Citation characteristics of non-citable documents and contributions to journal impact factor

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Journal impact factor (JIF) is defined as the number of citations within a given year to items published by a journal in the preceding two years, divided by the number of citable items published by the journal during those two years. However, the 'citable documents' include only articles and reviews, and the 'non-citable documents' (NCDs) actually can be and are often cited, and some may have higher citations. Here we explore the cited characteristics of NCDs and their contributions to JIF. All data were taken from the Web of Science database. The results showed that 315,017 NCDs (including editorials, letters, reprints, news items, corrections, biographical items, and book reviews) could be retrieved from 2012 to 2013. There were 160,580 editorials and 81,652 letters with the respective citations of 98,434 and 40,692 in 2014; the citations per item were 0.613 and 0.498 respectively. The contributions of these two types of NCDs to JIF are obvious. Of the 64 journals with NCDs ≥ 500 or NCDs ≥ 10 while the citations ≥ 20, 19 showed contributions of NCDs to more than 20%. Although some journals publish more NCDs, their contributions to JIF are not obvious; only for a few journals are the NCDs contributions to JIF higher. These are mainly medical journals.

Keywords: Citation characteristics, impact factor, journals, non-citable documents.

THE concept of impact factor (IF) was first introduced by Eugene Garfield (founder of the Institute for Scientific Information, ISI) in 1955 (refs 1, 2), and it was only in the early 1960s that Garfield along with Irving Sher, proposed the journal impact factor (JIF) to help select journals for the *Science Citation Index*[3]. Since 1975, when IF was confirmed by the *Journal Citation Reports* (*JCR*) as a bibliometric evaluation indicator for journals, it has gained increasing attention, leading to both improvement and misuse in scientific publishing[4]. IF has been used as a standard to measure the position and prestige of a journal within the communication system[5]. Though we cannot deny the contribution of IF in the scientific field in comparing journals and authors[6], there exist a series of problems as well[7–10]. IF has many advantages and limitations[11–13]. Hence several researchers attempted to supplement or correct IF using the *h*-index[14] and other indicators to measuring academic performance in a more fair manner[15].

IF is defined as the number of citations within a given year to items published by a journal in the preceding two years, divided by the number of citable items published by the journal during those two years[16–20]. Currently, 'citable documents' include only articles and reviews[21,22]; other types of documents are excluded from IF calculation, and are called 'non-citable documents' (NCDs). However, NCDs are referenced with a frequency relative to that of citable documents; these NCDs actually can be and are often cited. For example, an editorial published in *Hepatology*[23] in 2011 has been cited 1025 times to date, and a letter published in *Nature Methods*[24] in 2011 has been cited 1093 times.

The major types of documents as defined by ISI are articles, letters, notes and reviews. The definition of a note is 'a technical comment shorter than an article and restricted in scope; a brief article designated as such by the journal'. As of 1991, however, note was no longer the designation given to non-review articles in *Angewandte Chemie*, according to *JCR*, which instead used the designation of article[13]. When selecting the 'note' type in the *SCI* database, we found that only 274 notes were published in 1996, compared with 58,356 published in 1995; in 1997, the note type could no longer be found.

Recently, Wu[25] has called for a redefinition of IF, based on the study of Heneberg[26]. According to this proposal, the denominator for IF calculation should be the total count of all documents, not just those designated citable, since NCDs can in fact be cited. Citation of NCDs, which are not added to the denominator, leads to a

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total that seems larger than it really is[18]. Heneberg[26] showed that, in some journals, NCDs have been the means for artificially boosting IF. Our previous studies on *Nature* and composition analysis of IF of 10 international authority journals show obvious differences in the contribution of NCDs published by different journals to IF; these differences vary from 0% to 15% (refs 27, 28).

As early as 1995, Moed and Vanleeuwen[29] suggested that the accuracy of IF calculation should be improved. The authors concluded, based on empirical research of numerous SCI journals, particularly those with higher IF, that IF calculation for most journals recorded in *JCR* was inaccurate. The main cause for this was unreasonable definition of citable documents. They explained the irrationality of IF calculation using *The Lancet* and *Nature* as examples; and showed that IF of the former journal would decrease by 40% if only citable documents were counted, and that of the latter would decrease by 30% if letter document types were included in the denominator.

To further understand the influence of NCDs on JIF, we will discuss the citation characteristics of NCDs and calculate the contributions to IF of various NCDs published by different journals.

Methods

Definition of NCDs

NCDs refer to documents falling outside the ISI definition of citable documents. In early papers[30,31], articles, reviews and notes were regarded as citable documents; notes are no longer considered citable in the recent literature[16,27]. In fact, the note type can no longer be found in the *Web of Science* (*WoS*) as of 1997, and we suppose that it has been incorporated into the review type. In this article, NCDs include editorials, letters, reprints, news items, book reviews, biographical items and corrections, among others.

Access to data

Number of different document types: We accessed the *WoS* database and conducted a search for all documents published between 2012 and 2013. By refining document type, we obtained the total number of reviews, letters, reprints, news items, book reviews, biographical items and corrections. The search date was 6 September 2015.

Number of cited documents and citation of documents: We acquired data on the citation of different types of documents in 2014 and their total citation through the 'Create Citation Report' function in the *WoS* database. We also recorded the highest citation of papers in each document type. Citation per paper is defined as the total citations divided by the number of documents. The citation rate of documents is defined as the number of cited documents divided by the number of documents.

Determination of h-index: Using the 'Create citation report' in the *WoS* database, we obtained the *h*-index of different types of documents in 2014. This was determined by citation in 2014 to documents published between 2012 and 2013.

Contribution of NCDs to JIF: After analysing the editorials and letters published between 2012 and 2013, we determined which journals published 500 or more editorials and letters, or which published at least 10 editorials and letters with citation totals of not less than 20. Finally, we calculated the contribution value and contribution rate of NCDs to IF of various journals. The computational method used is

$$\mathrm{IF}_{\mathrm{NCD2014}} = \frac{C_{\mathrm{NCD2014}}}{N_{2012-2013}}, \tag{1}$$

$$R_{\mathrm{NCD2014}} = \frac{\mathrm{IF}_{\mathrm{NCD2014}}}{\mathrm{IF}_{2014}} \times 100\%. \tag{2}$$

In eq. (1), C_{NCD2014} refers to the number of citations within 2014 to NCDs published by a journal between 2012 and 2013. $N_{2012-2013}$ refers to the number of citable items published by the journal between 2012 and 2013. $\mathrm{IF}_{\mathrm{NCD2014}}$ refers to the contribution value of NCDs to JIF in 2014. In eq. (2), R_{NCD2014} refers to the contribution rate of NCDs to JIF in 2014, and IF_{2014} refers to the JIF in 2014.

Results

Citation characteristics of NCDs

Table 1 shows the citation characteristics of various types of NCDs published from 2012 to 2013. Within this two-year period, 160,580 editorials, 81,652 letters and more than 20,000 news items and corrections were included in the SCI database. Other types of NCDs, such as reprints, biographical items and book reviews, were included less often. According to citing efficiency, citation per paper and cited rate for editorials and letters were also the highest. Citations per paper and cited rate for reprints, news items and corrections were less than those of editorials and letters, and citing efficiency of biographical items and book reviews was rather low. Bibliometric characteristics were relatively consistent in *h*-index, highest citation of papers, citations per paper, and cited rate for different types of documents published within the two-year period.

Table 1. Citation characteristics of each type of NCD published from 2012 to 2013

Document type	Number of documents[a]	Citation[b]	Highest Citation[b]	Citation per paper	*h*-index	Number of cited documents[c]	Rate of cited documents
Editorials	160,580	98,434	767	0.613	84	58,419	0.364
Letters	81,652	40,692	1322	0.498	56	30,589	0.375
Reprints	338	244	45	0.722	11	116	0.343
News items	35,718	6535	430	0.183	34	4688	0.131
Corrections	24,639	2772	108	0.113	20	3378	0.137
Biographical items	6052	195	22	0.032	8	335	0.055
Book reviews	6038	76	7	0.013	4	177	0.029
Total	315,017	148,948	–	0.473	–	97,702	0.310

[a]Number of documents refers to the total amount of the literature published from 2012 to 2013.
[b]Citation and highest citation refer to the total citations of the corresponding document type, as of the date of retrieval.
[c]The number of cited documents refers to the amount of the literature whose citation is at least 1, as of the date of retrieval, within the corresponding document type.

Table 2. Top 10 most highly cited editorials included in the Science Citation Index from 2012 to 2013

First author	Abbreviated title	Source journal	Institution	Country	Publishing year	Citation
H. C. Zhou	Introduction to metal–organic framework	*Chemical Reviews*	Texas A&M university	USA	2012	767
T. Dobzhansky	Nothing in biology makes sense except in the light of evolution	*American Biology Teacher*	Rockefeller university	USA	2013	720
E. Cerami	The cBio cancer genomics portal: an open platform for…	*Cancer Discovery*	Memorial Sloan Kettering Cancer Center	USA	2012	562
J. M. Llovet	EASL–EORTC clinical practice guidelines: management of…	*Journal of Hepatology*	The European Association for the Study of the Liver	Switzerland	2012	548
V. L. Roger	Executive summary: heart disease and stroke statistics – 2012 update…	*Circulation*	Anonymous	Anonymous	2012	441
Y. F. Liu	Preface	*Statistics and its Interface*	Anonymous	Anonymous	2013	375
C. G. Begley	Raise standards for preclinical cancer research	*Nature*	Amgen Inc	USA	2012	342
C. M. Chen	Foreword	*Journal of Electronic Materials*	National Chung Hsing University	Taiwan	2012	338
B. Kalyanaraman	Measuring reactive oxygen and nitrogen species with fluorescent…	*Free Radical Biology and Medicine*	Med Coll Wisconsin	USA	2012	260
K. W. Kim	Dedication	*Environmental Geochemistry and Health*	Gwangju Institute Science and Technology	South Korea	2012	260

Editorials and letters with highest citation

From Table 1, we can see that editorials and letters have the highest citing efficiency among NCDs. However, based on a measurement of citation by paper, we cannot find the specific extent to which documents of these two types are cited. We have thus listed the ten most highly cited editorials and letters in Tables 2 and 3 respectively. The citation column in Tables 2 and 3 indicates the number of citations made in 2014 to items published by a journal between 2012 and 2013. Some editorials and letters published from 2012 to 2013 show very high citation in 2014; therefore, their contributions to JIF cannot be overlooked.

Contribution of editorials and letters to journal impact factor

To precisely understand the contributions of editorials and letters to JIF, we selected for analysis journals that published 500 or more editorials and letters, or at least 10 editorials and letters with citation totals of not less than 20. We conducted detailed statistical analysis of the number of documents and citations of articles, reviews,

Table 3. Top 10 most highly cited letters included in SCI from 2012 to 2013

First author	Abbreviated title	Source journal	Institution	Country	Publishing year	Citation
D. Darriba	jModelTest 2: more models, new heuristics and parallel computing	*Nature Methods*	University Vigo	Spain	2012	1322
Z. F. Udwadia	Totally Drug-Resistant Tuberculosis in India	*Clinical Infectious Diseases*	PD Hinduja Natl Hosp & Med Res Ctr	India	2012	167
T. Li	High-efficiency TALEN-based gene editing produces disease…	*Nature Biotechnology*	Lowa State University	USA	2012	160
A. Ribas	Hepatotoxicity with Combination of Vemurafenib…	*New England Journal of Medicine*	University Calif Los Angeles	USA	2013	156
J. Ernst	ChromHMM: automating chromatin-state…	*Nature Methods*	Univ Calif Los Angeles	USA	2012	152
Q. W. Shan	Targeted genome modification of crop…	*Nature Biotechnology*	Chinese Acad. Sci.	People's Republic of China	2013	149
J. F. Li	Multiplex and homologous recombination…	*Nature Biotechnology*	Massachusetts Gen Hosp	USA	2013	126
C. M. Jones	Pharmaceutical Overdose Deaths, United States, 2010	*Jama-Journal of the American Medical Association*	Ctr Dis Control and Prevent	USA	2013	126
D. L. Li	Heritable gene targeting in the mouse and rat…	*Nature Biotechnology*	East China Normal University	People's Republic of China	2013	123
S. H. W. Scheres	Prevention of overfitting in cryo-EM structure…	*Nature Methods*	Medical Research Council	England	2012	121

editorials, letters and other document types, and calculated the contribution value and contribution rate of the editorials and letters published by each journal to the IF. Table 4 shows the results.

Our analysis included 62 journals comprising 48 medical and some biological publications. Some of the journals selected have high global reputation, such as *Nature*, *Science*, etc.

Our analysis showed that *British Medical Journal* (*BMJ*) published the most editorials and letters within the two-year period, a total number of 2859. Other journals like *International Journal of Cardiology*, *New Scientist*, *The Lancet*, *New England Journal of Medicine*, etc. published over 1000 editorials and letters.

NCDs published by *New Scientist*, including editorials, letters and other types of documents, have made greatest contribution to IF, with a contribution rate of 78.6%. Five journals showed an NCD contribution rate of greater than 30%, including *New Scientist*, *Clinical Nuclear Medicine*, *British Journal of General Practice*, *BMJ* and *Medical Journal of Australia*. Fifteen journals showed an NCD contribution rate between 20% and 30%. *Science* and *Nature* published a relatively larger number of editorials and letters, and their citations were higher as well, but their IF contribution rates were only 4.3% and 7.7% respectively.

Three journals were found to have NCD citation over 4000: *New England Journal of Medicine* (5568), *Science* (5158), and *Nature* (4110). Another three showed NCD citation over 2000: *Journal of the American Medical Association*, *The Lancet*, and *BMJ*. Among the journals listed above, *Nature* and *Science* are comprehensive, while the others are medical periodicals. Although citations to *Nature* and *Science* were over 4000, the contribution rate of their NCDs to their IF did not exceed 10%. Article and review document types made the greatest contributions. The contribution rates of the remaining journals were greater than 10%, with *BMJ* showing a high value of 32.9%.

Conclusion

(1) Editorials, letters and other documents are defined as NCDs by ISI, and thus not accounted for in the denominator when calculating the IF of a journal. However, these documents actually can be cited, and some editorials and letters are cited extensively.

(2) Of all NCDs, editorials and letters make the most significant contribution to citation totals and IF. During the two-year period used in this study for the calculation of IF in 2014, editorials and letters demonstrated good

Table 4. Contribution value and contribution rate of editorials and letters to impact factor (IF) of some journals in 2014

Journal	Number of editorials and letters	Articles and reviews		Editorial, letter and others		IF[b]	Contribution value[c]	Contribution rate[d]
		Number	Citation	Number	Citation			
New Scientist	2635	450	6	3870	22	0.062	0.049	0.786
Clinical Nuclear Medicine	524	245	530	530	379	3.71	1.547	0.417
Medical Journal of Australia	989	305	800	1150	440	4.066	1.443	0.355
British Medical Journal	2859	541	5411	6077	2648	14.896	4.895	0.329
British Journal of General Practice	584	252	218	595	94	1.238	0.373	0.301
Cell Research	195(15)	179	1571	202	600	12.128	3.352	0.276
International Journal of Cardiology	1860	1767	4892	1880	1821	3.799	1.031	0.271
JAMA Internal Medicine	528	164	1519	542	518	12.421	3.159	0.254
Annals of Thoracic Surgery	1002	1048	3371	1217	1116	4.281	1.065	0.249
Chemical Engineering News	575	776	56	4356	18	0.095	0.023	0.243
Scientific American	649	227	99	655	31	0.573	0.137	0.238
Current Science	595	632	414	716	127	0.856	0.201	0.235
JAMA	1555	453	11,573	2568	3524	33.327	7.779	0.233
PLOS Medicine	192(26)	233	2303	192	698	12.88	2.996	0.233
Archives of Internal Medicine	456(16)	138	1776	465	536	16.754	3.884	0.232
Nature Biotechnology	314(37)	185	5889	521	1661	40.811	8.978	0.22
Emerging Infectious Diseases	360(15)	639	3315	365	901	6.598	1.41	0.214
British Journal of Haematology	320(11)	591	2195	913	582	4.699	0.985	0.21
Leukemia	299(15)	462	3766	318	964	10.238	2.087	0.204
Endoscopy	592	297	1141	600	275	4.768	0.926	0.194
Veterinary Record	670	515	558	2106	134	1.344	0.26	0.194
CMAJ	523	211	881	1387	199	5.118	0.943	0.184
Nature Reviews Drug Discovery	214(11)	87	2978	444	619	41.345	7.115	0.172
Journal of Allergy and Clinical Immunology	477(16)	628	5713	2312	1118	10.877	1.78	0.164
Journal of the American Academy of Dermatology	617	532	1745	2376	341	3.921	0.641	0.163
Nature Methods	397(23)	306	8362	415	1474	32.144	4.817	0.15
NEJM	2383	708	33,697	2524	5568	55.459	7.864	0.142
Molecular Psychiatry	92(13)	248	2496	108	340	11.435	1.371	0.12
Plastic and Reconstructive Surgery	895	922	2258	925	304	2.779	0.33	0.119
Current Biology	705	762	6280	752	839	9.343	1.101	0.118
Lancet	2655	589	22,493	3412	2726	42.817	4.628	0.108
Journal of Clinical Oncology	815	1223	16,216	12,463	1936	14.842	1.583	0.107
Journal of the American College of Cardiology	1024	881	12,348	7682	1331	15.527	1.511	0.097
American Journal of Respiratory and Critical Care Medicine	699	539	5995	721	643	12.315	1.193	0.097
Annals of Internal Medicine	800	312	4833	835	510	17.125	1.635	0.095
Neurology	1134	1072	7689	6196	790	7.91	0.737	0.093
Science	1590	1673	50,542	3695	5158	33.293	3.083	0.093
British Dental Journal	539	281	264	609	25	1.028	0.089	0.087
JAVMA Journal of the American Veterinary Medical Association	530	427	614	604	57	1.571	0.133	0.085
Circulation	1077	1060	13,992	1222	1297	14.424	1.224	0.085
European Journal of Cardio Thoracic Surgery	729	779	2179	740	196	3.049	0.252	0.083
Clinical Infectious Diseases	561	955	7675	699	651	8.718	0.682	0.078
Blood	808	2264	20,934	9835	1670	9.984	0.738	0.074
Nature Materials	59(11)	292	9608	309	760	35.507	2.603	0.073
Nature Medicine	299(10)	350	9244	588	723	28.477	2.066	0.073
Philosophical Transactions of the Royal Society of London, Series B	52(12)	596	3664	62	278	6.614	0.466	0.071
European Urology	650	400	4785	658	358	12.858	0.895	0.07
Chest	588	818	4335	611	316	5.686	0.386	0.068
Journal of Pediatrics	500	828	2781	524	197	3.597	0.238	0.066
Gastroenterology	561	514	6747	578	421	13.946	0.819	0.059
Nature	2244	1729	66,884	3527	4110	41.061	2.377	0.058
Neurosurgery	818	800	2223	1039	132	2.944	0.165	0.056
Journal of Urology	2003	1204	4713	6650	275	4.143	0.228	0.055

(*Contd*)

Table 4. (*Contd*)

Journal	Number of editorials and letters	Articles and reviews		Editorial, letter and others		IF[b]	Contribution value[c]	Contribution rate[d]
		Number	Citation	Number	Citation			
Radiology	290(10)	761	4711	328	269	6.544	0.353	0.054
Critical Care Medicine	790	712	4271	3360	238	6.333	0.334	0.053
Lab on a Chip	67(16)	1138	6615	89	354	6.124	0.311	0.051
Urology	834	1083	2012	840	85	1.936	0.078	0.041
European Heart Journal	575	607	7960	606	332	13.661	0.547	0.04
Oil Gas Journal	748	931	25	757	1	0.028	0.001	0.038
ACS Nano	84(23)	2369	29,299	130	600	12.621	0.253	0.02
Proceedings of the National Academy of Sciences of the United States of America	896	7705	72,690	1242	1085	9.575	0.141	0.015
Angewandte Chemie International Edition	131(23)	4564	47,990	235	545	10.634	0.119	0.011

[a]Numerals in parenthesis are editorials and letters with citation totals of not less than 20.
[b]IF calculated by the citation analysis of *WoS* database which has a certain error compared with that in *JCR*.
[c]Contribution value to IF of NCD. [d]Percentage rate to IF of NCD.

performance in measurement of highest citation totals, citations per paper, *h*-index, number of cited documents and cited rate of documents; they are thus important document types JIF that cannot be ignored.

(3) Many journals published a large number of NCDs. *Nature*, for example, published a total of 1729 articles and reviews from 2012 to 2013, and more than 2244 editorials and letters during the same period. *Science* published 1590 editorials and letters during this period, only slightly lower than the number of articles and reviews published. Medical journals, many of which are internationally renowned with higher IF, published larger number of NCDs such as editorials and letters. Therefore, we must consider whether diversification of document types is an indication of maturity of an academic journal or the inevitable choice for promoting its influence in the field.

(4) The contributions of NCDs to JIF were found to be primarily normal, with only a few journals showing higher contribution rates of NCD to IF. We considered journals that published higher number of editorials and letters, and editorials and letters with higher citation totals; the contribution rates of NCDs published by these journals to IF are relatively high. However, some journals that published less NCDs or NCDs with lower citation totals demonstrated higher contribution rates JIF, a result of less citation of the articles and reviews published.

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