Motivation and aims

The size of benefits arising from conducting research crucially depends on the alignment of incentives with the genuine goals of the research endeavour, as well as the efficient use of resources, most importantly the human potential given by the curiosity and creativity of researchers. Financial rewards to research institutions in particular are key drivers in hiring and promotion processes, and these influence what kind of research culture is being fostered. Moreover, research communication is essential for research to unfold its value, and it is therefore not surprising that publications have received much attention in research assessment.

While it is important to discuss publishing models and research evaluation as core elements for developing suitable frameworks for "open science", such links are usually not given enough attention in discussions on the future of research. With the membership of the Global Young Academy (GYA) not only spanning the planet, but also the wide diversity of research areas (in both the sciences and humanities), we accepted the challenge to fill this gap by organising a focused workshop on "Publishing models, assessment, and open science" (see below for details).

The nature of our workshop only allowed for a rough mapping of the problem landscape, as well as an inexhaustive collection of ideas for concrete steps forward. Nevertheless, we consider it most valuable to share our outcomes with everybody who is interested in contributing to the further development of the global research ecosystem.

We hope that the points we raise encourage further debate and investigation. The GYA would be looking forward to receiving feedback and to connecting with others for exchanging ideas and thoughts, as well as drawing up and implementing concrete plans of action.

Summary of outcomes

Our landscape mapping led to a *question framework* that is suitable to form the basis for further debate and investigation, covering five aspects:

A)   A framework for the global research endeavour,
B)   Communication,
C)   Quality assessment: making review work,
D)   "Open" science,
E)   The publishing business.

From these, we derived a set of *core issues*:

– we need a new global culture of dialogue, debate, and constructive criticism
– communication needs to get back to the core of academic publishing
– research quality and integrity are essential, and lack of either destroys credibility
– there is little value in research of large quantity and low quality
– achieving the same outcome with *lower* output volume (and *fewer* resources) means *higher* efficiency
– meaningful review requires time and cannot cope with a flood of output volume
– openness and protection of intellectual property are partially conflicting goals
– the research community can and needs to be in the driving seat for change

In addition, we arrived at 15 *concrete recommendations*.

We recognise that several of our suggestions are not new. Forming part of an ongoing transformation process, some are already being put into practice. We consider it important that they receive attention and are given the opportunity to develop further rather than being hindered.

GYA question framework on publishing models, assessment, and open science

A) A framework for the global research endeavour

– What are the goals of the global research endeavour, and what do we value?
– What should be incentivised, and how can that be done?
– Who are the "stakeholders", and how do they interact and depend on each other?
– Why are we doing research? What do we want to achieve, and how do we achieve it?
– Why do we publish?
– Do we need to depressurise the research environment?
– How does one avoid enforcing a global system that serves the purposes of a few countries but not others?
– How can we transition to a less-output higher-quality framework? (↔ quality assessment)
– How can efficient research management support research and benefit society?
– Do we need more or less regulation?
– How can the framework drive capacity building?

B) Communication

– How do we support communication about scholarly research?
– Who should we be communicating to?
– How do we foster dialogue and debate?
– What can we learn from citizen-science communities?
– How can we advance beyond the archaic printing-press model?

C) Quality assessment: Making review work

– How can the review process best assess "quality" (or "qualities")?
– What can review achieve?
– What purpose should it serve?
– What do we need assessment for? Do we trust or mistrust?
– What are suitable criteria?
– What can academia learn from quality control in industrial manufacturing?
– Who should review?
– How should review be organised?
– How can we go beyond static countable outputs?
– To what extent can metrics inform judgement?
– Are there meaningful indices that relate to content?

D) "Open" science

– What should "open access" actually mean, and where does it go wrong?
– What steps should be taken immediately in order to make the voice of researchers heard?
– How "open" should science be? Why does "open science" work or not work?
– To what extent is "openness" in conflict with receiving deserved credit?
– Does "open" imply a mandate to communicate rather than just publish?
– Who owns science? What proprietary rights should be protected,
  and how does copyright go together with openness?
– How should we value the creation of research data?
– How do we break away from "quality" being associated with specific forms of output and context?
  (↔ quality assessment)

E) The publishing business

– Who should pay production charges?
– What should the respective roles be of publishers, funders, research institutions, governments,
  and the research community or individual researchers?
– How to measure the quality of journals or publishers?

Selected recommendations

1. **Acknowledge the diversity of the research landscape and make use of the creativity of researchers.**

   With the research landscape having evolved historically, we see key differences in procedures not only generally between the sciences and the humanities, but already between different research areas, and even within the same research area, in particular when it comes to models of research collaboration. This calls for much flexibility and diversity in how the research ecosystem operates rather than for stiff one-size-fits-all solutions. Researchers have repeatedly demonstrated their creativity and know-how in developing technology for implementing new models for research communication and collaboration, including various forms of citizen science projects and the sharing of data. They have an intrinsic and genuine interest for their research area to flourish, and many of them are driven by the desire to make valuable contributions to society. Some research communities might have already established potential solutions. Good policies would create a supportive and flexible framework in which most suitable approaches evolve in a process, and must not be overprescriptive on details or punitive on researchers.

2. **Establish globally fair dually-open access to research dissemination taking into account the perspectives of both readers and authors.**

   Research needs to be understood as a global endeavour, and fair access needs to be free from potential barriers related to geographical location. It would be inappropriate to factually enforce models that reflect the research environment of the most-developed countries on the rest of the world. The SciHub usage map indicates that even read access is an issue already across well-developed countries. Better access as reader must not come at the cost of worse access as author. A charge waiver for less-developed countries does not provide a sustainable long-term solution for providing authors with indiscriminate access to academic publications. Moreover, publication charges meeting an unequal distribution of power within institutional hierarchies is likely to create barriers for those near the bottom, including younger researchers whose creativity is one of the most valuable resources. If we accept that open publishing serves the public interest, it might be worth thinking about globally fair publicly-funded academic publishing with dually-open access (to both readers and authors).

3. **Keep alternatives to publication models charging the author (e.g. "gold" open-access).**

   Such a model re-enforces the understanding of scientific publications serving the interests of the author (e.g. promotion/appreciation) rather than the reader. It appears to be unfair to load the burden of delivery on those who already give away their creative work for free. Moreover, it discriminates against authors lacking funds and makes them more vulnerable to institutional control. At the same time, acceptance of articles becomes a financial incentive for publishers, while they no longer need to "sell" to readers. This fosters a market of predatory publishing and has already been seen to lead to unsustainable proliferation in the number of journals and/or publishers.

4. **Support extending the model of community-wide preprint servers (like arXiv.org) to further research areas.**

   The publication landscape and the accessibility of research look much different across research areas. Community-wide preprint servers provide a platform for open-access communication of results, while putting articles on an equal footing with regard to the visibility irrespective of the journal they appear in. Such preprint server systems should be controlled by the research community and provide archival security. The GYA and national academies could play a role in reaching out to encourage and support research communities in implementing such systems.

5. **Acknowledge publishers as providers of services, and support engagement between publishers and research community on what services are desired.**

   Publishers provide a service to the research community, but like suppliers of materials, instruments, or computers, are not themselves a key actor in the research ecosystem. The research community should be able to decide which services and products it would like to pay for. As for any supplier, a close engagement with the research community on the further development of services with regards to needs and desired features should be encouraged. There are a wide range of possible contracting models between research communities and commercial publishers, and good commercial propositions are likely to find their market.

6. ***Give credit to the creators and curators of data and software.***

    Data are fundamental to all experimental and observational research. Many research investigations create new data. Frequently, data can be used for purposes other than those they were originally created for. Sharing data therefore can make research more efficient and provide returns that otherwise would not arise. Data products themselves carry value, not only publications that draw conclusions on evidence. Giving credit to data encourages early and wide dissemination. The allocation of a Digital Object Identifier (DOI) to data as well as mechanisms and infrastructure to cite data have already been put in place. As for other forms of output, the adherence to high-quality standards for data products should be fostered. The provision of dedicated training opportunities might be indicated. Research software on the other hand is an important tool for carrying out research. It has traditionally been indirectly credited through a journal article that describes it. However, it has become fashionable in many research areas to share software via online platforms like GitHub, where it now can be allocated a DOI as well.

7. ***Assess research publications carefully on their technical correctness.***

    The observed lack of reproducibility of claimed results in a large number of research publications prompts for a change of culture on quality and integrity. The F1000Research criteria, which demand that work is well designed, executed, and discussed, provide a suitable example of such a qualitative assessment:
    *   Experimental design, including controls and methods, is adequate,
    *   Results are presented accurately,
    *   Conclusions are justified and supported by the data.
    Such criteria are essential in the sense that submissions that do not meet adequate technical standards should not be given credibility.

8. ***Consider further complementary qualitative criteria of assessment that relate to achievements and outcomes.***

    The arising value of a research publication is intrinsically linked to its qualitative achievements and outcomes, i.e. the significance of the differences it makes. While a publication itself already reports some achievements, one fundamentally cannot get around the fact that outcomes will build up over time, leaving some uncertainty on guesses of outcome-related quality measures whenever these are made. However, seemingly small advances are valuable, and guesses on future value can be wrong. Lasting value is frequently poorly judged within less than five years from the publication date. In fact, it takes time to follow up with new observations and experiments that might at the end disprove claims made. Relevant quality criteria might include novelty, relevance, readability, as well as efficiency. The readability of a publication makes a difference on the absorption of the new knowledge, and the clarity of abstracts is particularly important. Giving weight to research efficiency, i.e. taking into account the amount of resources used, affects the appreciation of research carried out in less affluent countries, outside the mainstream, and by younger researchers, which usually runs on lower budgets. In contrast to these criteria, citation counts hide the reason for citing a publication (including it being flawed), and thereby can only provide a measure of quantitative reception rather than quality.

9. ***Do not discourage researchers from taking risks or exploring the unknown.***

    The global research endeavour profits from a diversity of researchers following different approaches. Attempts to generally request outcomes at investigation stage are worrying, given that methodologies require an unbiased approach to evidence not pre-empting any "desired" result. While benefits and outcomes are ultimately important, they cannot be enforced but need to arise from research complying with thorough standards of technical quality. Human curiosity is a powerful driver for advancing knowledge, and many breakthroughs are the result of serendipity. Moreover, short evaluation cycles tend to place undue time pressure on research whose benefits and outcomes arise on longer time-scales. Incentives provided to researchers need to take this into account.

10. ***Take care of specificities of the local research environment and needs.***

    Any meaningful research evaluation must match desired goals of the research ecosystem. There may however be different sets of goals. Established research evaluation systems have usually arisen around high-quality research in countries with well-developed research systems, and are not necessarily equally suitable to work in different environments. Significant differences can be found already between countries that have rather similar economies and are in geographic proximity. Moreover, within the same country, one finds research institutions that serve different purposes (such as e.g. fundamental

research, human wellbeing, regional development, industrial strategies, or national/global challenges) operating within academic, governmental, or industrial environments. A weighting that accounts for the specific environment and goals could be incorporated in an evaluation framework based on a set of qualities of research.

11. *Clarify the role of reviewers of research publications and establish the concrete expertise of reviewers. Institutions should provide suitable training.*

The review process of academic publications suffers from a lack of clarity of what is being asked from reviewers, with most journals providing insufficient guidance and most institutions never offering any suitable training. On the other hand, the quality of reviews is crucial for leading to a proper assessment of the quality of research articles. Reviewers might not be able to make a well-informed judgement on all relevant aspects of a publication, and advice from several reviewers with clearly defined and established complementary expertise should be sought.

12. *Raise the profile of reviewing research publications as a key task in academia.*

Careful review is indispensable for qualitative assessment, and it requires significant time and effort. Making it a rather unimportant side task that is not given much attention triggers the failure of any review system. Integrating review as part of appreciation systems would provide incentives that lead to much-needed improvements to its quality. By carefully reviewing publications, researchers moreover develop skills that are useful for their own research work.

13. *Keep the valuable information provided by peer review for use in qualitative assessment.*

The peer-review process already provides a qualitative assessment of research publications. It would seem quite odd to throw it away or lock it up, and then try to construct other assessment metrics. However, while research needs to be up for scrutiny and is being advanced through the process of questioning, the currently prevalent desire for prestige and citation figures conflicts with a much-needed culture of dialogue, debate, and constructive criticism. Several journals already practice models of open pre-publication peer review (publishing the review reports), while platforms for open post-publication peer review exist as well. While open peer review would face severe issues

if it was generally imposed, its acceptance could grow in an evolutionary process within a flexible environment. Emerging research communities in particular could take on the role of early adopters.

14. *Encourage and support initiatives that foster communication in academic publishing, dialogue and debate, as well as a culture of constructive criticism.*

The genuine role of academic publishing is to communicate results and to foster debate, rather than to serve research evaluation. An obstacle arises from the fact that openness and transparency conflict with hierarchies and power. However, the latter are not compatible with research following evidence. Research institutions need to set the scene for a culture of open dialogue, debate, and constructive criticism. It would make an essential element for a research ecosystem that truly embraces "Open Science". Critical review can fulfil the valuable function of providing support to the author. Some training might be indicated for researchers to better learn both how to criticise constructively and how to take constructive criticism.

15. *Strengthen incentives that support the transition to a quality-first ("slow") global research environment.*

The competition for bibliometric scores drives an increase in the number of publications. However, we become unable to control and assess their technical quality if the rate of publishing exceeds the rate of thorough review. If that happens, the production of low-quality outputs is incentivised. Not only does this mean that the average value of outputs will decrease, but even the total value of all outputs is at risk of shrinking. Research cannot function properly by everybody publishing and nobody reading. Publication platforms (e.g. journals) can establish a reputation through the quality of the review process, provided that such processes are transparent. While evaluation and appreciation systems need to put quality before quantity, the behaviour of researchers plays a key role in driving change. Their perception of what counts as research "excellence" does not always agree with the reality, and therefore they should be made aware of the fact that there are ways to academic success beyond maximising bibliometrics.

The global research landscape was not designed for purpose, but we continue to see competitive evolution of various models under different conditions related to the local environment and the specific field of research, with a range of actors. There isn't "the system" that always existed and is for everybody to follow.[1] Consequently, much about how research is currently being conducted and evaluated could actually make less sense than what one might be tempted to think.
We should not allow assessment systems to force us into a certain environment, but the ideal environment should rather define the most suitable assessment system.

Researchers experience first-hand the extent to which an environment supports them in achieving their goals and ambitions, to what extent it creates obstacles, and whether the incentives it provides are right or not. If something appears to be heading the wrong way, they should not hesitate to take an active part in changing direction. In fact, their knowledge, experience, and expertise are most valuable.

We feel that rather than trying to heal apparent symptoms, one must get to the very core of the issues we are facing, and to dare to question everything. It would make for an interesting exercise to think about how a built-for-purpose global research ecosystem would look like, while investigating how environment conditions could be set so that current systems evolve to become fit for purpose.

We most strongly doubt that research "excellence" can be meaningfully evaluated to a single number. While excellence comes in many flavours, research serves a multitude of interests and purposes while delivering various benefits. In different contexts, these carry different weights. While scientists tend to prefer "objective" measures, overcoming subjectivity must not come at the cost of losing adequacy. We consider some "subjectivity" inherent to a well-informed human judgment being a much smaller issue than the unavoidable imperfections of "objective" metrics. In fact, we manage to master our lives using human judgment. It seems mostly forgotten that citation metrics are actually neither objective nor robust: they are based on subjective decisions (some of them not being quality-related) and evolve over time.

There are many problems with peer review, but we think that these can be fixed, whereas we do not see ways to overcome fundamental shortcomings in the interpretation of bibliometrics for research evaluation, which is not what they have been designed for. A major issue with assessment by review is potential favouritism and corruption. Openness and transparency however are key means to overcoming these, and should therefore be essential to academic culture.

We note that the use of established bibliometrics for research evaluation also stands in the way of developing and adopting new forms of research communication and sharing information, given that these are coupled to specific types of countable outputs. We can now easily create audio-visual dynamic and interactive content, and also manage large amounts of data. We consider flexibility and acknowledgment of diversity key for a vibrant research ecosystem.

Usual open-access policies fail the common argument that "publicly-funded research is to be made available to the public". Given that most members of the public are unable to understand the research articles, "open access" constitutes no more than "open retrieval" for them, and they do not benefit directly. If we were serious about making research truly accessible for everybody, we would need to change the way it is being communicated. As a result of lack of readability of the academic literature, it has become hard for students to find guidance for gaining knowledge of a specific research area, and researchers aiming at understanding topics outside their core field of expertise face similar difficulties.

Given that new knowledge only unfolds a societal value once it is spread and adopted, research communication should be an essential element of research. Large efforts have been undertaken to encourage academics to communicate and engage with the wider public, more recently explicitly promoting dialogue models. In contrast, open dialogues within academia have become rare. Fostering openness, clarity of expression, and wide communication could also ease overcoming disciplinary confinement.
The spectrum of audiences with regard to their background knowledge and expertise is practically continuous rather than easily separable into academic and non-academic. It actually makes sense to publish the same findings more than once by presenting them in forms suitable for different audiences.

New information and communication technologies not only provide unprecedented opportunities for sharing data and knowledge, but have also removed or blurred dividing lines between communities. "Citizen scientists" can readily embrace such opportunities without being restricted by the rules of academic assessment or driven by false incentives. It would not seem wise to disadvantage academic researchers.
The principles of openness are in partial conflict with the principles of copyright legislation. While it is sensible to protect intellectual works against false attribution (e.g. plagiarism) and misrepresentation, legal barriers to access and reproduction can be counterproductive.
Compromising on the rigour of research methodologies would come with the loss of credibility. The trust in "experts"

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1   We would like to recommend "Untangling Academic Publishing: A history of the relationship between commercial interests, academic prestige and the circulation of research" (A. Fyfe et al. 2017, DOI: 10.5281/zenodo.546100) for a historical perspective.

is already under pressure from external factors, and it is therefore important that research communities do not destroy it themselves by failing to uphold quality standards.

Ensuring quality requires critical scrutiny, which can be delivered through review processes. The quality of review could set a benchmark for the quality of a publication venue. Research flourishes through debate, and by means of constructive criticism we can raise each other up. Progress is not hindered by being "wrong" (we all are many times), but by being quiet. We need to break the perception that criticism is something negative. With the research landscape continuing to evolve, we need to understand that all researchers are part of a global effort. A global research ecosystem should properly account for substantial differences in local environments, goals, and needs. We would fail to make efficient use of our global human potential for driving societal development if we were to adopt apparent solutions that only reflect the situation of a small number of the most-developed countries.

We hope that our analysis encourages joined-up thinking between innovators who currently address various aspects of the research ecosystem, and that our views can help to develop structures that will make research flourish as a truly global endeavour.

Workshop format

The GYA workshop on "Publishing models, assessment, and open science" was organised as a side event to the GYA Annual General Meeting on 23/24 May 2016. It took place in Eindhoven (Netherlands) and was attended by 8 GYA members[2]. As advance preparation, the workshop participants were asked to read a range of documents, and at the beginning of the workshop were asked to share their individual reflections before engaging in a group discussion.

The essential reading consisted of the following documents:

- "Excellence by nonsense" (M. Binswanger, 2014), http://book.openingscience.org/ basics_background/excellence_by_nonsense. html [*part of a book „Opening Science"*]

- "The future of Scholarly Scientific Communication", Summary Report of a Royal Society Conference (2015), https://royalsociety.org/~/media/ events/2015/04/FSSC1/FSSC-Report.pdf

- "The Metric Tide", Report of the Independent Review of the Role of Metrics in Research Assessment and Management" (J. Wilsdon et al., 2015), Executive Summary and Recommendations, ISBN: 1902369273, DOI: 10.13140/RG.2.1.4929.1363 [*with further encouragement to read the full report*]

- "Introduction. The History of Copyright History: Notes from an Emerging Discipline." (M. Kretschmer et al., 2010), http://books.openedition.org/obp/1060