



## Correspondence

## Lognormal distribution of citation counts is the reason for the relation between Impact Factors and Citation Success Index



### 1. Introduction

In a recent paper published in the *Journal of Informetrics*, Milojević, Radicchi, and Bar-Ilan (2017) present a Citation Success Index (CSI) to compare the citation capacity of two journals. CSI between two journals is defined as the probability of a randomly chosen paper from one journal having larger citation count than a randomly chosen paper from the other journal. They found that CSI is a relatively tight function of the ratio of the Impact Factors (IFs) of the compared journals and the probability will be high if the IF ratio exceeds 6 implying the effectiveness of IFs in comparing journals to some extent. Such idea of pair-wise journal comparison metric is also used by Stringer, Sales-Pardo, and Amaral (2008) for ranking journals. Stringer, Sales-Pardo and Amaral find that the citation distribution of papers in a given journal in a specific publication year will converge to a steady distribution after a transient time which can be approximately modeled as log-normal distribution. In this work, we show that such a log-normal form is the cause for the specific relation between the IFs ratio and CSI.

### 2. Citation Success Index

Let  $t$  be a target journal and  $r$  a reference journal and the citations of each paper  $\{c_t^i\}$  and  $\{c_r^i\}$  respectively. The average citation of each journal is  $C_r = \langle c_r^i \rangle$  and  $C_t = \langle c_t^i \rangle$ . The Citation Success Index (CSI, denoted in formula as  $S_{tr}$ ) of the target journal  $t$  compared with the reference journal  $r$  is defined as the probability of the citation count of a randomly selected paper from journal  $t$  being larger than that of a randomly paper from journal  $r$ , i.e.,

$$S_{tr} = \sum_{c=0}^{\infty} [P_t(> c) + 1/2P_t(c)]P_r(c), \quad (1)$$

where  $P_t(>c)$  is the fraction of papers having a number of citations larger than  $c$  in journal  $t$ , and  $P_r(c)$  is the fraction of papers with  $c$  citations in journal  $r$ . The tight function between  $S$  and  $C_t/C_r$  reported by Milojević et al. (2017) is given as

$$S_{tr} = \frac{f_0}{2} + \frac{1-f_0/2}{1+qx^{-k}}, \quad (2)$$

where  $\chi = C_t/C_r$ ,  $q = 1/(1-f_0)$ ,  $k = 1.23$  and  $f_0$  is the fraction of uncited papers in the reference journal  $r$ , and is given as  $f_0 = \frac{1}{(1+qIF^\alpha)^\beta}$ , where  $\alpha = 0.94$ ,  $\beta = 2.37$  and  $q = 0.33$ .

### 3. Data

To test our hypothesis that the log-normal form is the cause of the tight logistic shaped function relation between CSI and IF ratio between any two journals, we extracted papers published in 2012 and 2013 and their corresponding citation counts in 2014 of 53 journals in the field of 'Psychology, Educational' from Web of Science. Only publications of the Web of

**Table 1**

The details of the selected journals. Journal name, number of papers (N), average citation per paper (C) are shown.

Journals	N	C
Journal of Educational Measurement	51	1.29
Journal of Educational Psychology	164	3.95
Child Development	296	3.99
Educational and Psychological Measurement	104	1.23
Scientific Studies of Reading	51	3.22
Journal of Counseling Psychology	120	2.72
Educational Psychologist	36	4.47
Creativity Research Journal	87	1.34
Reading Research Quarterly	43	3.26
School Psychology Review	50	2.42
Learning and Instruction	94	3.71
Journal of the Learning Sciences	32	3.12
British Journal of Educational Psychology	75	2.24
Reading and Writing	161	1.78
Educational Psychology Review	46	3.02
School Psychology International	85	1.60
Cognition and Instruction	30	2.73
Learning and Individual Differences	280	1.80
Journal of Creative Behavior	35	2.14
School Psychology Quarterly	44	2.27
Journal of Literacy Research	32	1.25
Journal of Research In Reading	55	1.20
Journal of School Psychology	84	2.49
Social Psychology of Education	67	1.09
Psychology in the Schools	155	0.94
Psychology of Music	81	1.54
European Journal of Psychology of Education	119	0.83
Measurement and Evaluation in Counseling and Development	39	0.62
Instructional Science	108	1.54
Journal of Emotional and Behavioral Disorders	41	1.54
Dyslexia	30	1.97
Contemporary Educational Psychology	64	1.88
Behavioral Disorders	33	0.97
Early Education and Development	115	0.85
Training and Education in Professional Psychology	60	1.78
Journal of Psychoeducational Assessment	92	1.16
School Mental Health	41	1.22
Gifted Child Quarterly	32	1.28
Metacognition and Learning	24	1.71
Educational Psychology	87	0.87
Journal of Experimental Education	46	1.17
Journal of Diversity in Higher Education	35	0.89
High Ability Studies	15	0.60
Revista de Psicodidactica	18	1.06
Language Assessment Quarterly	40	0.65
Journal of Applied Research in Intellectual Disabilities	102	1.18
Discourse Processes	53	0.83
Studies in Educational Evaluation	29	0.79
Journal of Early Intervention	29	0.83
Applied Measurement in Education	34	0.53
Educational Measurement-Issues and Practice	17	0.82
Journal of Educational and Psychological Consultation	29	0.66
Infancia y Aprendizaje	12	0.33

Science document type “Article” and “Review” were included in the data collection. The details of the selected journals are listed in [Table 1](#).<sup>2</sup>

<sup>1</sup> In original paper ([Milojević et al., 2017](#)), CSI is calculated using citation counts based on a citing window that is the same as the citing window of the IF reported in the Journal Citation Reports (JCR). CSI can also be calculated using other citing windows.

<sup>2</sup> A journal's average number of citations per paper calculated by ourselves is a bit different from the IF of the journal reported in the JCR. We downloaded the citation data of those journals, followed exactly the same procedure and parameters, from Web of Science twice at different time and they are slightly different. Issue of reproducibility of journal IFs in JCR have also been discussed by [Larivière et al. \(2016\)](#).

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