Open Science and Goodhart's Law

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ABSTRACT

The influence of Goodhart's law to the development of Open Science is discussed. Science Citation Index (SCI) and Open Access (OA) are important steps in the path from Science to Open Science (OS). The main conclusion is that flawed openness replaced quality in Open Science.

KEYWORDS

Open Science, Open Access, Article Processing Charges, Goodhart's Law, Free Journal Network

1 FROM SCIENCE TOWARDS OPEN SCIENCE

1.1 Science

Traditionally, scientists disseminated their findings by publishing their results in scientific journals. This is a key mechanism for knowledge transfer among scholars and therefore an important subject of cognitive science. In the old days, the process of writing a scientific paper was completely different. The author had to type the paper on a typewriter leaving spaces for handwritten greek letters, symbols and formulae. With the advent of copying machines only cumbersome paper "cut-and-paste" method was available. Smaller misprints were overtyped whilst larger corrections required replacing whole pages. Professional typists, not available for everyone, could speed up the process. Manuscripts were sent for publication by ordinary mail in several iterations, depending on the referees' requests.

Rise of technology quickly brought up big changes. The introduction of personal computers replaced typewriters by keyboards and drastically enlarged the population of those who were able to compose texts on a computer and simple editors introduced cut-and-past method of writing. Specialised software for producing high-quality scientific drawings and diagrams enabled publishers to request camera-ready manuscripts from the authors. Authors no longer focused only on the subject of their work but also on the look it will have when printed.

1.2 Characteristics of Classical Publishing Model

Classical publishing model was robust and healthy. It was free for authors. Certain journals were even paying author fees. Surprisingly, it was (almost) free for readers via libraries of public universities.

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Main players involve authors, editors, referees, publishers, libraries, readers, universities, learned societies, funding agencies and taxpayers.

Publishing within classical publishing model was time consuming and required efforts from all parties. This somehow prevented the inflation and hyper-production of papers.

The model was mainly "subscription model" where articles were available in printed volumes of a journal. University and departmental libraries subscribed to major journals, covering selected fields of science. The contents of earlier volumes were available to library users. Most libraries were open to local community and also to visiting researchers. Several learned societies, universities and institutes published their own journals, associated with a given library and used them for exchange purposes. Instead of paying subscription to a similar journal they would simply exchange the journals. In this way a library was able to save money to subscribe to journals that were not available for exchange. This was an important way for wealthy western scientists to help scientists from Eastern block and third world countries. Later the revenue from scientific publishing was one of the main sources of income of major learned societies. Unfortunately, by acquisitions and mergers eventually a very small number of huge multinational publishers emerged. These publishing houses control the field of scientific publishing.

1.3 Transition to digital

The advancement of technology, in particular ICT (Information and Communication Technology), in the second half of the twentieth century with the transition from analog to digital completely transformed the process of scientific publishing.

The costs of all stages of publishing decreased. More and more work was transferred from publisher – printer to author. Publishing a paper became easy and inexpensive. The number of scientific journals started to grow even more rapidly.

Surprisingly, major publishers did not lower the cost of subscription to their journals. On the contrary, they started to bundle journals. If a library wanted to continue subscription to a journal it had to subscribe to the whole bundle of journals, many of which it had no interest in.

When papers became available in a pdf form, the need for printed versions decreased. This also meant there was no way to prevent an unauthorised access to the paper. The first electronic journals appeared.

There is a big difference between subscription to printed journal and electronic journals. Old volumes of printed journals remain in the library and are available to anyone having access to the library. On the other hand, volumes of electronic journals remain with the publisher who may deny access to the paid volumes after the subscription runs out.

2 GROWTH OF SCIENTIFIC PRODUCTION; SHIFT OF GOALS

In the past century we experience tremendous growth of published scientific works. There are several factors contributing to this phenomenon.

2.1 Publish or Perish

"Publish or perish" is an aphorism describing the pressure to publish academic work in order to succeed in an academic career. It first appeared already in the first half of the twentieth century. For a long time the PhD was a sufficient proof of academic qualification. It was not unusual that the PhD Thesis was the greatest scientific achievement of a scholar. Unfortunately, the growth in the number of universities and scientists led to inflation of PhDs. Some scholars would simply stop doing research when hired. Employers began requesting a constant flux of publications as a proof of scientist's devotion to research. Those who were unable to maintain high publication rate would be discouraged to stay in academia. And quantity became a proxy for quality.

2.2 Quality control

Ever since scientific journals appeared in seventeenth century, the quality of publications was in the hands of scientists using the system of peer review. This was natural since everybody involved: authors, editors, referees and readers were scientists.

With the growth of number of journals it became clear that not all journals apply the same standards for accepting a paper for publication. Obviously there was a problem of quality control.

In mathematics there was a secondary system in place. It started in Germany before WWII. Eventually, three refereeing journals were established, one in the Soviet Union, one in the USA and one in Germany (nowadays at the European Mathematical Society). If a review of a paper does not appear in one of those refereeing journals, the paper is likely not to be interesting for mathematicians.

For science in general there is a similar publication, called Current Contents.

2.3 Citation index

If we know for each paper the list of papers it cites, we can also produce the inverse index, i.e. the list of papers that cite a given paper. Such index is called citation index. In 1964 Eugene Garfield conceived the Science Citation Index (SCI) [3]. Using citation index one can easily detect most follow-ups to a paper covering a topic of scientist's interest. Clearly there are certain limitations. One has to select a collection of journals from where papers and their references are included. This may introduce some bias.

2.4 Impact

On the other hand, if the database is stored in a computer one can easily perform some statistics. For instance one can store with each paper the number of its citations. One can also compute how many citations each author has. This may, again, help the scientist to select the papers to look-up and authors to follow.

However, it also leads to all kind of rankings. Citation indices became very useful not only to scientists but also to their employers and funding bodies. Instead of comparing the added knowledge of someone's research, it is "sufficient" to select the highest ranked candidate. Selection can be done by administrators or computers. No peer review is needed. The paradigm "Publish or Perish" was upgraded to "Be Cited or Perish".

3 BIBLIOMETRICS

With the Science Citation Index (SCI) a number of statistical measures were introduced that would help profiling an author, the work or the journal. The science of bibliometrics was born. It was later extended to scientometrics and ultimately to informetrics.

SCI introduced a number of measures, indicators or metrics, trying to capture certain properties of articles, authors and journals.

One such indicator is the *journal cited half-life.* It is the median article publication date for each journal citation during one calendar year. In general, the journal cited half-life is small for recent journals while it is large for older, well-established journals. On the other hand it depends, as any other indicator on the scientific field and the culture of publishing in that field. Finally, a large journal cited half-life indicates that publications in that journal remain relevant for a long time. Hence the new knowledge is persistent and not merely mundane. Nowadays, it would not be difficult to equip any bibliographic database with computation of journal journal cited half-life.

3.1 Journal Impact Factor

Notorious Impact Factor (IF) is a ratio between the number of citations in a given time period - usually a calendar year, to the articles, published in another time period - usually two calendar years before. Sometimes they present also 3-year or 5-year impact factors.

For some reasons a 2-year impact factor prevailed and became a standard. In certain sense a 2-year impact factor is complementary to a journal cited half-life. Definitely, a 2-year IF is not the best indicator for mathematics when compared with other sciences where citation culture is different. For instance, when 1756 SCIMAGO journals covering the subject area of Mathematics are ranked according to Cites/Docs. (2 year) for the year 2023, among the top 50 journals only one journal has Mathematics as the primary subject area.

3.2 Metrics and Ranking

Having different indicators for a set of journals is good. It gives a higher dimensional description of each journal. However, each indicator may be used for sorting and hence for ranking. There is a strong tendency to devise an indicator that would measure quality; an impossible task.

Never-the-less since early seventies the Impact Factor is considered by many a proxy for the quality of a journal. The false reasoning goes along the following lines:

- Outstanding scientists publish their work in high-quality journals.
- The work of outstanding scientists is frequently cited.
- High-quality journals have high impact factor.
- Wrong conclusion: Work published in a journal of high impact factor is of high quality.

3.3 Power law and related statistical laws

When plotting the distribution of ranked impact factors, one can observe the exponential decay. Impact factor $IF(r)$ of rank r journal is proportional to $1/r^{\alpha}$ for some constant α. This is known as the power law. Roughly speaking this means that there are only a few journals with high impact factor and there are many journals with small impact factor. One way of stating this is that 20 percent of most cited journals receive 80 percent of citations; see [7]. Several of these laws were first observed in bibliometrics. However it is interesting to observe that these laws are universal and apply to a variety of unrelated situations, perhaps by choosing the right value of parameter α.

4 GOODHART'S LAW

British economist Charles Goodhart is credited with expressing the core idea of a law in a 1975 article on monetary policy in the United Kingdom. "When a measure becomes a target, it ceases to be a good measure"; see [4]. Another way of saying is "that once a metric is used as a basis for decision-making or control, it loses its reliability as an accurate measure".

The main rationale behind this law is adaptation or even gaming to improve one's rank. If high rank means high reward, it is plausible, that some people will do anything to improve their score for the given indicator. Each measure for assessment of researchers and journals became prone to Goodhart's Law.

4.1 Goodhart's Law and Bibliometrics

When the number of publications are counted, researchers will tend to split long papers and publish short bits and will thus increase the number of publications. Instead of publishing papers alone they may increase their output several times if more coauthors sign the same publications. There is no increase in quality of their output.

When the number of citations decide who is winning a grant, the number of citations soared. The authors started citing their own papers, even if citations were not needed. When self-citations ceased to count, friendly researchers helped each other with citations.

When the *h*-index was introduced, the key publications of potential PIs in a research group had to be cited.

Employers and funding bodies understood that blindly rewarding high production authors with large impact papers does not mean rewarding high-quality science as there was no problem in publishing papers in low-quality journals and getting many citations in such journals. On the contrary, in many cases those fabricating papers and citations easily outperformed best researches. That is why the quality of journal in which the paper was published became important; in practice this meant journals with high impact factors.

By Goodhart's law, predatory publishers flourished, multiplying their journals and boosting their impact factors.

Production of new knowledge ceased to be important. It is the impact of their work published in high-impact journals that counts.

There is a difference in Goodhart's law and other laws, used in bibliometrics. Goodhart's law involves time and decision while laws based on power law are based on rankings.

There are not many studies of Goodhart'sl law in bibliometrics. An exception is a comprehensive study reported in [2].

5 OPEN ACCESS A STEP TOWARDS OPEN SCIENCE

5.1 APC model

The idea that authors or their institutions should make financial contributions for their publications is not new. In the times of paper publications, the publisher would grant some, say 25 reprints. For ordering extra reprints it was not uncommon to charge the authors. Also, one could be charged for insisting that the figures be printed in colour. On the other hand, some prestigious journals, started requesting article processing charges (APC).

Employers and funding agencies soon recognised that if they want their scientists to publish in the journals with very high impact factor, they will have to cover the costs of APC. Some scientific disciplines such as mathematics declined this model. When judging whether to pay APC or to send a graduate student to an international workshop many mathematicians give precedence to student. However, the publishers realised that money could be presented as a proxy for quality and raised their prices.

5.2 Diamond- and Green Open Access

In the last decade of the twentieth century some of the first purely electronic journals appeared. For instance, *The Electronic Journal of Combinatorics (E-JC)* was funded in 1994. It was free for authors and readers. It is run by scholars and not by commercial publishers. This is nowadays called a *diamond open access*, with no cost for authors and no cost for readers. E-JC is a founding member of the Free Journal Network [9].

Even before that, in 1991, an e-print server *arXiv* was launched where preprints in some scientific disciplines may be uploaded. Nowadays, such posting of preprint before peer review is called *green open access*.

For a while it seemed that this model will force big publishers to lower the prices of their journals. In the battle between scientists and multinational commercial publishing houses, the scientist should have won. It was expected that governments will support scientists in the fight against greedy publishers; [10]. However, politics works in mysterious ways.

5.3 Budapest Open Access Initiative (BOAI)

In December 2001 there was a two-day conference, producing a declaration called Budapest Open Access Initiative. The declaration was launched in February 2002, having 16 original relatively unknown individual signatories. This initiative has been financed by Soros' private Open Society Institute with 3 200 000 USD. It is recognised as one of the major defining events of the open access movement, [8]. Up till now it has been signed by about 0.1% of world scientists.

5.4 Gold Open Access and APC

Gold Open Access requires the author to pay Article Processing Charges (APC) to keep article freely available to the reader. Currently a typical APC exceed 3000 EUR. This brings enormous profits to publishers. It is estimated that the costs per article should not exceed 1000 EUR.

Clearly, APC model is not viable if costs are indeed covered by the author. The author must find someone who will cover the costs of APC. This is an ideal model prone for corruption at all levels. In the APC model, money becomes a substitute for quality. and researchers must compete for money that will cover their publication costs.

The difference between Green and Diamond Open Access and Gold Open Access is huge. One can speak of two opposing concepts sharing the same name: Open Access.

6 IMPLEMENTATION OF OPEN SCIENCE

6.1 Recommendations, Declarations, ...

There are numerous mostly political papers, initiatives, recommendations, declarations, pushing for Open Access, Open Science, Open Research, etc. Due to limited space we mention only a few of them. For more information, see e.g. [1, 5].

While the OA has been launched bottom up by 16 individuals meeting in Budapest, backed up by 3.2 Million USD from Open Society Institute, OS is a political concept that is revolutionising Science from top to bottom. It seems it was first formally expressed by UNESCO in November 2021 in the UNESCO Recommendation on Open Science.

The concept has been embraced by European Commission that pushes it through Horizon Europe down to member states. For instance, Slovenia recently received 16 000 000 EUR for promoting OS. It appears this money does not go for science but for administration.

The Barcelona Declaration on Open Research Information emerged from a workshop with over 25 experts interested in changing the research landscape. The declaration that was signed on 24 April 2024 is a political statement of an unidentified *community*. The authors do not act as individuals and do not represent scientific community. They write: *. . . we, as organizations that carry out, fund and evaluate research, commit to the following . . . "*. The first out of four commitments is strong. *We will make openness the default for the research information we use and produce.* It leaves no room for science outside Open Science. While OA was at first optional, OS makes it mandatory.

6.2 Goodhart's Law and Open Science.

Since journal impact factor remains a measure, the number of journals and publishers keeps increasing. In general, neither OS, nor universities nor funding organisations address the problem of low-quality high-impact factor predatory journals. Several scientists lower ethical standards and publish their papers in expensive journals with mild or no refereeing. The costs are reimbursed by their employer or funding organization.

Ever since the number of publications became a measure, scientists tend to publish papers with partial solutions to the problem. The number of co-authors per paper keeps increasing. The number of published papers grows out of proportion.

After citations became a measure, the number of references per paper keeps increasing. Some prominent journals fight citation inflation by limiting the number of references a paper may have. Clearly, the references published by competing authors are first to go.

Since APC remains as a valid model in OS, all kinds of unethical practices emerge. In many cases, a ghost author, who did not contribute to the paper but may secure covering APC costs is added to the list of authors.

It is disturbing that the goal quality is absent in some documents on OS, such as the Barcelona Declaration. The quality is replaced by openness and Goodhart prevails. Scientists will adapt to new goals.

7 CONCLUSION AND SUGGESTIONS

OS has some serious flaws. The main concern of OS is that scientists financed from public funds are not allowed to profit from their work – but everybody else can.

OS is only open to those within the system. Independent critical scientists adhering to high ethical standards are left out. OS is concerned only with current and future publications. No pressure to commercial publishers to open archives of papers published previously under paywall and make them free for everyone. A large part of science remains closed to authors and readers that are unable to secure money.

Scientists no longer decide what is the quality of their work. They even have to pay private companies to tell them that. For instance, public employers and public funders base their decisions about the quality of candidates on data bought from private companies running services, such as WoS or Scopus.

There is a problem of citation culture among different scientific fields. For eaxample, if average scientists from a scientific field, say A with high h-index compete for money in another field, say B they may be ranked higher than the best scientists of the field B. This may have negative effect on the future of the field B.

There is no real need for repositories at every public institutions. One repository at the European level with several backups would suffice. Instead of creating jobs for scientists repositories create jobs for administration. Repositories of papers and data are not intended for individual scientists. It appears they are intended for the AI data-harvesting algorithms of private companies. This service again will be sold back to scientists.

One could say, that the OS is a model that diverts public money from scientists to administration and private companies.

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