.

This plan does seem utopian to an un-

likely degree, considering the present lack of co-operation between publishers, libraries, authors and users. But it does appear possible: the initiative rests with the publishers, and the question is whether they will be enlightened enough to seize it – and seize it quickly, because they must act more generously than the legal minimum, or the other parties will control the developments.

Case 6: OA measures are not enacted

The OA legislation may fail in both the US and the UK. Possibly it may be reintroduced and succeed in following years, after which the developments should be similar to those shown above. This case, however, considers the possibility that the mandates will never pass. All of the factors that encourage authors to provide OA will still be present; all the factors causing users to want OA will be present; all of the factors increasing journal prices so that libraries cannot provide access without OA will be present. All of the factors inducing publishers to experiment with limited forms of OA will also be present: the need to attract authors and readers. Assuming a gradual growth of 'green OA', of OAJs and of article databases, and a continuing trend for authors to publish only via repositories, the conclusion is that OA will be delayed, but will come, at least for most scientific fields. The extent of the delay allows only guesses at the preferred forms of publication, and thus only one representative case with moderate increase in all four is presented. The time for reaching OA for the majority of items is visible in Figure 6. The time for almost-complete OA, unlike the other cases, requires extrap-

olation beyond even the bounds of this paper.

Conclusions

When will we achieve OA? The existence of special publication circumstances may prevent a literal 100% OA, so three dates are shown: the year for the 50% point (the time when half the articles become OA), the year for 90% and the year for 95%.

In Table 1, it is seen that the mandates, if adopted, will bring about 50% OA in 2006–2007, 90% in 2009, and 95% in 2012 or 2013. It is noteworthy that these dates are independent of what course is followed after the adoption of the requirement for OA. The system may vary widely, it may be satisfactory or unsatisfactory in other respects, but OA to scientific research articles will be present. If the publishers should pre-empt the legislation by being even more generous than it requires, they will advance the date by one year for 50% and for 90%, by about three years for 95%. The motivation for them to do so is not primarily to advance the date, but to retain enough control over the succeeding events to preserve journal publishing as a system. It will not be surprising to avid proponents of OA to find that it will be achieved even without government action. The 50% point will be delayed perhaps five years, the 90% and 95% points cannot really be predicted, but OA will be achieved. The transmission of scientific information requires producers and users. It also requires some form of intermediary, but not necessarily the present system. If publishers permit critical developments to fall out of their control, they themselves may fall out of the system.

Note added in proof

On 8 Nov 2004, the report giving the UK government response to the open access recommendations of the House of Commons Science and Technology Committee was released (<http://www.publications.parliament.uk/pa/cm200304/cmselect/cmsctech/1200/120002.htm>).

From this response it is clear that mandatory OA will not be achieved in the UK at the beginning of 2005. The discussion in this paper should be read with the assumption that the UK will introduce OA one year following the US, but otherwise following the original UK plan. The graphs

have not been adjusted, but this delay will increase the dates in cases 1–4 by between one and two years, depending on the eventual details. Cases 5 and 6 are not affected.

Acknowledgements

Some portions of this paper were presented at the 2004 Charleston Conference, 3–5 Nov 2004, and some of the background aspects are similar to the author's article cited in note 2.

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 11. See many of the opinions in the articles in the *Nature Web Focus*, Access to the literature: the debate continues... <http://www.nature.com/nature/focus/accessdebate/>
 12. That this decrease in prices is possible is shown by the 1–3% price decrease announced by the American Physical Society, and their anticipation that such decrease will continue, as stated in <https://librarians.aps.org/2005pricing.htm>

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