Letter to the Editor

New Insights Into the Relationship Between the *h*-Index and Self-Citations?

Sir,

Within the last decades, the increase in the number of researchers in the scientific community has led to an increase in the number of funding and tenure decisions that have to be made. It is therefore a necessity to find simple yet objective measures to compare the scientific achievement of researchers. Hirsch's *h* (2005) has been claimed to have these attributes because it incorporates both quantity and impact of a researcher's publications. One of the positive attributes of the *h*-index, compared to other citation-based scientometric measures, is that it is quite robust against self-citation behavior (Engqvist & Frommen, 2008; Hirsch, 2005). However, a recent article by Gianoli and Molina-Montenegro (2009) cast the truth of this opinion into doubt.

Gianoli and Molina-Montenegro's critique was twofold: First, they stated that an author's self-citation behavior does have an impact on the *h*-index. Second, this effect seems more pronounced for authors with a low h. The first result of Gianoli and Molina-Montenegro study is very much the same as found in a previous analysis (Engqvist & Frommen, 2008); however, the interpretation differed. Engqvist and Frommen looked at the effect size and showed that even *excessive* self-citation will cause the *h*-indices of two, in other respects, equivalent scientists to differ only slightly, on average merely by one unit. Any citation-based measure will be affected by self-citations, but Engqvist and Frommen's analysis shows that the *h*-index is remarkably robust. Gianoli and Molina-Montenegro in contrast did not quantify the effect self-citations have on an author's *h*-index, but concluded that self-citations do have a great impact on the *h*-index.

The novel part of Gianoli and Molina-Montenegro's contribution is the finding that the *h*-index might be more sensitive to self-citations for authors with a low *h*-index (i.e., authors at an early career stage). However, we identified three major errors in their analysis, which also highlight the pitfalls one might encounter in the analysis of self-citation effects.

First, the authors make use of Web of Science's "view without self-citations" option. Unfortunately, this function does not provide the number of citations without self citations, but rather the number of articles that cites a specific author, excluding articles by the author himself. Thus, an article that cites more than one article of the author still only counts once. Consequently, the measure of Gianoli and Molina-Montenegro largely overestimates the true proportion of self-citations.

Second, the authors analyzed self-citation behavior using the proportion of citations that are self-citations as measure. The major disadvantage of this approach is that it does not depend solely upon the rate of self-citations, but also how frequently an author is cited by others. Having a high proportion of self-citations does not necessarily correspond to a high self-citation rate; it can equally well reflect a low rate of non-self citations. Thus, their analysis is inadequate because they make use of a measure that might only be weakly related to the actual rate of self-citation. Average number of self-citations per published article would be a superior index of self-citation behavior.

Finally, Gianoli and Molina-Montenegro base their most interesting conclusion that self-citations have a higher impact on the *h*-index of young scientists solely on the fact that in the group of scientists with a low *h*-index ($h < 9$) the correlation between number of self-citations and *h*-index is significant whereas for the group of scientists with an $h > 9$ it is not. Unfortunately, finding a significant effect in one sample and failure to find a similar effect in a different sample does not answer the crucial question whether the two samples actually differ. Instead, there is need to test if the effect of self-citations on the increase in h differs between the two groups. This could have been done by testing the self-citation × group interaction on the *h*-index increase. Gianoli and Molina-Montenegro did not do this and we can therefore not decide whether the two groups differ or not. However, based on the effect sizes published in their article (low *h*-index group: 2.89 ± 1.01, high *h*-index group: 2.65 ± 2.21), it is very doubtful that there is a significant difference between the two groups (strangely the effect sizes in the two subgroups are smaller than the effect size of the total sample: 3.01 ± 0.8). Yet, by using the data set of Engqvist and Frommen we can actually test this particular effect. When using the same classification as Gianoli and Molina-Montenegro, we found no difference in the effect of self-citation rate on the *h*-index between scientists with a low ($h < 9$) and high ($h > 9$) *h*-index (generalized linear model: self-citation rate × *h*-group -0.82 ± 0.67, $\chi^2 = 1.49$, $p = 0.22$). Please note that the negative value of the estimate means that the effect was slightly stronger for the high *h*-index group, contrary to Gianoli and Molina-Montenegro's expectations.

Without doubt, self-citations have a moderate but significant effect on the h-index. However, in contrast to Gianoli and Molina-Montenegro's inaccurate analysis, we found no evidence that the effect should be particularly strong for scientists with a low h-index. Of course, there is nothing wrong with the arguments that advocate the use of a sharpened h-index, but the effort made to do this has to be judged in relation to the minor effect self-citations do have on the h. The cost for such elimination might be an index that is less intuitively understandable.

References

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