

Impact of citation practices: Beyond journal impact factors

Journal impact factors have taken center stage in the world of scientific publishing and have become increasingly important in the academic life of those who read and contribute to our journal. Although a great deal of attention has been devoted to the impact factor and its controversial role as a metric for promotion, compensation, and research funding, the human forces driving the impact factor have received less attention in our literature. Our personal citation practices ultimately drive the impact factors. More important than the indicators used to measure them, these citation practices figure prominently in formalizing the scientific structure of our field. They provide nothing less than the connective tissue of a body of knowledge, and because citation is a human process, it is not immune to contamination by bias, errors of commission and omission, and incentives to persuade¹ and self-promote rather than inform and acknowledge. The effects of citation are a matter of profound importance in academic ophthalmology, particularly given perceptions of eroding citation practices in the face of instant electronic access to abstracts, information overload, and increasing time demands on academic writers.

Even a brief exploration of the literature on this subject leads one to conclude that the effects of citation are manifold and potent. Citation at its most reduced level is a *pointer* to prior work and can be a highly specific reference or, similar to the social phenomenon of name dropping, a vague gesture in the direction of other work simply to establish association. Small² has described citation as a type of shorthand that serves to include larger and more complex data or ideas into an argument. Similar to the evolution of any written language, frequent citations soon become standard symbols that conveniently represent broader concepts and become part of the dialect of the field.

This shorthand language of science is subtle in appearance but very powerful. References are tucked at the end of manuscripts as afterthoughts, and yet their influence, in part because of increasing emphasis on citation-based impact factors, is often far greater than any text in the main body of a manuscript. Citation is intimately linked to the birth of new disciplines. For example, Morris and McCain³ use an analysis of interdisciplinary citation patterns to argue that the new field of medical informatics (1) is developing a core literature of its own and (2) that there are several distinct research fronts within this structure. Both are

signs of an emerging disciplinary focus with its own critical mass. As anterior segment surgeons who have come to enjoy membership in organized societies such as the American Society of Cataract and Refractive Surgery and the European Society of Cataract and Refractive Surgeons and access to a dedicated forum such as the *Journal of Cataract & Refractive Surgery* (JCRS), we too can map our development as a discipline along citation networks that branched from more general ophthalmology journals and ultimately reached a similar critical mass.

Citation therefore serves an important social role in medicine. By attributing an idea or bit of knowledge to a particular reference, we establish a form of academic succession, a lineage of ideas and proofs, into which we place our own work. When these associations are proposed, we are applying for admission to a community of scholars and this is an important mechanism for initiation of young scientists and clinicians into a larger social and professional dialogue (S. Rose, "Citation Rituals in Academic Cultures," presented at the 40th Annual Meeting of the Conference on College Composition and Communication, Seattle, Washington, USA, March 1989. Available at: http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1f/34/19.pdf. Accessed July 14, 2008). Repeated use of certain associations can have the effect of defining a canon of literature within our discipline⁴—lines are drawn, and frequently cited references are included among the sacred scriptures of our tradition. Conversely, omitted work is relegated to the apocryphal literature; literature that may be useful but perceived to be of lesser importance to the field and its mission. Rose extends this analogy by referring to our citation practices as ritual (S. Rose, "Citation Rituals in Academic Cultures," presented at the 40th Annual Meeting of the Conference on College Composition and Communication, Seattle, Washington, USA, March 1989. Available at: http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1f/34/19.pdf. Accessed July 14, 2008). Indeed, citation practices that run counter to the norm are likely to turn heads and offend sensibilities and, in the extreme, can lead to rejection by the community that is tantamount to excommunication.

If we accept the argument that our citation practices affect the knowledge structure, the culture, and the perceived value of contributors in the field, we also accept that we should approach these behaviors with a deep sense of responsibility, not only as writers,

but also as readers and peer reviewers. What are the signs of good citation practice? A definition is elusive, but the values that we strive for in citation should reflect those held in common by the scientific and clinical community at large. Errors in citation are far easier to spot than good citation practices and are perhaps more informative. These errors might be roughly divided into errors of *bias* and errors of *accuracy*.

Bias in citation manifests at least 2 ways. First, we begin with a pool of medical literature that is already biased toward positive results. There is additional evidence that when we cite, we amplify this bias by citing studies with a statistically significant primary outcome measure twice as often as those with a *P* value greater than 0.05.⁵ Self-citation, whether in reference to the author or the journal, is another form of bias that has raised concerns of impact inflation. In the year 2000, one-fifth of all citations in 289 diabetes papers across 170 journals were author self-citations.⁶ Journal self-citation rates in 1998 were similarly high across the 5 or 6 highest impact journals from several clinical specialties, with rates in ophthalmology ranging from 10% to 25%.⁷ Contrary to what we might expect, correcting the impact factor for self-citation across these 36 journals had no impact on rank order.

Misquotation of another's data is an example of an error of *accuracy*. Porrino et al.⁸ reported that 63 of 154 papers referencing a clinical classification system for hand fractures incorrectly reported clinical criteria that directly impact treatment decisions. Other errors include incorrectly interpreting another's study or suggesting that the cited work directly supports the current argument when it does not or does so ambiguously. We make such mistakes out of misunderstanding or cursory reading and can be motivated by a persuasive strategy to strengthen an argument with the implied assent of the cited experts. Finally, omission of key references or attribution of work to a secondary reference rather than a primary source can distort the field by re-mapping key contributions inaccurately. This challenging issue, a recently noted example of which is Alpíns'⁹ under-acknowledged vector approach to analyzing surgically induced astigmatism, can be addressed through errata and correspondences¹⁰; but once in the literature, such errors are prone to propagation. Errors of omission or inaccurate attribution also occur when review articles are used in lieu of primary sources. Surveys and reviews garner some of the highest impact ratings, in part because such articles are written by authorities whose mastery of a subject and the associated literature carries significant value in the economy of knowledge. Such papers can capture the Gestalt of a subspecialty in ways that a focused scientific report cannot and often suggest new pathways to progress. They serve

as a convenient, comprehensive repository of information and a resource for other citations. We cite reviews because they are comprehensive, but many of the ideas are gained by proxy through external references that often go unread.

Given these pitfalls and the resonating effects of citation practices, are there any simple guidelines for better exercising our responsibility to cite accurately and with as little bias as possible?

1. We should not settle for a superficial knowledge of the literature. Most of the errors described above can be addressed by reading every citation we cite at least once, not just the abstracts, and looking carefully at citations in those manuscripts for primary sources. There are many gems under the surface, but some digging is required.
2. Use caution when citing review papers. They are appropriate to cite when novel concepts, data, models, or metaanalyses are presented, but primary sources always take precedence.
3. Do not dismiss papers with negative results out of hand. First, consider whether sample sizes were adequate and methods were sound; if so, such results may be important to address.
4. Use more specific callout text to the literature. Be sure the reader knows why the source is critical to the current argument. If a reference does not have a clear connection to the argument, perhaps it can be omitted.
5. Include the citation immediately after the clause or phrase that calls on it. Clustering references at the end of a sentence with a string of callouts dissociates references from their text.
6. Avoid listing references for the sake of showing the number of manuscripts available on a topic. Such lists are often cited at the end of an introductory statement such as "LASIK is the most commonly performed refractive surgical procedure" to efficiently acknowledge a body of generally related work. A problem with this practice is that it increases the number of citations dramatically, trumps up the impact of each paper in the list, and at the same time dilutes the impact of other cited papers that were chosen on the basis of specific impact. An alternate approach is to indicate that a search was performed, specify the search engine and key word(s) used, and report the number of relevant articles that were identified. In general, though, such statements rarely require references.
7. We should scrutinize any self-citations carefully and subject them to the same criteria we use for other references. Awareness of the many incentives for self-promotion can help keep these forces in check.

We exercise considerable power when we cite others' work. The JCRS is revamping the instructions to authors and will continue to ask reviewers to comment on the appropriateness of the references in articles they review. A renewed focus on good citation practices will help us participate more fully as members of our scholarly community, place our own work in the proper context of this community's evolving story, and help maintain balance as we "shape what is knowledge and belief" in our subspecialty (S. Rose, "Citation Rituals in Academic Cultures," presented at the 40th Annual Meeting of the Conference on College Composition and Communication, Seattle, Washington, USA, March 1989. Available at: http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1f/34/19.pdf. Accessed July 14, 2008).

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REFERENCES

1. Gilbert GN. Referencing as persuasion. *Soc Stud Sci* 1977; 7:113–122
2. Small HG. Cited documents as concept symbols. *Soc Stud Sci* 1978; 8:327–340
3. Morris TA, McCain KW. The structure of medical informatics journal literature. *J Am Med Inform Assoc* 1998; 5:448–466
4. Strassels SA, Carr DB, Meldrum M, Cousins MJ. Toward a canon of the pain and analgesia literature: a citation analysis. *Anesth Analg* 1999; 89:1528–1533. Available at: <http://www.anesthesia-analgesia.org/cgi/reprint/89/6/1528>. Accessed July 14, 2008
5. Nieminen P, Rucker G, Miettunen J, Carpenter J, Schumacher M. Statistically significant papers in psychiatry were cited more often than others. *J Clin Epidemiol* 2007; 60:939–946
6. Gami AS, Montori VM, Wilczynski NL, Haynes RB. Author self-citation in the diabetes literature. *Can Med Assoc J* 2004; 170:1925–1927; commentary by NKovačić, A Mišak, 1929–1930
7. Fassoulaki A, Papilas K, Paraskeva A, Patris K. Impact factor bias and proposed adjustments for its determination. *Acta Anaesthesiol Scand* 2002; 46:902–905
8. Porrino JA Jr, Tan V, Daluiski A. Misquotation of a commonly referenced hand surgery study. *J Hand Surg* 2008; 33:2–7
9. Alpins NA. A new method of analyzing vectors for changes in astigmatism. *J Cataract Refract Surg* 1993; 19:524–533
10. Koch DD. Astigmatism analysis: the spectrum of approaches [editorial]. *J Cataract Refract Surg* 2006; 32:1977–1978