# Commentaries

# Open science is good science, so what's getting in the way?

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## Abstract

The replication crisis in psychology has revealed that questionable research practices may have undermined the credibility of previously published research. This has led to meta-scientific efforts dedicated to improving research integrity and credibility by prioritizing transparency and reproducibility of research. This can be done through the use of open science practices, such as study preregistration, open data sharing, open source/code sharing, open-source publishing, and prioritizing replication studies. Many scientists agree that open science practices align with their scientific values, yet they are not currently standard practice. It is proposed that incentive structures that reduce the likelihood of adopting open science practices play a role in scientists' decision-making as they design, conduct, analyze, and disseminate results from their research. In order to improve the quality of the scientific record, systemic paradigm shift must occur at each step along the way.

Over the past decade, the social sciences have experienced an upheaval. Labeled by some as a "replication crisis" or a "credibility crisis", several high-profile attempts to replicate published effects were unable to do so (Camerer et al., 2018; Open Science Collaboration, 2015). This prompted questions over the quality of previously published research and produced a devastating loss of trust and confidence in psychological findings (Vazire, 2017). This crisis of credibility, though deeply troubling, has galvanized a growing number of researchers to work toward the improvement of psychological science (Munafò et al., 2017; Spellman, 2015). Many practices identified to improve scientific methodology across academic disciplines fall under the broad label of "open science", an initiative that aims to make science open and accessible at all stages, which serves to increase transparency, rigor, and replicability, and ultimately improve the quality of published research (Munafò et al., 2017). Open science initiatives also serve to increase access to resources, data, and results, which in turn increases diversity, inclusion, and equitable distribution of opportunities (Grahe et al., 2020). Open science reduces publication bias, increases dissemination of research, increases the reliability of the scientific record, increases public trust, and fosters collaboration (Munafò et al., 2017; Grahe et al., 2020).

One way researchers can increase transparency is to preregister their studies, so that their methods and planned statistical analyses are established and shared before collecting data. This helps to foster trust in researchers' methodology and results (Nosek et al., 2018; Vazire, 2017), and reduce publication bias in the literature (Lakens, 2019). Study preregistration and registered reports are two strategies for doing this. Study preregistration aims to reduce the likelihood that researchers will engage in questionable research practices (e.g. changing their hypotheses or analytical plan after data are collected), but does not necessarily mitigate publication bias since the decision to submit the study for publication is still not made until after results are known (Scheel et al., 2021). Similarly, registered reports can offer a way to share planned hypotheses, methodology, and statistical analysis before data are collected. With registered reports, however, studies are peer-reviewed before data are collected, and the decision to publish the results is made based on the quality of the methodology rather than whether an effect was found or the "significance" of the results (Scheel et al., 2021). This serves to reduce questionable research practices and publication bias, and increase the overall quality and rigor of published research.

Additional methodological strategies to improve the scientific record include open data sharing and study replication. When researchers openly share their data, it allows other researchers to check for errors or replicate the performed statistical analysis (Wicherts et al., 2011). In addition to allowing others to check for potential errors in reporting, openly sharing data ensures that correct statistical information is available for meta-analysis (Wicherts et al., 2011). Through systematic study replication, the credibility of scientific claims can be established and strengthened (Nosek & Errington, 2020). Replication efforts also serve to identify and reduce published false positives (Vazire et al., 2020). Though replicability alone is not sufficient to ensure the credibility of research, it can be considered a necessary prerequisite (Vazire et al., 2020). Some go so far as to call study replication the "gold standard" of scientific research (Jasny et al., 2011).

Open science also aims to increase the dissemination and accessibility of research through open access to published articles or preprints, as opposed to restricting access to research to those who can afford subscriptions or who are currently employed by or students at subscribed institutions (Cook et al., 2018). Publishing research can be a time-consuming process, often taking months if not years for results to be published in the scientific literature (Vosshall, 2012). Preprint servers, such as PsyArXiv (www.psyarxiv.com), allow researchers to post their manuscripts publicly before they are published in journals. This occurs before a journal's peer-review process, and can serve to provide immediate access to study

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results, as well as open the paper up to broader peer review and invite feedback before it's published. There are notable risks involved with allowing open dissemination of results via preprints, including a possible increase in the dissemination of poorly conducted studies and poorly analyzed data, as was seen during the Covid-19 pandemic (Glasziou et al., 2020).

When asked, most scientists agree that transparency, openness, and reproducibility throughout the research process strengthen results and further scientific knowledge (Anderson et al., 2007). Methods to increase the quality of published research are widely known, so why isn't this standard practice? The incentive structure, which plays a role in the hiring and tenure process, is a primary motivator among academic researchers (Nosek et al., 2015; Nosek et al., 2012). Graduate students in many fields are prepared primarily for academia from the start of their doctoral programs, but academic positions are scarce and competitive. Selection committees favor quantity of publications, but this drive to publish as much as possible as quickly as possible fosters research practices that are often incompatible with open scholarship (Smaldino & McElreath, 2016). For example, many hiring committees do not count replications in the publication count, nor are replications included during evaluations for promotion, despite their importance in strengthening the scientific record (Nosek & Errington, 2020). In other words, what's good for science is not always good for the scientist's career (Nosek et al., 2012).

Whether or not the current moment in the history of psychological research can be considered a "crisis," the goal of improving science is an ongoing aspiration. The path to policy change involves paradigm shift at many points along the way, from the attitudes and behavior of individual researchers to systemic matters, such as incentive structures and publishing practices. We have strategies that will improve the scientific record, but barriers to the adoption of more robust research practices exist at each one of these points. In order to improve the quality of the scientific record, it is critical that we begin systematically making robust research practices possible, normalized, and incentivized.

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