journals by the SCI database. Calculation of the IF for non-English journals in their native countries or regions may be a useful way to complement the data in the SCI database [8,10,11]. At the same time, it must be remembered that at present, English is the *lingua franca* of science, just as German was in the 19th and early 20th centuries, and Latin and Greek before that [11]. Further bias has been created by a tendency towards self-citation among American scientists [12].

Differences across research fields and subject areas

Different citing behavior across subject field imposes a bias on the IF. Articles in rapidly growing areas tend to cite much more recent references than more traditional research fields, in particular theoretical and mathematical areas [13]. This diversity leads to the wide variance of IFs across subject categories. The IF of underrepresented fields is affected negatively [13].

Collecting citations over only two years post publication has an important effect on the IF. Journals in rapidly growing research fields, such as systems biology and bioinformatics, tend to publish papers with a short time interval from submission to acceptance. A large percentage of papers are cited within two years of their publication. This, in result, leads to a high IF. However, there are many journals with longer citation half-lives. Many papers from such journals are still cited frequently much longer than two years after their publication. ISI defines "citation half-life" as the median age of the articles that were cited in the year for which the half-life is reported. Fields with more "durable" literature have a small percentage of short term citations and thus lower journal IF [13]. This field property together with the low number of references per article gives mathematics, for example, a recorded average citation impact that is only a quarter that of biochemistry [14]. Whitehouse [15] has analyzed this for the *British Journal of Radiology* as one example of a journal with long citation half-life. Only 12% of the cites to this journal in 1999 quote the previous two years' publications, but more than 50% of the cites in 1999 to the *BJR* quote papers published in the previous nine years. The scientific impact of the *BJR* is thus underestimated if the calculation is based only on cites to the previous two years' publications. While this affects most journals to some extent, it seems that the highest ranking journals remain quite stable, regardless of the timeframe used for the calculation of the IF [8,16].

A given research field is often also cited by related fields [13]. For example, clinical medicine draws heavily on basic science. As a result, basic research in medicine is cited three to five times more than clinical medicine. The IF is affected accordingly [17,18].

Differences between journals that have nothing to do with journal quality

A distinct weakness of the IF's algorithm lies in the inclusion of articles into the numerator count that are considered as "non-citable" in the denominator count. Citations to "non-citable" items may dramatically increase a journal's IF [19,20]. Journals publishing large proportion of "non-citable items" can thus achieve higher IFs than journals that predominantly publish "citable" items.

Similarly, the ISI algorithm does not take into account a journals' respective composition of research articles, technical notes and reviews [20]. Reviews are more likely to be cited than original research papers [13,21]. Journals publishing a high proportion of review papers consequently attract more citations and thus are likely to achieve a higher IF.

Editorial preference for longer articles seems to increase a journal's IF. Seglen [21] has shown that the citation rate is proportional to the article length, i.e. longer articles are cited more often.

Given the rapid growth of electronic publications, the online availability of articles has recently become an important factor to influence the IF. Murali et al. [22] determined how the IF of medical journals is affected by their online availability. In that study, a document set obtained from MEDLINE was classified into three groups, namely *FUTON* (full text on the Net), abstracts only and *NAA* (no abstract available). Online availability clearly increased the IF. In the FUTON subcategory, there was an IF gradient favoring journals with freely available articles. This is exemplified by the success of several "open access" journals published by BioMed Central (BMC) and the Public Library of Science (PLoS). Open access journals publish full-text online papers free of subscription fees [23]. BioMed Central (BMC) is an "open access" publisher in business since 2000. BMC hosts over 100 biomedical journals ranging from general interest to specialized research. More than twenty journals published by BMC are currently tracked by the ISI and over half of these have IFs available for the recent years. *BMC Bioinformatics* was assigned its first IF for 2004. At 5.4, it places the journal second in the field, only marginally below the traditional competitor *Bioinformatics* (IF = 5.7), which has a 20-years' publishing history and is connected to a major learned society within this field of research (International Society for Computational Biology).

PLoS (Public Library of Science) is another example of a successful "open access" publishing strategy. It started publishing two open access journals in biology and medical research in 2003 and 2004 respectively [24]. PLoS Biology was assigned its first IF of 13.9 for 2004. In the ISI