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Written dissemination of information is an essential part of science. As biologists, we all are or will be authors. But our commitment to publication does not end there; we also are or will be called on to provide peer review of manuscripts submitted to journals.

Our reviewing efforts are important. We have the opportunity to help authors improve the effectiveness of their messages and to strengthen analysis and interpretation of results. We can improve our own writing by critically scrutinizing that of others. The discipline benefits, because clearly articulated and interpreted results stimulate further productive research. And, finally, society benefits if accurate information is available to guide public policy. Indeed, the credibility of modern science and the value of science-based policy ultimately depend on the quality of peer review. The entire enterprise suffers when a rigorous peer review process is bypassed, as often occurs in the so-called gray literature that is produced by government agencies and consulting firms.

How can we improve the effectiveness of our reviews? Manuscript writing is learned by trial and error (who doesn't wince on re-reading an early publication?). We also imitate other writers and heed the advice of senior colleagues and how-to manuals (e.g., CBE 1983, Day 1983, McMillan 1988). Our training as reviewers relies on a smaller range of experiences. When articles that we reviewed appear in print, we see what our input has achieved. The reviews we receive of our own manuscripts illustrate styles that either encourage and educate or discourage and infuriate. Most writing manuals contain little or nothing about reviewing, and the confidentiality of the process restricts the opportunity to imitate or collaborate with senior colleagues. To help fill this void, this article offers suggestions, distilled from our own experiences and those of colleagues, that should enhance reviewing effectiveness without requiring any compromise of rigor. These suggestions complement those of Rosenzweig et al. (1994) and Gaugler and Freckman (1990), who have addressed parallel issues in discussing the effect of the reviewers on funding of grant proposals.

## A nonconfrontational attitude

The review process all too often is needlessly antagonistic, for a variety of reasons. The explanation may lie with increased numbers of biologists competing for journal space and recognition, or just end-of-millennium testiness. Consider adopting the following nonconfrontational attitudes while reviewing.

**Assume that you and the author share a common enterprise.** The dictionary defines *peer* not only as a person of the same rank, but as a comrade and associate. Assume from the start that the author shares your enthusiasm for your scientific discipline, and allow yourself only reluctantly to be convinced otherwise.

**Write to convince the author.** Why be acidic or engage in personal attack behind a cloak of anonymity? Such tactics have much potential for harm (Packer 1989). At the least, nastiness will alienate the author (and the editor). Perhaps you have identified legitimate problems with the study, but, if your review is poorly received, the author may simply publish elsewhere or shelve a study that has value. To avoid writing such a failed review (the only correct description of one that is ignored), put yourself in the author's shoes and ask whether your review would be considered evenhanded and helpful. You can be direct in your criticisms, but be dispassionate and never engage in *ad hominem* attack.

**Don't assume that your assignment is to sleuth out crimes.** As authors, we three have received reviews of our own manuscripts that apologize for failing to find major flaws. Such apologies hint at a perhaps unconscious assumption that authors must be hiding something and that a reviewer's job is to unearth it. If no glaring flaws are evident, the temptation is to rail against "inadequate sample size," vaguely "inappropriate" analyses, or the like. Some journals explicitly instruct reviewers to identify flaws, an unfortunate emphasis.

**Assume that the author understands the study system.** In your own work, you have spent hours puzzling over a theoretical problem or slaving in the laboratory or field. Assume, at least to begin with, that the author has done the same and thus probably knows his or her system better than you do. Your perception of a problem may be accurate, or it might reflect an incorrect understanding of the study system. Acknowledge this by using conditional, rather than condescending, wording in your review. It is more truthful to write "I am unfamiliar with details of the system, but I do not understand why nocturnal mating was expected" or "Perhaps I missed something, but I did not see the value

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of the yeast system for studying chromosome structure." rather than "It is well known that these animals never mate at night" or "The yeast system has no value for a study of chromosome structure". Keep in mind that your entire review may be discredited in the eyes of author and editor if you take an overly firm position on an issue (for example by using unconditional wording) and your position is a matter of opinion or is shown to be incorrect.

**Don't hold the author to an impossible ideal.**

Perhaps you perceive that the author did not use the best research design or analysis. Point out the alternative methodology, because the author may have missed it and may be able to use your insight in her or his next study. But avoid being too strident; the author may have been constrained by any number of factors unknown to you such as quirks of the study system or severely limited time and resources. Also keep in mind that the ideal design and analysis often are matters of debate. It is appropriate to ask the author to explain why a certain approach was used, but the ultimate issue is whether the approach yielded useful information.

**Pinpoint the good as well as the bad.** It is appropriate that scientists are trained to be critical. Unfortunately, we too often forget to make our criticism constructive. Most studies contain at least nuggets of good information and insight. As you read, point out the nuggets along with perceived weaknesses. Even when you advise rejection, suggest, if you can, how the nuggets might be made accessible in a restructured manuscript or other format.

**Specific tips**

Writing a review requires time, thought, and energy. There are several ways to expend these scarce commodities most efficiently to maximize the chance that your review is effective.

**Focus on the aspects of a manuscript that you are competent to judge.** Editors try to choose reviewers whose expertise complements their own and that of other reviewers. In the process, they may intentionally send you a manuscript that falls outside your specialty. If the manuscript is so foreign that you cannot do it justice, return it promptly. Consider, however, that an outside perspective can be invaluable in identifying strengths and weaknesses that the "experts" miss. If you feel comfortable only with some parts of a manuscript, your review still can be valuable. Clearly state what parts are outside your expertise. You will do much for the field and your own credibility by admitting where you feel knowledgeable and where you do not.

**Discuss your reactions with colleagues.** Your first reactions to a manuscript may be strong and difficult to articulate. Allow them to gestate before writing the review. In the process, you can gain new perspectives (and share your own ideas about reviewing) if you confer with graduate student, postdoctoral, or faculty colleagues. Be aware that manuscripts are privileged communications. Some reviewers maintain author anonymity by

talking to colleagues about issues raised in a manuscript without mentioning specifics or authors' names. Others pass on the manuscript or parts of it to recipients who can be trusted to maintain confidentiality. Any wider distribution and discussion of manuscripts should be done only with extreme care and after consulting the journal editor.

**Read the manuscript both for the forest and the trees.** The single most important service you can provide is to approach a manuscript with a global perspective. Is the conceptual framework clear and appropriate? Does the study actually address the questions it poses? Do the conclusions follow? Keep in mind the journal in question and its audience, because a manuscript inappropriate for one journal may be perfectly appropriate for another. Because authors have a notoriously hard time keeping enough distance from their writing to see it as a nonspecialist would, another valuable service is to read as a naive reader and to pencil editorial suggestions on the manuscript itself. Purge unnecessary jargon and insist on definitions for necessary technical terms. Authors whose native language is not English merit special effort.

**Demand scholarship in citations.** Scientific papers include citations to acknowledge similar ideas and to provide the proper conceptual framework for a study. It is all too easy, however, to bypass the scholarship entailed and to cite narrowly or inappropriately. At the worst, this ploy may make a study seem more novel by minimizing the contributions of others (see also Maddox 1990). In reviewing, insist on solid scholarship just as you insist on appropriate analysis of results. Suggest appropriate citations that have been missed, including historical ones (Jackson 1981 gives a good example of the pitfalls of ignoring older studies). Point out citations that incorrectly portray previous results. Do not hesitate to correct citations to your own work; after all, you know it best. Making such corrections is most efficient if you identify yourself (see below).

**Write to assist the editor.** A journal editor often handles manuscripts outside his or her expertise. Here, especially, the editor relies on the reviewer for more than a list of comments to the author, which may take the form of a cryptic in-group conversation. Be sure to provide separate comments for the editor, in which you explain what contribution the manuscript makes, what audience would read it, and what revision is necessary. Also provide a candid overall recommendation with supporting argument. Conditional wording can help ("If this manuscript can be revised to broaden the message and address the concerns listed in my review, it would make an important contribution; otherwise it may be better for a more specialized journal"). Above all, do not simply state in your review that "This manuscript should be accepted" or "This manuscript must be rejected". Such unsupported positive or negative recommendations are basically useless in a rational decision process.

**Write with economy, clarity, and precision.** A fine journal correctly makes this demand of authors. The reviewing situation is symmetrical: just as you attempt to understand a manuscript, the author and the editor will attempt to understand your review. Revise and proofread it before you send in the final product.

**Be prompt.** Authors hate long turnaround times. Some delay is unavoidable, but you also are an author, so observe the golden rule and make reviewing a high priority. If you are snowed under—a pervasive condition that needs no apology—promptly decline to review and suggest alternate reviewers.

### **Don't be shy!**

Here are some unorthodox, even bone-chilling, ideas to consider as you review. They involve the actual or potential loss of anonymity.

**Contact the author directly.** Suppose that a critical passage in the manuscript you are reviewing strikes you as absolutely cryptic. For your review to be accurate, you must determine whether the passage represents a major flaw in logic or analysis for just a piece of bad writing. You should at least write a conditional review that considers both these possibilities, and you should recommend that the author re-think the logic or clarify the passage as appropriate. A much faster option that works well with some authors is to pose your question directly via telephone or e-mail. Be sure to inform the editor of your contact with the author and of what you learned.

**Sign your review.** Along with the preceding suggestion, this directive may appear foolhardy. But there are major potential benefits. If your identity is known, you are likely to write a more careful and constructive review, and the possibility of direct communication with an author is opened. Indeed, you may wish to foster such communication by inviting the author to contact you, giving your phone number or e-mail address. If you are skeptical of this suggestion, undertake an experiment. Identify yourself in your next few reviews and ask in retrospect whether these reviews were more judicious than others you have written and whether unexpected benefits of communication and collaboration ensued. If not, or if you feel compromised in your ability to be frank, you can always return to anonymity. We especially urge this change in procedure on those biologists whose jobs are secure. Where those with tenure lead, others can follow.

**Resist being threatened by competition.** A manuscript may echo your own unpublished ideas or results. This situation is touchy and tempts you to be especially critical. But, follow the example of Darwin when presented with Wallace's work, and keep in mind that no two studies are identical and that all solid studies make a contribution. Rather than taking any action that might quash a colleague's work, you should welcome confir-

mation of your ideas or findings. It is appropriate for you to inform the author of your work. If your similar efforts are sufficiently well developed, you may wish to ask the author to acknowledge them. For all practical purposes, this approach requires that you reveal your identity. If you try an oblique approach (writing that "similar work exists that should be cited"), the author simply will be mystified.

### **Advice for authors, too**

Reviewers should judge manuscripts with an open, constructive attitude. But a reviewer occasionally may be responding to inadvertent—or deliberate—provocation. If you are an author with no wish to provoke reviewers, contemplate the flip sides of the suggestions in this article. Use the simplest, least contentious wording to convey your ideas; be scholarly in citation, understanding and correctly representing studies you cite, and avoid glossing over limitations in your own study. If your results disagree with those of others, do not imply that yours are correct and others wrong; rather, propose reasons for the different results and suggest further studies that might resolve the issue. Do not set up the conceptual framework for your study in terms of perceived failings of other studies.

### **Action items**

Here is a final plea to the activists among you. If you agree with our suggestions and the philosophy behind them, make your opinion felt beyond the reviews you write. Discuss the review process with colleagues at all levels of their scientific careers. Recommend changes to the editor if you think that a given journal provides incomplete or inappropriate instructions to reviewers. Encourage journals to adopt a policy under which the editor transmits to the author only the substantive points from a confrontational review, or asks the reviewer for a less confrontational revision, and in either case informs the reviewer that elements of the original review were unacceptable. Suggest journal policies that provide reviewers with immediate feedback on their efforts, for example, by sending them copies of other reviews of a manuscript and of correspondence between editor and author. Finally, work to make rigorous peer review an integral part of all scientific endeavors, whether they involve the evaluation of project proposals, communication of the results of pure or applied research, or the development of science-based public policy.

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