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Editorial

A closer look at bibliometrics

It being June at the time of this writing, the dreaded 2009 journal impact factors (*IF*) have been released. Accordingly, my perennial frustration about this bibliometric that purportedly measures the "academic worth" of scientific journals, is tweaked once more. Notably, however, concerns about the weaknesses and misuses of *IFs* for evaluating the "impact" of scientific journals (and sometimes those who publish in them) are somewhat mollified by the recent proliferation of other metrics. Aside from my intent to make these known to the wider reading audience of *DNA Repair*, I offer comparisons between multiple bibliometrics now in use, in the hope that such efforts may yield insights about their relative strengths and weaknesses. The timeliness of this editorial is underscored by several recent letters to *Nature* on the use (and misuse) of bibliometrics, presumably also prompted by the time of the year [1–3].

Besides the well worn *Impact Factor (IF)* and *5-Year IF*, the panoply of players in the bibliometrics game now includes the *h Index (hI)*, the *SCImago Journal Rank (SJR)*, the *Eigenfactor (EF)*, the *Article Influence Score (AIS)*, the *Source Normalized Impact per Paper (SNIP)*, the *Immediacy Index (II)* and the *Cited Half-Life (CHL)*. Explanations of the mathematical derivation of these metrics are available in the literature for those brave enough to struggle with them [4]. It suffices to say that *SNIP*, *SJR*, and *AIS* are considered to be conceptually similar to *IF* [4].

I examined the *IF*, *5-Year IF*, *hI*, *EF*, *SJR* and *AIS* for the calendar years 2007, 2008, and where available, 2009. In so doing I generated a series of rankings for *DNA Repair* relative to an arbitrarily selected series of journals to which this periodical may be reasonably compared with respect to content. This is by no means a straightforward endeavor because the content of the journal is a variable mixture of the biochemistry, molecular biology, genetics, cell biology and toxicology associated with the causes of and biological responses to DNA damage. Simply stated, *DNA Repair* is specialized in its focus (as its moniker clearly implies) but diverse in its content. Hence, comparisons with other journals can be complicated, particularly when performed in the context of arbitrarily defined research fields or subfields of the larger discipline of biology. For example, SCOPUS (a search tool developed by Elsevier that provides the raw data from which the metrics of *SJR*, *hI* and *SNIP* are derived) defines the field of *Biochemistry & Molecular Biology* as one that "*covers resources on general biochemistry and molecular biology topics such as carbohydrates, lipids, proteins, nucleic acids, genes, drugs, toxic substances, and other chemical or molecular constituents of cells, microbes, and higher plants and animals, including humans.*" [5]. It defines the field of *Genetics & Heredity* as one that "*includes resources that deal with the structure, functions, and properties of genes, and the characteristics of inheritance. ————— [This] category is distinguishable from Biochemistry & Molecular Biology by its specific emphasis on the gene as a single functional unit, and on the gene's effect on the organism as a whole.*" [5].

SCOPUS allows journal ranking based on a field called *Biochemistry, Genetics and Molecular Biology*, which can also be searched in the more restricted subfields of *Biochemistry, Biophysics, Cancer Research, Cell Biology, Developmental Biology, Genetics, Molecular Biology* and *Molecular Medicine* (among others). In contrast, The ISI Web of Knowledge allows one to search databases under *Biochemistry & Molecular Biology, Genetics & Heredity, Toxicology* or combinations of these fields, but not *Biochemistry* or *Molecular Biology* alone. Hence, though *DNA Repair* is ranked when the fields of *Genetics & Heredity* and *Toxicology* or the combined fields of *Biochemistry & Molecular Biology* and *Genetics & Heredity* are used as search topics, the journal is not listed in rankings for the category of *Biochemistry & Molecular Biology*, presumably because the journal does not "belong" to that field as defined by ISI. Similarly, *Cell* and *Molecular Cell* are not included in journal rankings derived by searching the ISI databases with the subfield of *Genetics & Heredity*.

The *ISI Web of Knowledge* reports *IF*, *5-Year IF*, *Eigenfactor* (*EF*) and *Article Influence Score* (*AIS*). The *SCImago Journal and Country Rank* reports *SJR*, *hI* and *SNIP* values. Rankings were examined for 3 years of data (2007–2009) generated by the *ISI Web of Knowledge* and 2 years of data (2007–2008) generated by *SCImago*. All data presented here are from 2007.

In my own considered view the derivation of a single numerical journal metric (such as *IF*) is of far less value than ranking comparisons between different but thematically related journals. I have thus presented the results of my analysis as rank ordered lists of about a dozen relevant (in my judgment) journals for each of the metrics examined.

Table 1 shows rankings derived from the *ISI Web of Knowledge* when searched for the combined fields of *Biochemistry & Mol Biol.* + *Genetics & Heredity*. Note that in general the *relative* rankings of the 12 journals listed do not differ greatly as a function of the metric used. [They also do not differ dramatically from year to year (data not shown)]. *Cell*, *Nature Genetics*, *Genes & Development* and *Molecular Cell* top the lists for all the metrics examined, while *Mutation Research-Fundamental and Mechanisms of Mutagenesis*, *Genetics*, and *DNA Repair* are consistently near the bottom of these particular lists *The Journal of Biological Chemistry* (*JBC*) and *Molecular and Cellular Biology* (*MCB*) are notable exceptions, however. The relative ranking of the *JBC* is close to that of *DNA Repair*, *Mutation Research* and *Genetics* with respect to *IF*, *5-YIF*, *AIS* and *SJR*, confirming the alleged conceptual relationships between these metrics. But both journals rank much closer to *Cell*, *Nature*

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Table 1
Comparisons between various bibliometrics.

ISI-BIOCHEM&MOLBIO + GEN&HER (out of 374)				SCImagoSJR-BIOCHEM&GEN&MOLBIO (out of 1365)	
IF	5-YIF	EF	AIS	SJR	Hi
CELL(2)	CELL(3)	JBC(1)	CELL(2)	CELl(1)	CELL(1)
NAG (4)	NAG(5)	CELL(2)	NAG(3)	NAG(5)	JBC(3)
G&D(10)	G&D(9)	MCB(3)	G&D(7)	G&D(7)	NAG(4)
MC(13)	MC(11)	NAR(4)	MC(10)	MC(9)	G&D(6)
JHG(17)	JHG(16)	EJ(5)	EJ(19)	EJ(27)	EJ(8)
EJ (29)	EJ(30)	NAG(6)	JHG(20)	JHG(37)	MCB(11)
NAR(39)	NAR(39)	G&D(7)	MCB(32)	MCB(40)	NAR(12)
MCB(45)	MCB(42)	MC(8)	NAR(42)	NAR(66)	MC(13)
JBC(54)	JBC(53)	JHG(16)	DNR(53)	DNR(71)	JHG(23)
MUR(93)	DNR(72)	GEN(22)	JBC(56)	JBC(73)	GEN(49)
DNR(99)	GEN(75)	DNR(70)	GEN(59)	GEN(90)	MUR(130)
GEN(103)	MUR(101)	MUR(83)	MUR(119)	MUR(234)	DNR(189)

Abbreviations: NAG, Nature Genetics; G&D, Genes and Development; MC, Molecular Cell; JHG, Journal of Human Genetics; EJ, EMBO J; NAR, Nucleic Acids Research; JBC, Journal of Biological Chemistry; MUR, Mutation Research/Fundamental and Mechanisms of Mutagenesis; DNR, DNA Repair; GEN, Genetics. Journal rankings are indicated numerically.

Genetics and *Genes & Development* with respect to *EF* and *hI*. This discrepancy presumably results from pooling the *Biochemistry & Molecular Biology* + the *Genetics and Heredity* datasets from the *ISI Web of Knowledge* in order to rank *DNA Repair*. Indeed, as seen in Table 2, when comparing rankings for the more restricted field of *Genetics & Heredity* (from the *ISI Web of Knowledge*) and independently, the *Genetics* subsection of the field of *Biochemistry & Genetics & Mol. Biol.* (from *SCImago*), these discrepancies disappear. Hence, the relative rankings of journals in the same general field can vary considerably, depending on the selection of journals and the precise definition of research fields and subfields used to search databases.

Another important variable concerns the use of any single bibliometric. Consider the spread of rankings for different metrics from the datasets shown in Table 1. In 2007 *DNA Repair* ranked 99, 72, 70 and 53 out of 374 journals examined for *IF*, *5-YIF*, *EF* and *AIS* respectively. The difference between a ranking of 53/374 (*AIS*) and 99/374 (*IF*) is considerable. Certainly if one wanted to publically extol the virtues of *DNA Repair* in 2007 one would tout the *AIS* metric, not the *IF*.

A comparison of the rankings for *DNA Repair* of 71/1365 and 189/1365 based on *SJR* and *hI* respectively (Table 1) is also revealing. These differences are magnified when one compares datasets confined to the field of *Genetics & Heredity* (*ISI Web of Knowledge*) and the *Genetics* subsection of the field of *Biochemistry & Genetics & Mol. Biol.* (*SCImago*) (Table 2). Note that *DNA Repair* ranks 16/132 based on the *AIS* metric but 39/132 based on *IF*.

Another disturbing conclusion derives from a closer examination of journals near the top of the rankings lists shown. Tables 1 and 2 indicate that *Cell*, *Nature Genetics* and *Genes & Development* enjoy high rankings with very little spread between individual bibliometrics, regardless of the datasets from which these were derived. The same holds true for *DNA Repair* in the category of *Toxicology* (*ISI Web of Knowledge*) and *Pharmacology & Toxicology* and *Pharmaceutics* (*SCImago*) (Table 3). Specifically, the journal ranks between positions 1–5/73 and 1–6/74 for the *Toxicology* subset (Tox only) of the field of *Pharmacology & Toxicology* and *Pharmaceutics* (Table 3). In contrast, if one pools the fields of *Genetics & Heredity* and *Toxicology* to generate a single data set, *DNA Repair* ranks 17/198 for *AIS*, but 41/198 for *IF* (data not shown).

In conclusion one is led to the realization that aside from the weaknesses intrinsic to the currently most widely used bibliometric, the *IF*, journal rankings can and do vary as a function of other metrics, as a function of the investigative fields used for evaluation, and how these fields (and subfields derived from them) are defined for analytical purposes. If we are to continue to endure the application of bibliometrics to the evaluation of individual scientists and scientific institutions, let alone journals, these (and possibly other) variables must be taken into account, and at the very least multiple metrics rather than any single one should be announced.

One hopes that contributors to (and readers of) *DNA Repair* are convinced that in the grand scheme of things the journal is a highly regarded specialty periodical. A top ranking in the field of toxicology based on the metric of article influence (*AIS*) is not to be sneezed at (Table 3). An *SJR* ranking of 71 out of 1365 journals (many of which are not highly specialized) evaluated in the general field of *Biochemistry, Molecular Biology and Genetics* (Table 1), is also gratifying. Finally, while I elected not to explore the criterion of *Source Normalized Impact Factor per Paper* (*SNIP*), in 2007 and 2008 this

Table 2
Comparisons between various bibliometrics.

ISI-GEN,HERED (out of 132)				SCImagoSJR-BIO&GEN&MB(GEN subcat.) (out of 208)	
IF	5-YIF	EF	AIS	SJR	Hi
NAG(1)	NAG(1)	NAG(1)	NAG(1)	NAG(1)	NAG(1)
G&D(5)	G&D(5)	G&D(2)	G&D(4)	G&D(3)	G&D(2)
GR(6)	JHG(6)	JHG(4)	JHG(9)	EJ(7)	EJ(3)
JHG(7)	GR(7)	HMG(5)	GR(10)	JHG(12)	MCB(4)
HMG(12)	HMG(12)	GR(6)	HMG(12)	MCB(13)	NAR(5)
JMG(19)	JMG(20)	GEN(7)	DNR(16)	NAR(21)	JGH(7)
JMM(21)	JMM(21)	JMG(16)	GEN(18)	DNR(24)	GEN(12)
MUR(35)	DNR(22)	DNR(22)	JMG(20)	GEN(28)	DNR(39)
DNR(39)	GEN(24)	MUR(28)	JMM(24)	EMM(111)	EMM(70)
GEN(41)	MUR(36)	HG(29)	HG(33)	MUT(112)	MUT(83)
HG(43)	HG(38)	JMM(38)	MUR(45)		

Abbreviations: see Table 1.

Table 3
Comparisons between various bibliometrics.

ISI-TOXICOLOGY (OUT OF 73)				SCImagoSJR-PHARM,TOX,PHARMACEUT.			
IF	5-YIF	EF	AIS	(All categ.) (out of 423)		(Tox only) (out of 74)	
				SJR	hI	SJR	hI
ARP(1)	ARP(1)	DNR(1)	ARP(1)	ARP(1)	ARP(4)	DNR(1)	DNR(6)
MUR(4)	DNR(4)	MUR(4)	DNR(2)	DNR(4)	DNR(33)		
DNR(5)	MUR(5)	ARP(10)	MUR(5)				
MUT(21)	EMM(24)	EMM(30)	MUT(22)				
EMM(22)	MUT(27)	MUT(35)	EMM(23)				

Abbreviations: see Table 1. ARP, Annual Reviews in Pharmacology; EMM, Environmental and Molecular Mutagenesis; MUT, Mutagenesis.

metric was used to rank order over 17,000 journals worldwide in the field of *Biochemistry, Molecular Biology and Genetics*. *DNA Repair* ranks in position 284, i.e., in the top 1.6%. (data not shown)

Parenthetically, the *IF* score for *DNA Repair* for 2009 is 4.199 (don't you love the use of three decimal points?), down from the 2008 score of 5.095. (Oh dear! What did we do wrong?) But if it makes you feel better, the 5-year *IFs* for 2009 and 2008 are much closer (4.611 and 5.007 respectively). Additionally, total citations for 2009 (4298) are up from 2008 (3979) and annualizing 5 months of data for 2010 suggests that the increase in citations continues. My personal evaluation of the journal (and the driving force that motivates me to continue to serve as Editor-in-Chief) is largely based on who is publishing what in *DNA Repair* and the composition of the Associate Editor group and the Editorial Board; obviously subjective, but reassuring (to me) parameters.

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