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Review

How to review a scientific paper

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A B S T R A C T

Scientific observations must survive the scrutiny of experts before they are disseminated to the broader community because their publication in a scientific journal provides a stamp of validity. Although critical review of a manuscript by peers prior to publication in a scientific journal is a central element in this process, virtually no formal guidance is provided to reviewers about the nature of the task. In this article, the essence of peer review is described and critical steps in the process are summarized. The role of the peer reviewer as an intermediary and arbiter in the process of scientific communication between the authors and the readers via the vehicle of the particular journal is discussed and the responsibilities of the reviewer to each of the three parties (the author/s, readers, and the Journal editor) are defined. The two formal products of this activity are separate sets of reviewer comments to the editor and the authors and these are described. Ethical aspects of the process are considered and rewards accruing to the reviewer summarized.

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Manuscript peer review for the purpose of evaluating suitability for publication in a scientific journal is the central element in ensuring the integrity of the process of scientific communication and the accountability of the involved parties- the author, the journal editor and publisher, and the reader. It is based on the premise that any piece of scientific information must pass the scrutiny of experts (peers) before it is presented to the larger scientific community. Even though peer review is central to the scientific process, there are no formal instructional programs and little guidance is provided to reviewers. Reviewing a scientific paper is both an art and a science and reviewers become better at the process through experience and "trial and error". In this paper, I offer some guidelines on how to review a scientific manuscript; my perspective is based on my learning of this role through my over 30 years experience as an author, reviewer, and editor. While instructional resources about the review process are sparse, the following articles, including a resource of this Journal (Elsevier, 2014), are useful (Allen, 2013; Benos et al., 2003; Black et al., 1998; Hoppin, 2002; Larson and Chung, 2012; Onitilo et al., 2014; Provenzale and Stanley, 2005; Szekely et al., 2014; Twaij et al., 2014; Vintzileos and Ananth, 2010).

1. Peer review- a brief introduction

The origins of scientific peer review date back to medieval times with the introduction of the *Philosophical Transactions of the Royal Society* in 1665 and the recognition that journal publication grants legitimacy to an author's work. Because of the fear that a questionable publication might tarnish the Royal Society's reputation, a system of review by qualified society members was developed (Kronick, 1990). The process of scientific peer review has evolved over the past 350 years (Burnham, 1990) and while its sophistication and magnitude have changed, its basic elements are

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unchanged. Today, approximately 1.5 million articles are published every year in peer-reviewed scientific journals across the world (Bjork et al., 2009). As peer review continues to be pivotal in the process of scientific publication, its critics have suggested that it should be replaced because it is overly time-consuming, expensive, inconsistent, biased, and outdated (Ioannidis et al., 2010; Jefferson et al., 2007; Kravitz et al., 2010). The increasing frequency of retraction of articles from various scientific journals also suggests that the process may not be working to detect errors and fraud. Despite its many limitations, however, there is currently no alternative to the scientific peer-review process and the endeavor should be to improve its quality. The reviewers are the most important elements in this process.

2. What does peer-review entail

While the reviewer of a scientific article serves one obvious master (the Editor who has requested the review), the reviewer also has an enormous responsibility to both the author/s of the manuscript and to the potential readers of the manuscript (specifically, the readers of the Journal for which the review is being conducted). While the general purpose of the review is to ascertain whether the manuscript is appropriate for publication in the particular Journal (based on relevance, quality of science, clarity of writing, significance, suitability for specific Journal), the reviewer has overlapping but distinct obligations to the Editor, the author/s, and the readers. Each Journal **editor** wants to publish high-quality articles that will have high impact on the field; additionally, they expect the article to be unimpeachable from a scientific and ethical perspective and of interest to the readership of the Journal. The reviewer needs to provide a specific recommendation to the Editor in this regard- this is done via a summary and specific recommendation (accept, minor revision, reconsider after major revisions, reject) in confidential comments to the Editor. The **authors** expect a fair review of their manuscript and clear guidance about how it can be improved to be of greater utility to their real audience- the readers. Here, the reviewer needs to provide a clear and constructive critique of the manuscript (strengths, weaknesses, comments on its different components- title, abstract, materials/methods, results, conclusions, tables and figures, references) and very specific recommendations about how it can/needs to be improved. A good principle is to treat the manuscript exactly the same way that one wants one's own manuscript treated- confidentially, respectfully, and carefully. The **readers** expect an easy-to-read manuscript that conveys important and relevant information. The reviewer should ensure

Table 1
Check-list of peer-review items.

Component	Questions
1. Overall	(a) Importance of the central question (what important gap in the existing literature does the paper seek to fill?) (b) Originality of the work. (c) Quality of the work. (d) Ethical concerns, if any. (e) Writing style and manuscript flow.
2. Title	(a) Is it specific and does it reflect the content of the manuscript?
3. Abstract	(a) Does it meet the word limits of the Journal? (b) Does it appropriately summarize the manuscript? (c) Are there discrepancies between the abstract and the remainder of the manuscript? (d) Can the abstract be understood without reading the remainder of the manuscript? (e) Whether structured or unstructured (should meet Journal guidelines), does it have information about the following 4 elements
4. Introduction	(a) Is it concise? (b) Is the purpose of the study clearly laid out? (c) Is a rationale for the study provided on the basis of a succinct review of the literature ("what gap in the existing literature does this study seeking to address")? (d) Are "unusual" or idiosyncratic terms defined? (e) What is the specific hypothesis being tested?
5. Materials and methods	(a) Is the type of study design specified? (b) Is there a statement of Institutional Review Board review, approval and the informed consent process? (c) Are the methods clearly described in terms of inclusion/exclusion criteria, procedures or tests used, measurements utilized, primary and secondary outcomes or independent and dependent variables, statistical analysis utilized? The methods should be stated in a way that would allow another investigator to precisely reproduce the study. (d) If the authors have stated a hypothesis, are the designed methods appropriate to reasonably test the hypothesis?
6. Results, tables, and figures	(a) Are the results clearly explained? (b) Does the order of presentation of the results parallel the order of presentation of the methods? (c) Are the tables, figures, and graphs appropriate and adequate? (d) Are the tables and figures appropriately labeled or titled and do they meaningfully add to the text?
7. Discussion	(a) Is the discussion concise and clear? (b) Is there a clear statement about the principal study findings? (c) Is it clear what new knowledge the study has provided? (d) Is it clear how the study findings "fit" or "don't fit" with the existing literature? (e) How are discrepant findings explained? (f) Are the strengths and weaknesses of the study noted? (g) Is there a clear and concise conclusion about the implications of the study and next steps, if appropriate? (h) Do the study conclusions clearly flow from the results and are NOT overstated or otherwise inappropriately stated?
8. References	(a) Does the reference list follow the Journal format? (b) Does the reference list contain errors? (c) Are important relevant references all included? Are there major omissions? (d) Are salient points of cited articles accurately quoted? (e) Are there more references than necessary?