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Coherent measures of the impact of co-authors in peer review journals and in proceedings publications

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HIGHLIGHTS

- This paper focuses on the coauthor effect in different types of publications.
- Unexpected relationships are found between coauthor and leading investigator.
- An empirical power law is found between the number of joint publications of an author and the rank of a coauthor.
- Interpretation is based on bibliometrics indices.
- The findings suggest an immediate test of coherence of scientific authorship in scientific policy processes.

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ABSTRACT

This paper focuses on the coauthor effect in different types of publications, usually not equally respected in measuring research impact. *A priori* unexpected relationships are found between the total coauthor core value, m_a, of a leading investigator (LI), and the related values for their publications in either peer review journals (j) or in proceedings (p). A surprisingly linear relationship is found: $m_a^{(j)} + 0.4\, m_a^{(p)} = m_a^{(jp)}$. Furthermore, another relationship is found concerning the measure of the total number of citations, A_a, i.e. the surface of the citation size-rank histogram up to m_a. Another linear relationship exists : $A_a^{(j)} + 1.36\, A_a^{(p)} = A_a^{(jp)}$. These empirical findings coefficients (0.4 and 1.36) are supported by considerations based on an empirical power law found between the number of joint publications of an author and the rank of a coauthor. Moreover, a simple power law relationship is found between m_a and the number (r_M) of coauthors of an LI: $m_a \simeq r_M^{\mu}$; the power law exponent μ depends on the type (j or p) of publications. These simple relations, at this time limited to publications in physics, imply that coauthors are a "more positive measure" of a principal investigator role, in both types of scientific outputs, than the Hirsch index could indicate. Therefore, to scorn upon co-authors in publications, in particular in proceedings, is incorrect. On the contrary, the findings suggest an immediate test of coherence of scientific authorship in scientific policy processes.

1. Introduction

In recent years, studies of complex systems have become widespread among the scientific community, specially in the statistical physics one. Many examples, e.g., Refs. [1–3], pertain to social phenomena in general, indicating that physicists

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have gone far from their traditional domain of investigations [4–7]. Moreover, one very modern topics of investigation is the role of measuring (as accurately and objectively as possibly done as in physics) the value of some scientific production [8,9].

In Ref. [10], it was shown that a Zipf-like law

$$J \propto 1/r, \tag{1}$$

exists, between the number (J) of joint publications (NJP) of a scientist, called for short "leading investigator" (LI) with her/his coauthor(s) (CAs); $r = 1, \ldots,$ is an integer allowing some hierarchical ranking of the CAs; $r = 1$ being the most prolific coauthor with the PI. The number of different coauthors (NDCA) is given by the highest possible rank r_M. Several CAs have often the same NJP with the LI.

It was observed that a hyperbolic (scaling) law is more appropriate, i.e.,

$$J = J_0/r^{\alpha}, \tag{2}$$

with $\alpha \neq 1$, usually such that $\alpha \leq 1$, and often decreases with the number of CAs or with the number of joint publications, e.g. when the number of CAs and when J are "not large". J_0 is a fit parameter, i.e. there is no meaning to $r = 0$.

As the h-index [11–13] "defines" the *core of papers of an author* from the relationship between the number of citations n_c and the corresponding rank r of a paper, through a trivial threshold, i.e. if $n_c \geq r_c$, then $r_c \equiv h$, thus one is allowed also to define the *core of coauthors of a scientist* through a threshold [10], called the m_a-index,

$$m_a \equiv r, \quad \text{as long as } r \leq J. \tag{3}$$

This is a specific measure of the core of the most relevant CAs in a research team, centered on the LI. In brief, in the h-index method, one implicitly assumes that the number of "important papers" of an author, those which are the most often quoted, allows to measure the impact of a researcher [14–17]. No need to discuss lengthily the h-index power, variants, or defects. However, such a citation effect is often due to the activity of a research team, centered on the LI [18–21]. In fact, the size and structure of a temporary or long lasting group is surely relevant to the productivity of an author [16]. In contrast, the m_a index as introduced measures the role of coauthors, *rather than citations*, to indicate the most important coworkers of an LI, allowing to measure the LI team core. Technically, one could thus measure the relevant strength of a research group centered on some leader and measure some impact of research collaboration, e.g., on scientific productivity [22]. The invisible college [23,24] of a PI would become visible, easily quantified, whence pointing out to some selection in the community.

Several other measure definitions can be deduced, as in the h-method, i.e. taking into account the whole surface of the histogram, i.e. the cumulated number of joint publications (NJP)

$$\Sigma \equiv \sum_{r=1}^{r_M} J_r, \tag{4}$$

for the CA with rank r has published J_r publications with the LI. An often discussed part of the histogram is that up to the threshold; it corresponds to the cumulated NJP limited to the core, i.e.

$$A_a \equiv \sum_{r=1}^{m_a} J_r. \tag{5}$$

The notation is reminiscent of the A-index [25–27], in the Hirsch scientific output measurement method of an author. Of course, $A_a/\sum$ gives the relative weight of the core CAs in the cumulated NJP.

Moreover, one can define an a_a-index [10] which measures the surface below the empirical data of the number of joint publications *till the CA of rank* m_a, normalized to m_a, i.e.

$$a_a = \frac{1}{m_a} \sum_{r=1}^{m_a} J_r \equiv \frac{A_a}{m_a}, \tag{6}$$

and similarly the index

$$a_M = \frac{1}{m_a} \sum_{r=1}^{r_M} J_r \equiv \frac{\Sigma}{m_a} \tag{7}$$

measured from the *whole* histogram surface. Obviously, $A_a/\sum \equiv a_a/a_M$. The notations are similar to those of the h-index scheme, where they somewhat measure the average number of citations of papers *in the Hirsch core* [13].

Note that the true mean μ of the J *vs*. r distributions, i.e. the average NJP per CA, is obtained from

$$\mu = \frac{\Sigma}{(NDCA)} \equiv \frac{\Sigma}{r_M}. \tag{8}$$