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COMMENTARY

The Ethics of Scientific Publishing: Black, White, and "Fifty Shades of Gray"

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Scientific discovery has been reported in print journals since 1667, and the entire associated process of experimentation, manuscript writing, peer review, publication, and discussion has withstood the test of the centuries. One might, thus, consider it highly evolved, effective, and resilient. With more than 25,000 diverse medical journals currently in existence, some catering to very niche areas, few can doubt that it is highly evolved (1). Its efficacy is, however, in serious question, and with that, its resilience to survive into the future. Confidence among scientists in scientific reporting is now extremely low, with the lowest levels being found among medical researchers. Begley and Ellis in a survey of more than 1500 investigators, found that whereas those working in physics and engineering had reasonable confidence in the work published in their fields, the vast majority of those in medicine believe that more than half of published results are simply not reproducible (2). Irreproducibility may have many causes. Certainly the authors must bear responsibility through a failure of scientific rigor, honest error, or willful misbehavior; but the responsibility is shared with those who publish the work, either through a failure of the review process or an overeagerness of editors to publish positive results.

If research is flawed then, when discovered, editors currently turn to errata for small corrections and retractions for work that is more egregiously flawed or misleading. The retraction rate has increased dramatically over the last decade and is growing at a rate that exceeds the growth in the number of manuscripts published over the same period (3). A "retraction index" (RI) for journals has been described (4). The RI is derived by taking the number of papers retracted over the last 10 years, multiplying by 1000, and then dividing by the number of papers published in that journal over the same interval. The highest RIs are seen in the high-profile medical journals such as the *New England Journal of Medicine*, *Lancet*, *Science*, and *Cell*. These journals publish high-impact papers, are under close scrutiny, and have a relatively low denominator. Although the number of retractions is increasing fast, it is unclear whether this represents an increase in the problem or increased awareness; likely it is both.

So journals are publishing much research of dubious worth, probably vastly more than the retraction rates indicate, but does the problem lie entirely with the investigators, or do the editors, publishers, and the current system of academic advancement also bear culpability?

Author and Research Ethics

At its mildest, simply designing a poor study, with a methodology that cannot hope to address the hypothesis, and then "fishing" with subgroup analyses and shifting cut-points for a positive *P* value, is an ethical gray zone because investigators should simply know better. Such behaviors may or may not be intentional, and the review process, when applied properly, helps prevent inferior work in this category from finding its way into reputable journals. A study by Fang et al, however, shows us that the majority of retractions are the result of scientific misbehavior and not

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honest error (5). Misbehaviors cross a spectrum, and I have written previously on the "unholy trinity" of fabrication, falsehood, and plagiarism (6).

At the extreme end of the misbehavior spectrum, there can be complete and intentional fabrication of data to generate publishable results. When discovered, these may become high-publicity, even criminal cases. There are many current examples of fraudulence that include human cloning and the reporting of trials that never took place at all (7, 8).

Behind the extremity of fabrication stands its little brother, falsehood. In this scenario, data are manipulated to "improve" the result. It takes protean forms, but common examples include exaggerating numbers in experimental groups to boost the significance of the data, and the manipulation of digital images. The latter is increasingly seen in the world of molecular biology, where blots can be cut, replicated, or reused to force or simulate a desired outcome.

Plagiarism is the use of the words of others without attribution, and although probably not the most common form of misbehavior, is the most easily detected and the one we uncover most frequently at the *International Journal of Radiation Oncology • Biology • Physics* (the Red Journal). How much reproduction of text it takes to cross the line into plagiarism is not fixed and requires reading both the work of the plagiarist and the original source, and then considering context. At the Red Journal we use antiplagiarism software to compare all manuscripts received with the published literature. When similarities are found they are highlighted and the editors alerted. Almost all papers have an overlap of less than 15% with the published literature, and these are usually the aggregate of common phrases or materials and methods. Egregious plagiarism is usually in the 50% to 75% word match range. Such papers are now usually detected before review, and the likelihood that we will see such papers in print in the future has declined sharply.

The issue of authorship is a troubling one for authors and editors alike. An author is "one who originates or creates," and authorship is clearly defined by the International Committee of Medical Journal Editors (9). Those who do not fulfill these unambiguous criteria should only be mentioned in the acknowledgements. Author lines are growing longer, a fact that may relate to the multidisciplinary nature and complexity of contemporary research, but which also likely relates to a culture in which the first author feels the need to pay back, or flatter, colleagues and pay respect to the head of his or her division or department. Flanagin et al (10) reported that somewhere between 11% and 29% of those on the author line were undeserving. This is a difficult issue for editors to police, and although perhaps it does not represent a serious offense, it represents the fuzzy edge of good ethical behavior. If this goes unenforced within a department or laboratory it may act as a "gateway" to more troubling behaviors in the future.

A new phenomenon, bogus peer-review, has arisen in recent years. To make their own lives easier, editors have for some years been offering authors the opportunity to suggest peer-reviewers for their papers and asking for these reviewers' e-mail addresses. Some unscrupulous authors have suggested names but given e-mail addresses they have created for the purpose (11). When reviews are solicited the authors then provide them in glowing and supportive terms. More than 300 papers have been retracted for rigged peer-review since 2012.

Postsubmission misconduct, and misconduct around authorship, have been felt by some to be less grave than falsehood and fabrication because the science remains "unpolluted" by bogus results. Biagioli (12) has argued, however, that these "lesser" misbehaviors must be repetitive to achieve their goal of academic advancement. "Many academic fraudsters aren't aiming for a string of high-profile publications. That's too risky. They want to produce—by plagiarism and rigging the peer-review system—publications that are near invisible, but can give them the kind of curriculum vitae (CV) that matches the performance metrics used by their academic institutions. They aim high, but not too high." Put another way, small misbehaviors, by their extent and number can widely undermine the academic culture.

Editorial Ethics

We should not be under any illusions that misbehavior is entirely the preserve of authors. Editors have a raft of self-serving behaviors of their own. At the very least they are responsible for the publication of large numbers of irreproducible papers based on poor methodology and "*P* value fishing." Developing an effective peer-review process to weed out such papers is the editor's responsibility. Editors, however, are under their own pressures. There is a strong bias toward the publication of positive results because they are the most eye-catching. There is a perceived need to boost the impact factor of the journal. This may happen through the acceptance of weakly reviewed "positive" or controversial papers. It may also happen through a quiet policy of journal self-citation. In this the journal leans on the authors to cite papers published within its own pages during the impact factor "window" of the 2 previous years. This practice is considered self-promoting and distorts the validity of the metric (13). If conducted flagrantly, journals can have their impact factor suspended, but editors are usually too artful to carry the practice this far. Again, as with the concerns regarding authorship expressed in the previous section, it is a gray behavior that, if ignored, begins to slowly erode the ethical foundation of the scientific publication system.

Editors, like authors, have their own forms of extreme misbehavior. "Pay to cite," or "citation reward," programs are now being uncovered, as are "citation cartels." In the latter, editors of 2 or more journals come together and quietly agree on a policy whereby they ensure that one