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Debates: Impact Factors

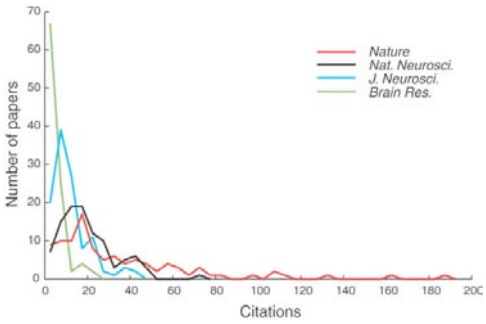
'In Japan, the impact factor is quite important. Your status in the field is dependent on how many reports you have published in high impact factor journals. Moreover, in cases when the journal is not listed on PubMed, the journal is looked down upon.' (Japanese scientist interviewed by Roland, Frass, and Bernhard, 2002)

Introduction: The Institute for Scientific Information (ISI)-administered Impact Factor has become the standard tool of evaluation for scientists around the world seeking to publish their papers, academics themselves being evaluated according to the ISI ranking of the journals in which they have published. Journals which do not appear in the ISI Journal Citation Index (JCR) are considered 'non-prestigious', and this in turn discourages authors from sending good-quality papers to them, further reducing their chances of inclusion in the index.

Evaluating Impact Factors: A recent study tracked the citation rate of 204 papers originally submitted to a conference in 1991 and subsequently published in ISI ranked journals, beginning two years after the conference, and ending three and a half years later. Variables considered to have an influence on the citation of the articles included; impact factor of the journal in which the article was published, outcome of the experiment (positive or negative) and whether the article presented a clear hypothesis, as well as characteristics such as numbers and types of subjects, controls, and blinding. Of these variables, the most clear indicator of the amount of citations a paper is likely to receive was found to be the impact factor of the journal that the paper was published in. Although newsworthiness and clarity of hypotheses also had a significant, though lesser, effect on the frequency of citation of papers, neither these factors, nor the methodology of the articles were found to be correlated with the effect of the prestige of the publishing journal. This seems to suggest, not only that weaker articles published in prestigious journals receive more attention than they are due, but also that good articles published in less well known journals solicit less citations than they deserve. This reflects upon the validity of current citation statistics, as well as raising the question of how journals decide which articles are worthy of publication.

How do impact factors work? A common way to evaluate journals is through impact factors; computer compiled statistics, measuring how often the 'average article' in a journal has been cited in a particular year or period. The annual JCR (Institute for Scientific Information - Journal Citation Report) impact factor is a ratio between citations and recent citable items published (1). Thus, the impact factor of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years (i.e. where (a) represents total cites in 2002, (b) (subset of a) represents the 2002 cites of 2000-2001 articles, and (c) gives the total number of articles publishing in 2000-200, then b/c gives the impact factor). This type of calculation is useful as it equalizes the status attributed to small, seldom issued, or recently founded journals with that of large or frequently issued publications or those with a long publishing history available to cite.

Types of papers: The amount a paper is cited will also depend on the type of paper it is. Reviews tend to receive a higher number of citations than other types of article and method papers generally attract very few. In addition, the subject which the paper focuses on will affect its citation record, as some disciplines produce more papers each year than others. A recent paper in the British Dental Journal pointed out that taken literally, the impact factor implies that oncology is 15 times as important as dentistry. The general journals were also found to have an advantage. An editorial published in Nature Neuroscience examined the distribution of citations to individual papers in Nature Neuroscience, Nature and two larger journals, Brain Research and the journal of Neuroscience. Their graph, reproduced below, shows highly skewed distributions, with lower medias than means, reinforcing the point that as an arithmetic mean, the impact factor has little relevance to the citations of an individual article. The long 'tail' that Nature shows, which is typical of high-impact journals, represents a small number of disproportionately highly cited articles. A letter to Nature on the' tyranny of impact factors' pointed out that the mean number of citations is 114, but 69% of papers have fewer than the mean, and 24% have fewer than 30 citations. One paper has 2,364 citations but 35 have 10 or fewer.



In addition, the time taken to publish varies according to the time required to achieve experimental results. Therefore, a paper in, for example dermatology, will take longer to yield citations than one in developmental biology. This can be taken into account by using 'cumulative' as well as 'current' impact factors.

The English language bias: In addition to the higher ranking received by older and more established publications, and the variation depending the type of paper, impact factors are also skewed towards English language publications. The ISI list includes a minority of non-English language publications, but as with the increasing dominance of English-language publications, these receive fewer citations, a proportion which will continue to decrease as overseas scientists target those journals which receive most citations. Interviews conducted with scientists from France, Israel, and Japan by revealed that most listed the English language as one of their criteria when selecting a journal because of the Impact Factor.

Low impact factors and WIFs (see bel ow) also lead to problems for non-English language publications themselves. Widespread ignorance of non-English-language papers on the Internet a search engines like Google or Pubmed. This has detrimental effects, not only on the availability of research in this field, but also on the journals themselves. As well as the fear of low expo-

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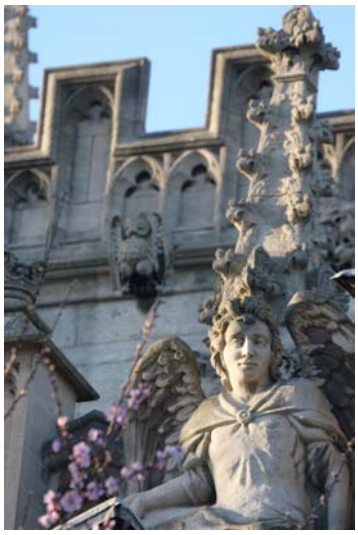
sure of important work turning scientists towards English-language journals, funding for more local journals, which are largely run by scientific societies and were previously partially or entirely funded by government, is diminishing alongside subscription rates with many journals ceasing to publish or publishing only intermittently.

So far, no very viable alternatives to the Impact Factor that compensate for the English language bias have been suggested. ISI is perhaps doing more than its critics to improve access to non-English language publications; its regional sites' offer research from Europe, the Middle East and Africa, Latin America and the Caribbean and the Asia Pacific region in local languages alongside English, and has now launched a translation site with languages including French, Spanish, German, Portuguese, Japanese, Chinese, and Korean. Nevertheless, the inequalities of the Impact Factor system need to be taken into account, and perhaps an alternative system would be a world-wide, rather than US or Euro-centric site, inclusive of all rather than selected journals. Impact factors should perhaps also indicate the identity of the users, in terms of which discipline and country they are from and whether they are based in academic institutions, industry or government, thus giving a more exact representation of the journals' audience and a more useful tool for those wishing to research or publish in them.

Web Impact Factors: Increasing numbers of journals now make articles available on the web, and some journals are solely web based, a phenomenon that traditional impact factors are of course unable to take into account.

When evaluating a journal it is therefore important to examine web citation factors. Their have been various suggestions as to how to measure the impact of electronic publications: one suggestion for calculating electronic journal prestige is that downloads are calculated per paper divided by the number of papers published in an issue, perhaps also taking into account reading of abstracts and 'turnaways', those denied access due to lack of a subscription.

The ISI Web Impact Factor (WIF) represents the number of pages linking to a web space, divided by the number of pages in the web space. Hit rates are also used as a measure of web site success, but can only be measured at the server, and are only an indication that users visited the site, not that they acquired useful information. The WIF differs in respect to time period from the journal impact factor, as while the later measures citations made in journals published during a certain time period, to articles published in another time period, a web citation measurement provides a 'snapshot' from a search engine database of all links to a web space at the time of measurement. The WIF also takes into account links from within a site itself.



Naturally, like the traditional impact factor, the WIF does not guarantee a completely non-biased evaluation of the relative quality of journals, and must therefore be used with caution. Among the drawbacks of the WIF system is the fact that the web is dominated by English-language sites, and therefore high quality journals in other languages may receive less attention. The Internet is also dominated by English-language material, which means that search engines and resources like PubMed are more likely to give search results in English than in other languages. The system of calculating web impact factors (WIF) also includes links from other papers in its calculations, meaning that English-language papers are likely to be more frequently linked to one another than to papers in other languages. As web statistics are set to become increasingly important, it is vital that a standardized system of user statistics is perfected. This has been begun by Counter with the support of several major scientific publishers.

One way in which the WIF could provide a better tool for evaluating research than the traditional Impact Factor is its potential to evaluate a particular paper in isolation. This ties in well with the increasing use of resources such as PubMed, where papers are retrieved by searching on specified terms rather the journal. This has potential to eliminate the problems illustrated above of the disparity between exceptionally highly articles in high prestige journals and the majority of papers.

One of the most controversial uses of journal impact factors is their use in evaluating the status of scientists according to where their work has been published. A new proposed method of ranking individual researchers, intended to be of use in selecting members of prestigious bodies such as the British Royal Society or the American Physical Society, has recently sparked interest among decision makers. The 'h-index', proposed by physicist Jorge Hrisch of the University of California, San Diego awards researchers a score based on both the number of papers they produce an their impact. The score is based on the highest number of papers that a scientist has written that have had at least that number of citations, so that a 'h-index' of 20 would signal publication of twenty papers with at least that number of citations each. Like the ISI impact factor, the scores would differ according to discipline, with top biologists achieving scores of up to three times higher than physicists, for example. The research has also be criticised by some who favour non-quantitative methods of judging scientific performance, such as expert panels, but most have greeted it as a welcome counterbalance to assessments based solely on journal impact factors. Hirsch has placed his work on the preprint server Arvix.

Until technical and political problems of accurate and fair calculations of impact factors are overcome, or an alternative form of user statistics is developed, it is perhaps best to agree with John Maddox, former editor of Nature, who dismisses impact factors as 'slightly spurious'. However, until a suitable alternatives have been developed, their creator Eugene Garfield's assertion that Impact Factors 'won't go away' still stands.