



Opinion Piece

How to write (and how not to write) a scientific review article

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The writing of a scientific review article provides a great opportunity for those who fully engage with the experience. Crafting a good review article requires the author to read the literature of the field of interest broadly and deeply. It should combine a comprehensive and current treatment of a subject, a critical evaluation of the literature, a model that synthesizes the existing data, and testable hypotheses that plat avenues of future investigation. It should, in summary, be an original contribution to the intellectual corpus.

There are a number of justifications for this essay. First, although most journals have extensive instructions about what should be included in research articles and how they should be constructed, there tend to be few guidelines about the writing of review articles. It appears to be assumed (erroneously) that authors already know how to write them and understand the ethical responsibilities of authors. Second, it is evident that large numbers of review article authors are unaware that composing an article requires original critical thought. Third, the criteria used by editors for acceptance of review articles often appear to be amorphous and lax. Fourth, there is an extreme reluctance for editors to confront violations of academic norms that are identified in review articles after they have been published. Finally, it is obvious that many review articles are being written and cited for the wrong reasons.

The first two points will be manifest to anyone who peruses journal instructions to authors and reads review articles. The next two points are derived from personal experience. The final point is based upon the fact that review articles are being used increasingly not as an introduction to a field of research but as sources of references to be included in the writings of indolent authors.

1. The science of writing a review article

A scientific review article should be regarded as a scientific endeavor and should employ the methods of science. Authors should provide and editors should demand a section describing how the sources for the review were identified. Presumably a modern literature review involves an Internet survey. One should provide a list of the databases and the search terms that one employed. A summary of the criteria for inclusion of cited articles and exclusion of articles that are not cited should be provided. Such an approach can facilitate the perpetuation of the article as a living document. It would provide an organizing principle for the periodic updating of the article with the

addition of new material and the reconsideration of earlier data.

Understanding the role of motivation in the writing of a scientific review article is essential. Unless one regards the primary accomplishments to be achieved through publishing the article to be an enhanced comprehension of a discipline and an original contribution to the literature that is the product of one's unique informed perspective then one should not accept the mantle of authorship. Of course, there are other legitimate considerations, but if they are dominant, then it is highly probable that the review article will be deficient.

It is possible that the principal rationale for writing an article is to highlight one's own contributions or those of one's research allies. There is nothing necessarily wrong with such an approach as long as one states that fact explicitly. Readers would then understand that the article is intended less as a review and more as a promotional advertisement.

Critical analysis means that for each article in the references, the data supporting the conclusion that is being reported should be scrutinized. There should be a determination whether there is a possible alternative interpretation consistent with the data presented or other data that diverges from that provided by the authors of the research article. Especially relevant are reconsiderations of data that might be understood differently in the light of more recent developments.

Each section, indeed each paragraph, should have a message that is important to the overall purport of the article. The conceptual framework of the field and the contribution of the material included in the review article to its development should always be evident. Controversies should be given prominent treatment focusing on their origins and possible resolutions. Ultimately the analysis provided should be directed toward supporting the synthesis of the data and concepts that will be embodied in the model presented.

2. Responsibilities of authorship

Given that the article is a creative endeavor with a subjective approach to a topic, all the authors should share a common perspective and should share responsibility for all of the content of a review article. If there is a disagreement among the authors about the interpretation of particular data, articles, or research areas then it should be so stated in the text. If any authors have not read each of the articles cited and, indeed, the entirety of the article that is being submitted for review,

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then they should refrain from being an author. The analysis of the articles being reviewed should be a collective analysis. Any deviation from this standard should be reported overtly.

One consequence of the principles delineated in this essay is that all the authors are responsible for any violations of academic norms that occur in articles that have been submitted for publication or published. In the case of a research article, there may indeed be data manipulation that would be difficult for coauthors to recognize, although it appears that insufficient diligence is often the blameworthy cause. With regard to a review article, there can be no such excuses. If one has indeed read the articles being reviewed and the submitted text, one would easily recognize when unacceptable shortcuts, duplicate publication, and outright plagiarism are occurring, especially if they are extensive. It seems improbable that one could agree on an interpretation of particular data or articles and not be cognizant that the text was one that had been previously published by someone else or oneself.

As an original work, there is the absolute expectation that passages have not been published previously by others or all or a subset of the authors [1,2]. It is insufficient in a review article to cite the source of text without some indication (quotation marks, indentation, etc.) that one is reproducing the text. Repeating verbatim the words of others without a clear indication of having done so is still plagiarism, because, despite having acknowledged the source of the ideas represented in the text, one has not declared firmly that the words themselves are reproduced. It is also unacceptable to modify previously published sentences or paragraphs (for example by changing tenses, substituting synonyms, rearranging the order of items in a series, etc.) without stating that one is doing so.

3. Figures, tables, and references

Before returning to general remarks about composing a review article it is appropriate to consider the proper assembly of some of its components. Figures and tables should be included in the article. A figure illustrating the model proposed in the review article must almost always be a feature. Tables can be usefully deployed to summarize critical facts about the topic of discussion. They could outline the data supporting a particular hypothesis. Alternatively, opposing columns in a table could detail the data that corroborate or contradict a hypothesis. Finally, a table could enumerate open questions or subjects for future research.

It is worth noting, at this juncture, that there is a difference that many authors fail to recognize between violations of copyright protection and plagiarism. One can infringe upon copyright and not be committing plagiarism, and one can commit plagiarism without infringing upon copyright. If one provides an accurate reference to a figure or table that one is acknowledging reproducing but does not obtain permission from the owner of a copyright, then one is infringing upon copyright but not committing plagiarism. If one reproduces a figure or table (or text) from an article without full acknowledgment that does not possess copyright protection then one is committing plagiarism but not infringing upon copyright. Even if the figure or table is modified (by addition or reformatting) its origin must be fully acknowledged, and appropriate permission must be obtained.

If there are data that are critical to the model or whose interpretation is controversial, every effort should be made to display those data in the review article. One must always endeavor to make it possible for readers to reach their own conclusions. If, on the other hand, a table is merely a compilation of articles where various data can be found, it would be preferable if it were relegated to supplementary material.

In the digital age, there can be no real justification for limiting the number of references in a review article. Clearly all the articles and only those articles that provide data or concepts that underlie the argument of the review-article authors need to be cited. Any discussion of a cited article that has been corrected or retracted should note that fact and the

reason for the correction or retraction. Indeed such publications should be included in review articles so that readers can be made aware of problematic aspects of earlier research that may have affected later components of the literature.

4. The abstract

Although having an outline of the review article from the beginning of its composition is very helpful, the abstract should be written when the rest of the text is substantially completed. It should also be original. Far too many abstracts are formulaic using statements such as “in the last X years,” and “here we review.” It is greatly preferable to describe why the review article is necessary and how it is organized. The context of the article in the scientific literature should be provided. The final sentence should not be just a summary of topics covered but rather a statement of the conclusion that the authors wish the reader should reach. A brief description of the proposed model that synthesizes the data in the field might be appropriate here.

5. Avoiding pitfalls

In order to avoid engaging even inadvertently in unacceptable practices one should shun certain procedures.

1. One should never copy and paste from an article even if one is intending to change the text later. Adopting this precaution will prevent the replication of text through honest error that plagiarists often claim is the origin of the textual overlap with previous publications that is discovered in their oeuvre.
2. Basing a review on the regurgitation of article abstracts is not helpful. Publications in which this tactic is deployed are merely glorified bibliographies, not review articles. Such compilations may save lazy readers some time and effort in conducting their own searches, but they are reminiscent of papers created to complete school assignments and are unworthy of mature scientists. A review article should be a critical analysis of research including of the underlying data.
3. It is inappropriate to agree to the task of writing a review article with the intention of assigning the actual writing to others. An author should be an author.
4. It is undesirable to apportion the writing of the article among different individuals for the reasons stated above concerning shared perspective and responsibility. Nevertheless if there is such a division of labor, then the sections written by particular authors should be distinctly indicated.
5. One should not accept requests for and one should not submit for publication multiple review articles that will cover substantially similar topics. If it is impossible to write the review article without considerable repetition of previous material, then it is better not to write the article at all.
6. During the process of preparing the review document one should avoid reading other review articles on the topic. This recommendation might seem to counter the previous advice to employ scientific methods during the assembly of materials. Surely one would want to build on previous work and to ensure that one is not engaged in duplicative endeavors! Nevertheless there is a great temptation to rely on the work of others in identifying the important articles in a field, in structuring the order in which articles are reviewed, and even in utilizing similar or identical language to describe research findings. If one has conducted the survey carefully and provided original analysis of the cited articles, it is highly unlikely that one will have composed a review article that is essentially similar to a previous one. Once one has nearly completed the article, it would be valuable then to read previous reviews to identify whether there are any gaps in the ensemble of articles considered or alternative interpretations of data that one might not have

recognized. It is in particular worth investigating whether elements of the proposed model have been previously described; if so, the earlier publication should therefore be cited.

6. Examples from experience

It may be worthwhile to provide a narrative of concrete examples of the shortcomings of recent review articles, their utilization as a citation source, and the difficulties encountered when attempts are made to ensure the integrity of the literature.

It is disturbingly common to encounter review articles that follow the following formula: “A et al recently found that [an excerpt from the article by A et al]. B et al showed that [an excerpt from the article by B et al]. Etc.” There are variations where review-article authors will change some words or use abbreviations that differ from those in their references. Such articles give the appearance that the authors have not even read the publications that they cite; they have obviously not critically analyzed the data that they contain.

Numerous review articles are structured on the basis of review articles previously published by the authors or by other authors. Evidence for these procedures is that the articles are frequently cited in the exact same or nearly identical order. Text is often copied in addition to the sequence of articles. Some variant on the word “recent,” having appeared in the original text, is often most inappropriately reproduced in the later article, when it describes data published more than a decade previously. The earlier review articles are frequently not cited. These unacceptable practices constitute either duplicative publication or plagiarism; the dependence of the building blocks or architecture of one’s review upon those of previous articles must be acknowledged.

Authors should preferably cite the original research underlying a claim being made in an article rather than a review article. Of course, if a concept or model is proposed or elaborated in a review article for the first time, and the concept or model is relevant to the argument, then the review article should be included in the references. However, review articles are often cited when there is need for support of a broad, vague statement. There is a tendency to include in the references review articles that have already been widely cited.

An example that has lately come to my attention is a citation of two review articles as supporting the statement that there is “growing evidence” for important developments in a particular field [3]. There were three problems with the citation. First, the two articles were published seven years earlier than the citing article. Second, the two articles actually are exemplars of duplicative publication. Third, one would be hard-pressed to find substantiation in either of the articles for the particular assertion made in the citing article.

In the life sciences, review articles are frequently cited more often than research articles. In the endless pursuit of increasing impact factors journal editors frequently resort to multiplying the number of research articles that they are publishing. There is little incentive for ensuring the originality of review articles before or after publication. I will provide two examples of the problems.

There exists a 2017 corrigendum to an *EMBO Molecular Medicine* review article that briefly notes the detection of plagiarism and duplicative publication, which is quite extensive. The article has nevertheless been cited more than 150 times since the erratum was published. Interestingly in 30 articles, it is actually the corrigendum, rather than the article where the content that is relevant is present, which is cited.

Two articles (#1 and #2) with some shared authors in two different journals were found to have two-thirds verbatim textual overlap. There was also extensive overlap between the text of #2, published in *Current Atherosclerosis Reports*, with that of an even earlier paper published by different authors; there was, therefore, very little original material in #2. A determination was made by the editors to retract the article with the later publication date (#2). However, after consultation with the authors, a “Research Integrity Group,” and a legal team, the decision was altered so that there was published a “Correction” stating “A

portion of this article was previously published...,” with no mention of the overlap between #2 with the article published by the other authors. It can be concluded that many journals, authors and citers are evading their responsibilities. Journals should neither hide the extent of the problems with a review article nor be afraid to retract them. Authors should not include articles that violate academic integrity standards among their references unless, of course, the purpose of the citation is to highlight the violations as instructive examples.

7. Examples based upon *Clinical Biochemistry* articles/issues

In order to provide some context specifically for the readers of *Clinical Biochemistry* that would nevertheless have relevance for any reader of this essay I decided to find a review issue that covered a topic that was likely to have been discussed in a comparatively small number of reviews in the past, so there could be a manageable retrospective assessment of review-article publication practices. The January 2018 issue, *Laboratory Diagnosis and Management of Plasma Cell Dyscrasias*, Edited by Ronald A. Booth, Christopher R. McCudden

Volume 51, pp. 1–112, appeared to fit the criteria. I decided to search PubMed with the terms “dyscrasia” and “review.” For the four five-year spans from 2000 to 2019 there were an average of 9.4, 11.6, 10.8, and 19 articles.

I proceeded to pick a year in the past (2007) when there were a higher-than-normal number of target publications, so I could have a sufficient sample of reviews to examine. I then analyzed using the on-line tool iThenticate the publications to which I had free electronic access that were in English for textual overlap with other articles. Unfortunately in the case of all seven of the articles that I first scrutinized [4–10], they each displayed duplicative text with either one or more articles written by a subset of the authors and/or with an article previously written by someone else. Regarding the two articles with the same author [9,10], one is a nearly word-for-word copy of the beginning few paragraphs and conclusion of the other longer article.

In recent issues of *Clinical Biochemistry* there have also been two corrigenda [11,12] issued for one article [13]. Comparison of the review article with those mentioned in the corrigenda [14,15] would indicate that the *Clinical Biochemistry* article displays extensive textual overlap with them. In addition the *Clinical Biochemistry* authors have only slightly modified wording in many passages and cited articles in the same order as the review articles from which they derived their material.

8. Creativity and benefit

The goal of this essay has been to assist review-article authors with guidelines that will promote the writing of an original typescript. The focus has deliberately not been upon the mechanics of text organization. Composing should be a creative endeavor that displays innovative thinking. Benefitting the reader in obtaining a current comprehension of a subject must be the objective achieved. Editors and authors should work together to try to ensure that the review article is a living document that possesses a revision mechanism that includes curated contributions by readers as the field progresses. Clearly the original version of the article should be preserved for the historical record, but its value to the scientific community will be greatly enhanced by keeping it updated. Such a well-written and dynamic review article would be a thing of beauty, “a joy forever. Its loveliness increases; it will never pass into nothingness.”

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Booth, A. (2009), A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, 26: 91-108. doi:10.1111/j.1471-1842.2009.00848.x) and a discussion with Dr. Stephanie Gardner, Purdue University. Recent essays also touch upon the value of review articles in another context (*Times Higher Education*, <https://www.timeshighereducation.com/features/how-can-academics-keep-literature>) or cover other issues discussed in this article (*Times Higher Education*, <https://www.timeshighereducation.com/opinion/we-must-take-academic-plagiarism-seriously>); Stebbing J, Sanders DA. The importance of being earnest in post-publication review: scientific fraud and the scourges of anonymity and excuses. *Oncogene*. 2018;37: 695–696. pmid:29035386. <https://www.nature.com/articles/onc2017390>).

The quotation at the end of the article is from *Endymion* by John Keats.

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