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How Well Do Bibliometric Indicators Correlate with Scientific Eminence?

A Comment on Simonton (2016).

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Abstract

Citing an earlier study on eminence in psychology, Simonton (2016) argued that associations between measures of scholars' reputation, scientific productivity, and citation counts are only small to moderate [Simonton, D. K. (2016). Giving credit where credit's due: why it's so hard to do in psychological science. *Perspectives on Psychological Science, 11,* 888-892]. However, this reading is based on partial regression coefficients, which underestimate the joint explanatory power of correlated variables. A reanalysis of the original data showed that a composite bibliometric index was substantially associated with reputation (β = .70, 46% explained variance). Very similar results were obtained with a newly calculated *h*-index (β = .67, 42% explained variance). While both Simonton's original analysis and the present reanalysis are inherently limited, the data suggest that the reputation of psychologists tracks their scientific contribution more closely than has been acknowledged in the recent literature.

Keywords: Bibliometrics; eminence; h-index; reputation.

How well does a scholar's reputation track his/her scientific contribution? In a paper published in *Perspectives on Psychological Science*, Simonton (2016) discussed the validity and reliability of indicators such as scientific productivity and citation counts. One of the main pieces of empirical evidence he presented was a detailed study of 69 eminent American psychologists born between 1842 and 1912 (Simonton, 1992). In the study, a summary measure of posthumous reputation was significantly predicted by the authors' (log-transformed) number of works cited and total number of citations, controlling for year of birth (earlier contributors to the field tend to be regarded as more eminent). However, the standardized partial coefficients of the two predictors were only .34 and .32. Citing this finding, Simonton concluded that "associations between various predictor and criterion variables tend to be small to moderate—certainly not large enough to make very fine discriminations among scientists." (Simonton, 2016, p. 889). The claim was reprised and amplified by Vazire (2017), who argued that "we should not attempt to differentiate the 'truly excellent' from other scientists doing sound work. We should admit that we can only reliably distinguish rigorous science from shoddy science; finer-grained distinctions are not often valid (Simonton, 2016)." (Vazire, 2017, p. 6).

The problem with this reading of Simonton's results is that the two bibliometric indicators included in the analysis—number of works cited and total citations—were highly correlated ($r = .80$; $p < .001$). The shared variance among predictors is partialed out in multiple regression; whereas partial coefficients are appropriate to draw inferences about the *unique* contribution of individual variables, they can be expected to severely underestimate the *joint* explanatory power of bibliometric indicators, which is the relevant effect size in this context. To test this possibility, I obtained the raw data of the 1992 study (Dean K. Simonton, personal communication; June 17, 2018) and reanalyzed them with multiple linear regression. Controlling for the effect of birth year, works cited and total citations explained an additional 47% of variance in reputation, corresponding to a semipartial multiple correlation of .69 ($p < .001$). Similarly, replacing the two indicators with a unit-weighted composite of their standardized values (a rough combined index of publication "quality" and "quantity") yielded a standardized partial regression coefficient $\beta = .70$ ($p < .001$; $\Delta R^2 = .46$). In other words, the validity of bibliometric indicators was substantial (despite range restriction; see Simonton, 2016), in stark contrast with the picture painted by partial coefficients.

To explore the robustness of this finding, I used the Google Scholar database to compute an *h*-index (Hirsch, 2005) for each of the 69 psychologists included in the 1992 study (https://scholar.google.com; search performed on June 18-19, 2018). Similar to the bibliometric composite described above, *h* combines information about the quality and quantity of an individual's publications. I restricted the search to the years between each author's first and last cited publication in Simonton's (1992) dataset. I repeated each author search using the first name (e.g., "Gordon Allport"), the first initial (e.g., "G Allport"), and all the initials when applicable (e.g., "GW Allport"). This helped locate publications despite inaccuracies in the older citation records. I excluded duplicate entries but included multiple editions of the same book. The resulting *h* values are available in a data file at https://doi.org/10.6084/m9.figshare.8868533.v1 together with the variables from the original dataset used in the present reanalysis. The correlation between *h* and the bibliometric composite was .83 ($p < .001$); this is interesting considering that the two indices were computed using different procedures, databases, and citation time windows (1981-1985 for the bibliometric composite, up to 2018 for the *h*-index).

The partial regression coefficient of *h* controlling for birth year was $\beta = .67$ ($p < .001$; $\Delta R^2 = .42$), not significantly different from that of the bibliometric composite ($p = .752$).

This new analysis shares the main limitation of the original: in both cases, bibliometric indicators include posthumous citations, and the relations between eminence and citations over time are obviously bidirectional. In the preceding paragraphs, I used the word "predictors" to indicate the role of bibliometric indices in the regression model, not their ability to predict eminence in the future (which is likely lower than suggested by the regression coefficients). That said, there is evidence that early productivity and citations do predict later recognition (e.g., Chan, Mixon, & Torgler, 2018); also, the impact of reputation on later citations appears to be weaker for more highly cited scientists (Pedersen et al., 2014). These findings indicate that eminence is unlikely to be the main driver of citation rates.

Assessing scientific eminence remains a challenging task, which cannot be reduced to simple bibliometric analysis; but the idea that reputation is only weakly correlated to productivity and citations is not supported by Simonton's data. Of course, all the psychologists included in the analysis were born more than a century ago; the results of the study are unquestionably dated, and may or may not apply in today's scientific landscape (and/or in disciplines other than psychology). Nevertheless, Simonton's conclusions have been repeated without these caveats (e.g., Vazire, 2017); if unchallenged, they may contribute to create a distorted consensus on this important issue. The present reanalysis suggests that the reputation of psychologists tracks their scientific contribution more closely than has been acknowledged in the recent literature, and inspires more optimism about our ability to identify and reward exceptional achievement.

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