

Sharing the science

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Abstract

An enquiry into what lies behind as well as ahead of the difficulty to find *bona fide* scientific knowledge in the ‘information age’.

1 Introduction

When research students in public-interest subjects — spanning the broad spectrum of science — return merely references of websites and blogs, the academic supervisor is justly alarmed. The difficulty of the young researchers — or any researcher, for that matter — to reach ‘scientific-grade’ information in its respected ‘article’ form is at least surprising in a time dubbed ‘information age’. How can this be possible?

2 Direct communication

Classic scientists such as Sir Isaac Newton and Gottfried Leibniz communicated their scientific ideas through private correspondence, as that was a common and convenient medium of their time ([The Newton Project, website](#); [Leibniz-Archiv, website](#)). In fact, the personal communication model (Figure 1) continues to be used by modern day researchers either out of need to exchange ideas, or as a way to circumvent the expenses of purchasing articles. This is also the primordial form of self-publishing, albeit at a very limited scale.

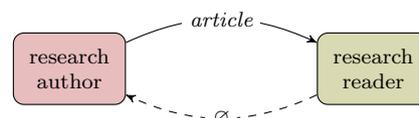


FIGURE 1 Direct, personal communication of scientific information

3 Repository

If researchers are to communicate at a greater scale, then the complexity of multiple-reader and multiple-author interactions requires a ‘hub’ structure such as a repository — for instance, a library or an archive (Figure 2). Historical archives such as [The Newton Project \(website\)](#) or the [Leibniz-Archiv \(website\)](#) make scientific content widely available, and could set an example for the communication of current research.

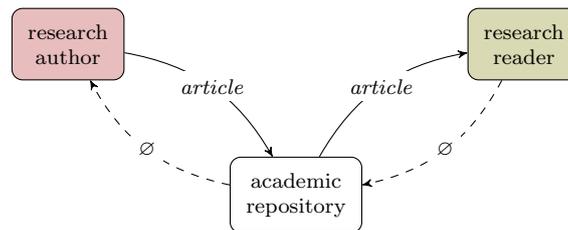


FIGURE 2 Scientific information shared through a generic *free* academic repository

A free, public-access repository of scientific publications is not all that difficult to set up and maintain, but it is quite a novelty for the tradition of academic publishing. In technically oriented fields such as information technology, software engineers — especially of the ‘open source’ movement — commonly use repositories to exchange code and applications.

4 Publishing

The communication of research, from writing to storage and transmission, is currently entrusted to academic publishers, who become the recognised — and perhaps exclusive — vendors of scientific knowledge (Figure 3).

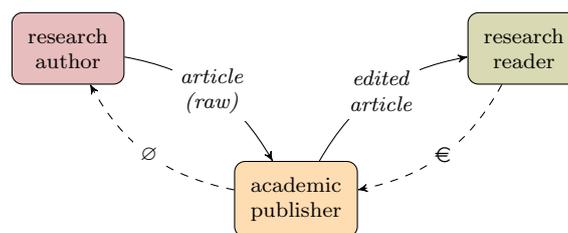


FIGURE 3 Academic publishers add value to the scientific communication, typically for a fee

Mandated by the mission of the academic publishers to improve and facilitate scientific communication, the publishing process adds value to the transmission of knowledge, such as improving the content of the articles as well as the chances or the experience of finding the intended information (Table 1).

TASK	ACTOR	INTENDED OUTCOME	CONTRIBUTION	KEY
Typesetting	Author/ Typesetter	Professional layout and meaningful formatting (incl. illustrations and tables)	Better article (form)	
Reviewing	Academic peers	Content verified by experts	Better article (essence)	
Editing	Editor/ Academic peers	Grammatically correct text	Better article (essence)	
Distribution	Publisher	Liaison with academic libraries; more recently, also with web portals	Visibility of the articles	

TABLE 1 The contribution of publishing to the scientific communication

Somehow, though, money is prevalent in academic publications — more so than the postage fees of personal letters (§ 2) or the running costs of online repositories (§ 3). To safeguard their commercial ventures, academic publishers charge fees for the added value they provide, usually reflected in the *prices* attached to the volumes and articles they produce — Figure 3. It could be argued that academic publishers go beyond their ‘added value’ mission, and well into profit-making territory, becoming ‘information brokers’ (Table 2).

From the point of view of the research authors, publishers enhance the content of the articles and produce a professional-grade output, so authors are grateful for the value added to their work throughout the publication process. Oddly enough, though, as producers of ‘raw material’, research authors give away their research output at zero price (Figure 4) — even though this becomes the input to a commercial, and often *for profit* publishing ventures (Figure 3).

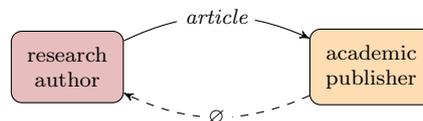


FIGURE 4 The standard fee to the author of scientific knowledge is ‘zero’

From the point of view of the research reader, scholarly-grade information is indeed plentiful, but at the same time *hindered* through money and/ or time. As true commercial products, the price of articles is usually proportional to their desirability, while a final ‘zero price’ usually means articles that are either (a) of trivial or ‘neutral’ importance (i.e. just for authors to claim that they publish, their bosses to be content, and publishers to gain ‘roughage’ for the journals), or (b) outdated information, after passing an ‘embargo’ phase — despite the fact that hiding or hindering public-interest information is largely viewed as unethical. Once again, academic publishers appear to be exceeding their ‘added value’ mission in the name of profit, and at the detriment of the research reader.

Finally, since there is a commercial venture, there is the additional point of view of the financial investor. Public-interest information has a potentially large user-base (e.g. scientific research, education, general culture), so there is reasonable interest in investing in the publishing process — after all, the process has a legitimate or even noble mission. Two extra comfort-factors for the robustness of the academic publishing industry are the facts that (a) the raw material is provided for free, and (b) the most important — i.e. responsible, labour intensive, time consuming, and thus potentially expensive — task of *reviewing* scientific information is carried out by academic peers, typically at zero or marginal cost for the publishers (Noorden, 2013).

PoV	KEY	VALUE OF PUBLISHING
Research author		Enhanced format and content of articles; professional-grade output
Academic publisher		'Information brokerage' model: harness the potential of the scientific communication
Research reader		Scholarly-grade information; hindered (sometimes prohibitively) by money and time; free alternatives (incl. illicit means or 'bypass' techniques)
Financial investor		Opportunity to finance a viable/ lucrative venture (public-domain scientific knowledge seen as commercial commodity)

TABLE 2 The value of publishing from different points of view (PoV)

5 Meta-information

Two important services for the classification and retrieval of scientific information are abstracting and indexing. In older times, authors and publishers were responsible for such meta-information, but nowadays these services are largely outsourced to indexing and abstracting services (I&AS) such as [Scopus \(website\)](#). In addition to this trend, a new type of ancillary services has become quite strong in recent decades, revolving around another kind of meta-information: that provided by rating and ranking agencies (R&RA) such as [The Web of Science \(website\)](#) — Figure 5, Table 3.

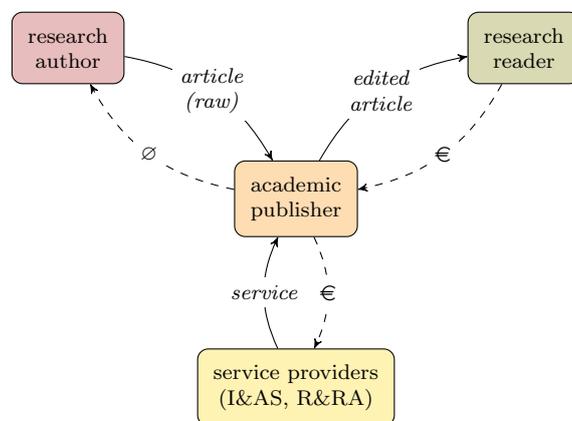


FIGURE 5 Meta-information services are a costly add-on to academic publishing

TASK	ACTOR	INTENDED OUTCOME	CONTRIBUTION	KEY
Indexing & Abstracting	I&AS	Accurate keywords and abstract	Finding the right article	
Rating & Ranking	R&RA	Publication statistics — e.g. impact factor (of journal), number of citations (of article)	See the popularity of an article (or author, journal, etc.)	

TABLE 3 The contribution of meta-information to the publication system

Abstracting and indexing handles *objective* meta-information, usually supplied by the authors themselves. Such meta-information is useful for classification, from the perspective of the publisher or the archivist, and retrieval, from the perspective of the reader — Table 4.

PoV	KEY	VALUE OF I&A	VALUE OF R&R
Research author		Accurate representation of the article	Stress to collect points; cultivate a ‘point-collecting culture’; working for token outcomes (instead of essence)
Academic publisher		Accurate representation of the article	Know where they stand; feed a ‘competition spirit’ (instead of a ‘mission spirit’)
Research reader		Find the intended articles easily	‘Select by statistics’ decision-making; reinforcing loops (<i>artificial</i> ‘natural selection’ for publications)
Service providers (I&AS, R&RA)		Business opportunity	Business opportunity

TABLE 4 The value of ‘meta-information’ from different points of view (PoV)

On the other hand, rating and ranking handles *subjective* meta-information, as it involves comparisons with other works. Such meta-information typically determines the articles (or journals, authors, citations, etc.) that are most popular over certain time intervals, which does not necessarily reflect ‘qualities’ other than ‘making it to the top’ of statistics. This is useful for publishers, for instance to adjust their pricing scheme or advertising effort. From the point of view of research authors, it may be useful (or just curious) to know the most popular authors and journals, but with considerable *caveats* — popularity features reinforcing loops (i.e. ‘vicious cycles’) involving authors, journals, and the currency of popularity, which is citations (Perdicoulis, 2012).

Whether objective or subjective, the contribution of the ‘meta-information’ ancillary services (Table 3) has different value for the various stakeholders, according to their points of view (PoV) — Table 4. For research authors, for instance, creating a ‘point culture’ (e.g. impact factor, number of citations) is not any different in spirit than the mundane ‘loyalty point’ systems administered at petrol stations and supermarkets. And stressing over the collection of ‘points’ is not exactly a game for thinkers — even assuming that they would still have the mind and interest to focus on the essence of their research work.

From the point of view of the research readers, ‘popular’ is likely to be confused with ‘appropriate’ or ‘good quality’. The selection of articles to read is made with popularity criteria, created by the rating and ranking agencies. Even if these agencies are unbiased towards particular research groups, they hold overwhelming power to make decisions such as to which articles (or journals, authors, research groups, or universities) are worth being consulted and cited. Diversity of information and freedom of choice are unsparingly harmed in a patronising ‘we show you what is good’ model.

6 Financial models

It has been evident so far that an elaborate system of sharing public-interest scholarly-grade scientific knowledge requires financing to stay functional — at least until the system reinvents itself. Let us consider a number of financial models at various perspectives of the academic publication system.

6.1 Financial independence

The direct communication model (Figure 1), the repository model (Figure 2), and the basic publishing scheme (Figure 3) presuppose a financial independence of the ‘producer’ of scientific information — i.e. the research author. Selling at zero price (Figure 4) seems to be the best possible deal for research authors, as paying to publish is definitely worse (Figure 7). Such financial independence is generally secured by employment contracts (in research or not), or by grants, scholarships, or funded research projects.

6.2 Subscriptions and sponsors

The most widely accepted way for the academic publishers to secure their income is ‘bulk-rate’ sales through institutional subscriptions, which are often state-sponsored (Figure 6). Nonetheless, single articles often escape these ‘package deals’, and end up being sold to the readers in the classic ‘the reader pays’ model (Figures 3 and 5).

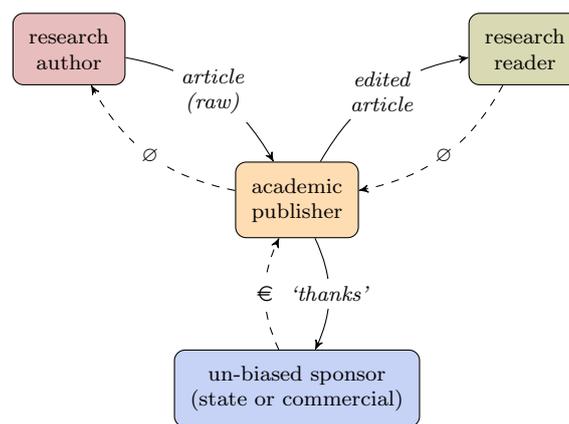


FIGURE 6 Sponsored model: an external sponsor is paying for the added-value

Another way for publishers to secure their income is an emerging trend of charging the authors (Figure 7). This arrangement breaks all the rules of commercial transactions, but is fuelled by the desire or need of research authors to publish, and has created a new species of ‘predator’ publishers (Butler, 2013; Beall, website).

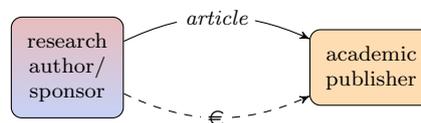


FIGURE 7 ‘Paying to publish’ is an odd transaction, and may even raise ethical concerns

The ethical concerns raised by the ‘paying to publish’ model are not limited to the victimisation of authors. In fact, authors can become the *aggressors* to promote dishonest or unreliable material by paying an unscrupulous ‘academic’ publisher — probably of the same kind as the ‘predators’.

6.3 Open Source and Open Access

The world of software brought about a commercial model that would make no sense in any of the previous centuries: ‘open source’. One of the key motives behind that was the altruistic ‘community development for the common good’. Another particularity of the open source movement is that theft is of no concern: it does not make any sense to steal something that is free and belongs to all.

In the open source movement, whoever proves to be good at creating value is recognised by the community and can even make money by providing services such as consultancy and training (Figure 8). Companies that follow this model with considerable success include [redhat \(website\)](#) in the domain of operating systems and [MySQL \(website\)](#) in the domain of relational databases.

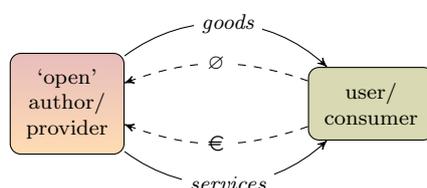


FIGURE 8 ‘Open’ providers charge nothing for their goods as authors, but offer their services for a fee

Academic publishers, who are also meant to work for the benefit and advancement of the community, followed the example of the software community, but with a twist: they do not make the *source* available, such as raw data or un-compiled documents, but merely the *product* — i.e. the articles and books in their finished form. The resulting ‘open access’ (OA) publishing is new only by name: its financial models are similar to those presented in § 6.2 (Springer, 2012) — except that their designated colours are not related to the colour scheme of this article. In the ‘green OA’, the production costs are covered by a benefactor (Figure 6), while in the ‘gold OA’ they are covered by the author (Figure 7).

6.4 ‘Ad-funding’

Newspapers and non-scientific journals have long used an advertisement-funded model for their publications (Figure 9). Search engines have followed suit, with notable success stories such as that of [Google \(website\)](#). Advertisement is not common in scientific journals, and perhaps would blemish the image or prestige of a journal — e.g. on the grounds of bias (cf. Figure 6). Curiously, though, advertisement appears blatantly in exceptionally well established journals such as [Science \(website\)](#).

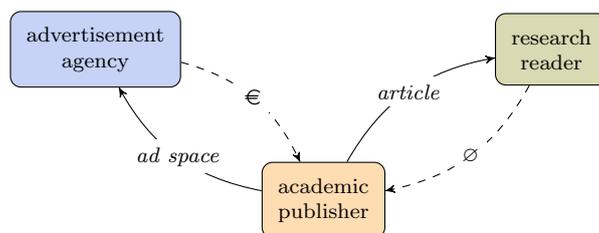


FIGURE 9 Publication funding generated from advertisement

6.5 Going German

The idea that search engines and portals should pay the academic publishers for any material they find and display recently arose in the German government (Pfanner, 2012). While this is difficult to implement, the idea aims at a zero price for the readers — whether research professionals or the general public.

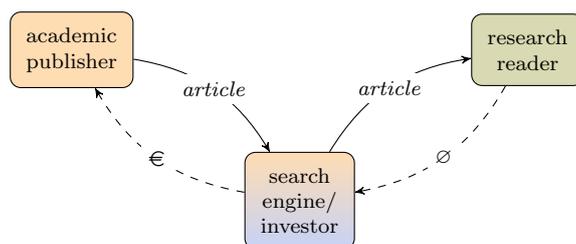


FIGURE 10 Publications funded by search engines

7 Discussion

Public research knowledge, which is essentially all the scientific discoveries and developments for a better society and better science, need not be kept ‘under lock and key’ for any intrinsic reason — after all, its production seems to be secured by the researchers (§ 6.1). Prices are mandated by the academic publication system which, as it stands, is not efficient enough to secure free delivery of the scientific content to the research readers.

Consequences of this general unavailability of free trustable scientific information are varied, and all damaging to the progress of science and the society at large. Some research readers may turn to the classic ‘personal communication’ model (§ 2); others may seek un-authorised copies online (and are likely to find them); more naïve (or more desperate) researchers may settle for risky alternatives such as consulting online encyclopaedias, personal websites, and blogs.

Regarding the research authors, who make commendable efforts to produce trustable scientific knowledge, it does not seem fair to be elicited or coerced to continue supporting a less-than-efficient academic publication system — especially when so many people make money *except* the research authors (Noorden, 2013). The situation becomes more accentuated when the authors ‘pay to publish’, raising concerns of exploitation or trustworthiness.

In addition to the issues of financial efficiency, meta-information such as rating and ranking taint the genuine efforts of sharing the scientific knowledge: the pleasure of sharing a discovery and satisfying the curiosity of others is replaced by an implanted spirit of competition that turns scientific knowledge into private property destined to yield profit — and oddly enough, for its brokers.

The competitiveness built on the ‘natural selection’ among articles and authors striving for ‘citation success’ (Perdicoulis, 2013) may eventually backfire: the survival, success, and even demise of academic publishers naturally corresponds to their function, value, or contribution. In case of ‘backfire’, the lobby may struggle to remain in power, probably at the expense of the community-wide sharing of public information. At any rate, the interest should be focussed on the scientific knowledge itself — at least that is in the mission.

8 Challenges

Would it be possible to make the academic publishing system significantly more *efficient*, so that it meets its ‘added value’ mission in the dissemination of scientific knowledge? This may require shedding *for profit* status, adopting new-technology production means, and rethinking the role of meta-information such as rating and ranking.

When do we know that all this change has been successful? When any researcher in public-domain themes is able to find and retrieve *bona fide* work of other researchers easily and free of charge. Besides giving away their finished research products for free (whether or not someone else commercialises them), it would be at least courteous if researchers had to pay equally *zero* for the raw materials they need — i.e. the articles they must read as part of their research.

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