

Ideal Open Access (OA²) and the Lineage of Reproducibility

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Introduction

Open Access is defined as unrestricted access to primary research articles for everyone. Scientific primary research publications demand the best of quality, ethics and rigor, regardless of the originality from non-OA or OA, and reproducibility is at the heart of this [1]. With the promise of the internet, the ideal OA (i.e. OA²) will present sufficient details to allow easy reproduction; however, articles with a fashionable "OA" label without solid data risk being nonsense, which is now happening in predatory journals [2]. Therefore, we need to urge our policy of copyright law and an intellectual property crediting system to align with OA. Otherwise, lots of issues may arise [1].

Historically and currently, there are many successful scientific communities. For instance, in *Caenorhabditis elegans* research, Sydney Brenner, followed by his post docs, has trained generations of protégés as professors in many institutions; all the academic descendants have originated from this lab following a clear mentor-student lineage. This community can share some details of their knowledge, techniques, hypotheses and designs, analyses and data in annual conferences, most likely before final publication. This is a situation that we could term as an in-context archaic OA (OA²), with new dimensions in OA (i.e. including sharing raw data, methods and results). If a particular discovery is sufficiently significant, other members in this community can build on the original by vigorous and independent testing, without the need for formal external incentives, regulations or coercion. In general, communications within the community is excellent. On any controversy, the researchers will argue face to face scientifically rather than personally. Finally, at least one or more lines of reproducibility follow the lineage of members and labs. Moreover, the essential philosophy is "Your success is my success". Outside such communities, instead, we may hear other philosophies. They have a default agreed way to assign credit for sharing. Many other communities have similar systems so science moves forward well [1].

However, science, particularly medical science, faces questions of economy much faster and in a more scientifically complex manner than before, so there is a trend towards having serious conflicts of interest (COI) [3] and irreproducibility, resulting in a verification burden [4]. If no such research lineage is available or if it is ending, we need a stronger system to create this reproducibility [1].

At another hand, confusion between OA philosophy and policy causes great confusion. Facing the OA impetus, our policy systems seem to lag behind. Hopefully, good policy will be developed to educate authors and readers. Good policy promotes good practice. Leading journals may make contributions to this. Leading institutions are expected to do something. Law should contribute to science by aligning with the modern computing and modern publishing context, where good policy may ensure less confusion and translate into constructive action [1].

We need to explore the practical aspects. The OA² model will focus on making publishing more efficient. One multidimensional package for OA² should be developed for novel transparency, fair responsibility and crediting systems as follows:

Authors' self-conscience

Authors must take responsibility for ensuring the quality of their data: they need to avoid erroneous, selective or irreproducible data. Post-publication tier system will give interactive feedbacks for these efforts.

Peer-review system

The COI for reviewers should be described in detail to ensure fair practice. For a control, the double-blinded review process should be optional, with anonymous submissions to reviewers, minimizing factors that contribute to the publishing of irreproducible data. Additionally, reviewers could suggest key experiments that need external verification. In addition, the reviewers' report and author responses, and the name of the reviewer should be optionally disclosed online. The peer-review process should not tolerate or overlook irreproducible data during the interactive process. Post-publication system will give feedback for these efforts. Lastly, the reviewers would get credit for their work.

Editor's systems

First, editors may need to be invited to make editorial decisions in a process that highlights fairness, transparency and speed. The editors need to act decisively alongside reviewers to identify the key experiments to verify. Editors should provide a swift, supportive and fair editorial service. Moreover, editor decision letters and author responses, and the name of editor should be optionally disclosed online. Editor and reviewers get intensively involved in interactive-review process. Editors should get credit as a motivation.

Publication systems

Some OA² articles could be updatable with modules, such as independent and available for collaboration, suggestion and comment throughout (<http://push.cwcon.org>). OA² would encourage authors to include links to the underlying data, wherever necessary. Publication would provide experimental details along with results and discussions, including all article components (figures, tables, video and other data files) at appropriate points. Each component would be treated as an individual item and given a unique identifier (DOI), so that they could be hyperlinked, discovered and used. Readers may pick up, discuss, identify and verify each part separately. In general, the impact for OA² articles will include both the citations, with a focus on results and conclusions and verification, with a focus

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on building parts [1]. The yet-to-be-verified parts would remain as interesting challenges that are worthy of further exploration. The content in OA² can be expanded in full detail, and readers may delve deeply into the work by exploring figures and their supplements, watching videos, downloading datasets, viewing article-level metrics and more. In particular, unlike traditional non-OA publications, it is unnecessary for OA² to have datasets for publication to fit underlying hypotheses. OA² would not always require perfect stories in biology and biomedicine, but it will recognize and reward reproducible results. Thus, it may free scientists from pressure to tell a “perfect” story. In principle, if the data are true, the gaps in an imperfect story will possibly be identified and completed in the future [1].

Raw data sharing

Researchers can get higher visibility, more citations and connections by putting their data online, but they must go about it in the right way. This is a must for verification.

Method system

Step-by-step protocols and a clear online method will be provided by OA² publications in enough detail to allow independent testing.

Data reproducibility system

OA² will follow a checklist (go.nature.com/oleip) intended to prompt authors to disclose technical and statistical information in their submissions, and the reviewers need to pay attention to reproducibility. Only true data will allow pieces to be stitched into a full article. OA² encourages the publication of creative, but reasonably complete designs and hypothesis alone, with follow-up experiments as updates. The reproducibility of the data and results will invite verification from labs with no COI. Besides, the key experiments may have an independent verification system. Funding agencies may allot grants that make this aspect mandatory or a “sting” policy could be carried out [1]. Removing the requirement for originality may allow OA² to publish experiments that verify published articles, particularly if an article is controversial.

Authority indexing system

OA² will need pass strict requirements for indexing systems, such as PubMed, enter the impact classification and have novel download metrics.

Publishers

The OA² publishers (e.g. OMICS group) may need to take all the pains to exploit digital media to presenting all types of results, thus stimulating maximal utility for continued research and inducing attention and participation to most audience, to make exhaustive crowd-sourcing for troubleshooting, contribution, discussion and verification, promote innovation, collaboration, fuel continuous improvement, to maximize the exposure for all published research, to maximize the reach and influence of new findings, at least as the mission targeted by eLife. Similar to and evolving further from its shoulder, OA² will lead an exceptional superb publishing option for authors to advance scientific achievements by making novel research available quickly, openly, reproducibly, and in a most cost-effective way that helps others to build upon it. OA² makes data most reproducible, most accessible and best re-useable, and to attract most attentions in every corner for discoveries, and to track, evaluate and report the pace and impact of published articles on research itself and society. The publishers certainly obtain their stable deserved revenues for providing such service. Currently, it is unnecessary for all publications to have a single model if the quality is adequate. We predict that the push for reproducibility will lead towards OA², where all parts have a DOI and are easy to verify separately, which will create a lineage of reproducibility.

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