What is Truth? Standards of Scientific Integrity in American Heart Association Journals

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The pursuit of scientific knowledge engenders both a profound sense of wonder and responsibility. As life scientists, we endeavor to discover hidden truths that will illuminate specific pathways underlying basic life or death processes, or the mechanism of action of a therapeutic intervention. But what is truth? We expect what is true in a given set of experiments to be self-evident in our publications; however, increasingly, we are confronted with cases of skewed truth or outright fraud. One could argue the increase in scientific misconduct relates to the ever-rising demand to publish data. This demand in publishing is reflected by a steady increase in both the number of scientific journals and total articles published over the past 60 years (Figure). Interestingly, recent evidence suggests an apparent escalation in the number of retracted articles during the last 10 years, when a particularly sharp increase in journal/paper number was observed (Figure). Whether the rise in the number of retracted papers, and by extension scientific misconduct, relates to increases in published articles or simply the greater detection/reporting of scientific misconduct is unclear. However, few would dispute that the pressure to publish (or perish) and the ease in which data figures are generated provide fertile conditions for scientific misconduct to occur.

The issues surrounding scientific misconduct have spawned several initiatives to detect and combat such practices. But what realistic remedy can we promulgate for the journals stewarded by the American Heart Association (AHA)? A recent National Academies panel was formed to define guidelines for journals to follow in matters related to data integrity. Unfortunately, there was no list of guidelines generated, and the conclusion of one editor was that the task of developing such a list rests on the shoulders of individual societies and journals. Some journals, such as Journal of Cell Biology, Nature, Nature Cell Biology, and Journal of Clinical Investigation, have already adopted tools and policies to assist in decreasing instances of scientific misconduct. The AHA is sensitive to issues of scientific misconduct and, while recognizing that the process will necessarily be an evolving one, believes it is time some general guidelines for submitting manuscripts to each of the 11 AHA-sponsored journals be delineated and shared with each journal’s readership. Of note, much has already been formulated regarding AHA standards for falsification of scientific data, plagiarism, and scientific misconduct on various websites and in the Instructions for Authors. However, none of these standards has previously been published. The intent here is not to burden reviewers with methods to detect scientific misconduct, although we rely heavily on reviewers or coauthors to bring to the attention of the editors any potential misconduct in manuscripts submitted to AHA journals. Rather, we wish to define some of the major forms of scientific misconduct and some general guidelines for authors to consider when contemplating submission of a manuscript to one of the AHA journals.

Plagiarism

Perhaps the most common form of scientific misconduct is plagiarism. When an author duplicates his or her or another’s written words or ideas from an independent body of text without reference to the original source, the author has committed plagiarism. Plagiarism is tantamount to intellectual thievery and should not happen. Yet some people find it acceptable to extract text from a variety of resources as if the ideas and words were their own. This occurred recently in a publication in Stem Cells and Development, in which authors of an accepted paper duplicated a portion of their introduction from another body of published work without attribution. The AHA does not condone any acts of plagiarism and asks trainees and principal investigators to consider using such text similarity comparison algorithms as Google (http://www.google.com/) or eTBLAST (http://invention.swmed.edu/etblast/etblast.shtml) to determine whether their written words have previously been used in another source. The Dèjà vu database (http://spore.swmed.edu/dejavu/) utilizes eTBLAST in its compilation of suspected duplicate articles in PubMed. When a verbatim quote is necessary, authors should use quotation marks and properly cite the source.

We do recognize that widely used methodologies or common statements of fact are reproduced in one form or another in numerous publications over many years. Sometimes, there is no better way to express a universal protocol or accepted truth. Moreover, changing the language of a key methodology simply to avoid committing plagiarism could...
have adverse consequences in one’s ability to reproduce a finding. Thus, duplicating a long-held concept or idea or a specific methodology does not constitute plagiarism, but appropriate attribution is required.

Scientific writing is difficult, in part, because of an expansive literature that makes it challenging to construct new thoughts and ideas without consciously or unconsciously plagiarizing another author’s writing. On composing his 1965 masterpiece, “Yesterday,” Sir Paul McCartney thought surely he had heard it somewhere previously and unwittingly copied the music. Sir Paul was overtly concerned he had plagiarized another body of work. He did not do so, and “Yesterday” remains the most covered popular song in recorded history. We encourage all authors to be as self-critical as Sir Paul was 45 years ago and thoughtfully consider their own written words to avoid possible rejection of a manuscript or retraction of a published article.

**Scientific Ghostwriting**

Scientific ghostwriting occurs when a professional science writer is enlisted to write a manuscript about, for example, a clinical trial that writer had little or nothing to do with. Ghostwriters, by definition, are not included in the author byline and only rarely are acknowledged. Instead, participating scientists involved directly or indirectly with the manuscript’s contents are listed as authors. Because the written text is not from the listed authors, ghostwriting is a form of plagiarism and, although commonplace and often accepted in politics as well as in literary and film art, it has drawn increasing criticism within the medical research field. When a professional scientist is hired to write a manuscript, there must be full disclosure including any perceived conflicts of interest.

**Inaccurate Citations**

The establishment of a referenced bibliography should reflect the author’s understanding and thoughtful interpretation of the current and past literature as it relates to a new paper’s discovery. Often times, however, authors may not even have read certain papers of interest; yet, they report a central conclusion or interpretative finding only because others have done so in independent papers. Although the perpetuation of a skewed or incorrect truth through citations in subsequent bodies of work may not, on the surface, appear to be a form of scientific misconduct, it does constitute poor judgment by advancing a false sense of what is true. Thus, we urge authors to take considerable care when recording their bibliographies, paying particular attention to the historical order of a seminal discovery (ie, which source was first to report a specific discovery).

**Submission of a Manuscript Without Consent**

A recent electronic publication of an article in an AHA-sponsored journal was retracted because the corresponding author forged the signatures of several coauthors who had no knowledge as to the paper’s existence until it was published online. A similar retraction was rendered recently in the *Journal of Clinical Investigation*. Before a submitted manuscript is accepted for publication, the corresponding author must obtain appropriate signatures from each of the coauthors. Obtaining all author signatures signifies that each author approves the manuscript’s content and agrees to the copyright transfer. It is scientific misconduct to submit a body of work without informing a coauthor and/or to forge a coauthor’s signature. Ideally, author bylines should be determined at the outset of a study, with clear indications among the authors as to who is doing what experiment and the order of authorship. Moreover, to the extent possible, there should be full transparency among the authors as to who the first and second authors will be, as well as who should be the corresponding or co-corresponding author.

**Manuscript Duplication**

It is often advantageous to solicit a journal for feedback about the appropriateness of a manuscript and then submit the manuscript to the one journal of interest. It is quite another matter to submit simultaneously the same manuscript to more than one journal; essentially all journals prohibit this practice. At times a second manuscript, although not identical, is sufficiently related to warrant co-submission with the primary manuscript. Providing this information is important for reviewers in rendering a final decision as to the priority of a manuscript. Authors are reminded that it is not appropriate to list any manuscript in a bibliography as “submitted for publication” or “in review.” In fact, authors are asked to submit related manuscripts to assist reviewers in their evaluation. Sometimes, reviewers may conclude that important data in the related manuscript should be combined into the primary manuscript to strengthen conclusions drawn by the authors.

**Data Duplication**

As onerous as the copyright forms are to authors, they serve a critical role in safeguarding the ownership of published works by the sponsoring society or journal in which the work is to be published. For example, there may be an occasion in which an entire body of worked published in an AHA journal is proposed for publication in another medium. In such instances, the author must obtain permission from the AHA. Repackaging an AHA published article to another medium without explicit permission from AHA constitutes copyright infringement and is a form of scientific misconduct.
Data Manipulation

Fifteen years ago, generating a figure constituted a painstaking process involving cutting blades, rub-on letters, and traditional photography. We live in a digital world now with scanners and software programs that greatly facilitate figure generation. Regrettably, the same programs allow unscrupulous authors to “doctor” figures by altering the contrast or cutting and pasting lanes of data from one gel to another. The Journal of Cell Biology and Journal of Clinical Investigation have published clear examples of how data may be manipulated using such software as Adobe Photoshop.3,7 We provide here many of the same guidelines delineated in the aforementioned journals. Much of the material can be found in the Instructions to Authors in several of the AHA journals.

1. Gel blots may be digitally cropped, but authors must retain all original primary data in case a journal reviewer or editor requests to see it during the review process. Further, it is possible that AHA journals may adopt the same practice as other journals in publishing original blots online as a supplemental figure.

2. It is scientific misconduct to cut a lane from one gel and “splice” it together with another independent gel, giving the false impression that the entire gel is an original. When “splicing” lanes is essential, authors must clearly separate lanes from separate blots with enough space between them for readers to recognize each as separate blots. Moreover, authors must also write a brief statement in the legend of the figure acknowledging the independent nature of the blots.

3. It is not acceptable to use a control blot from one experiment as the same control for an independent experiment. This form of splicing is surprisingly prevalent but nevertheless constitutes scientific misconduct. When in doubt, authors should simply repeat the entire experiment, which they need to do anyway to confirm the original finding!

4. Sometimes, it is necessary to alter the contrast of a gel or blot. This is permissible so long as the adjustment is made uniformly across the entire medium, and a statement to this effect is provided (either in legend to figure or in Materials and Methods). It is scientific misconduct to enhance or reduce the contrast of a selected region of a gel or blot. Moreover, it is scientific misconduct to increase or decrease selectively the fluorescence of only a portion of a microscopic image (eg, enhancing the fluorescence within the nucleus of a cell without an equivalent adjustment across the entire image). As with gels and blots, any manipulation to a microscopic image must be done so evenly across the image, with full disclosure of the adjustment in the figure or in Materials and Methods, or both.

5. Authors often show their best data and readers assume that similar findings were found in independent experiments. The easiest way for authors to demonstrate the representativeness of a finding is by including data from an independent study as a supplemental figure. It is scientific misconduct to show the results of an experiment that was performed only once, unless the author discloses that the experiment was performed only once. A careful reviewer would likely ask that the authors provide additional experiments to substantiate the finding.

Data Fabrication

Perhaps the most egregious acts of scientific misconduct are those in which an investigator (or his/her subordinates) creates data to deceive a reader. For example, data points on a graph may be simply made up, or a figure depicting a cell or tissue type is falsely shown to represent something that is untrue. The most recent high-profile example of data fabrication was from a South Korean stem cell researcher, Hwang Woo-suk, whose research team was found to have committed data fabrication involving 2 publications in the journal, Science, which subsequently were retracted.12 This type of scientific misconduct is often times the most difficult to detect; however, a recent meta-analysis of scientific falsification and fabrication data revealed a probably underestimated rate of 2% for self-reported cases of data fabrication/falsification.13 We offer the following guidelines to our readers to assist in preventing any acts of data fabrication.

1. All scientific investigators should take a course in bioethics. In fact, many universities require students and postdoctoral fellows to have such training, and if the trainee is funded through NIH, enrollment in a Bioethics course is compulsory. Principal investigators may also need a refresher in bioethics, particularly given the advent of computer software programs that can be misused in data generation.

2. Principal investigators should further educate their trainees on the subject of scientific misconduct, preferably before a trainee even starts research.

3. Principal investigators should examine not only the final figure for publication but also the primary data. Often times, trainees may go about their work without the principal investigator meeting them regularly to evaluate the data first-hand. Principal investigators are ultimately responsible for the integrity of their research and, thus, every effort should be made to examine and question primary data.

4. Data should be screened at laboratory meetings. All principal investigators should hold regularly scheduled laboratory meetings for data to be scrutinized by all
members of the laboratory, including technical support staff.

5. Key experiments should be repeated within a laboratory by 2 independent people. Although cumbersome, this practice represents, perhaps, the strongest safeguard against possible data fabrication, especially when the purported finding is one seemingly too good to be true or contrary to current understanding.

6. When appropriate, data analysis should be performed in a blinded fashion to reduce experimenter bias.

7. Some institutions have an in-house review panel that, as a condition for submission of any manuscript, requires authors to submit the work for pre-review internally before it is formally submitted to a journal.

8. All investigators—whether trainee, collaborator, or laboratory witness—should consult the Office of Research Integrity web site for further instructions on how to detect or otherwise report cases of scientific misconduct (http://ori.dhhs.gov/).

Scientific integrity is dependent on personal integrity, and all coauthors must be fully cognizant of their fundamental responsibility to ensure the integrity of their submission. Reviewers, journal editors, and their staff expect that submitted manuscripts are valid and original works. Given the increasing burden on journal editors and reviewers to evaluate manuscripts in a timely manner, coupled with the accelerated pace science has undergone, it is virtually impossible to scrutinize all original data or validate submissions, even those that are carefully reviewed and accepted. However, in the rare situations in which there may be misconduct, the editors can raise questions but, without all of the facts at their disposal, their role is to direct specific questions regarding potential misconduct to the authors, and then evaluate the reported truth in the manuscript in light of the allegation and the authors’ response to it. In the end, the responsibility for ethical submissions to journals rests squarely on the contributing authors and their parent institutions, whose job is to investigate allegations of scientific misconduct and judge the validity of the allegation accordingly. It should be the goal of every life scientist to report truth in publications. We hope authors will consider these suggestions and those reported elsewhere to ensure sage, unbiased reasoning during the generation and ultimate interpretation of their scientific findings in order to safeguard what is true in their scientific exploration.

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References

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