ARTICLE

ASSESSING PUBLICATION IMPACT THROUGH CITATION DATA

Lisa Nagaoka

Lisa Nagaoka is an Assistant Professor at the University of North Texas.

Within academia, there is a growing movement to document journal quality as a means of evaluating research impact, particularly for the purpose of tenure and promotion evaluations. Indeed, this paper originates out of research I conducted for my tenure dossier for which I was required to demonstrate that I had published in high-quality journals. In my tenure case, citation data were used to supplement external reviewers' evaluations of my research productivity and potential. An alternative approach taken by some departments within my university is to divide journals into tiers based on a ranking system. The department can then explicitly lay out publication expectations for tenure-track faculty. For example, junior faculty may be expected to publish at least one article in a top-tier journal, three in a middle-tier, and one in a lower-tier journal. If candidates meet this hypothetical standard, then the department considers them to have met tenure expectations of research productivity and quality.

A variety of measures can be used to assess journal quality, including citation rates, subscription rates, and manuscript acceptance rates. For example, each year the American Psychological Association publishes the subscription and acceptance rates of the discipline's major journals as a measure of journal quality. In this article, I focus on journal citation rates as a measure of journal quality since these are the data to which I had access.

Citation Data from the Journal Citation Records

Journal citation information can be found in an electronic database, the ISI Web of Knowledge, which is maintained by Thomson Scientific and now incorporates Current Contents and the Social Science Citation Index. The Journal Citation Records (JCR) is an analytical tool within the Web of Knowledge that is designed to measure journal performance. The JCR database is selective. Journal selection is based on criteria such as broad international coverage, high citation rates, and timeliness of publication. Given these criteria, citation information can be found on 54 anthropological journals in the JCR. Of those, I selected 14 of the more well-known journals that regularly publish archaeological research (Table 1). Two broader scientific journals, *Nature* and *Science*, are also listed to illustrate the magnitude of difference in the audience size and impact of archaeological and anthropological journals.

Table 1 provides three different measures of journal quality generated by the JCR: impact factor, immediacy index, and cited half-life for a particular year. *Impact factor* is the citation measure most commonly used to evaluate journals. It calculates the citations per article in a journal over a recent two-year period. The data for 2004 in Table 1 are determined by summing the number of citations for all articles published in 2002 and 2003, and then dividing that by the number of articles published in 2002 and 2003. For *American Antiquity*, the average citation rate of articles published in 2002 and 2003 is 1.254 citations. It is ranked fifth in terms of citations after *Journal of Human Evolution*, *Annual Review of Anthropology*, *Current Anthropology*, and *Evolutionary Anthropology*. These four journals are broad anthropological journals, so *American Antiquity* has the highest impact factor in the JCR for journals publishing only archaeological research.

Two other measures generated by the JCR are used less often in journal evaluation. The *immediacy index* measures how quickly articles are cited and is the number of citations for the current year divided

by the number of articles published that year. For *American Antiquity,* the immediacy index indicates that for articles published in 2004, the average citation frequency by other articles published in 2004 was 0.184. In other words, about 1/5 of the articles were cited once in 2004. Compare the immediacy index numbers of archaeological publications to *Nature* or *Science,* where articles were cited an average of six or seven times within a year of publication. The *cited half-life* is a measure of the number of years in which 50 percent of the citations are published, or how long articles from the journal continue to be cited. Thus, for all the articles published in 2004 that cite *American Antiquity,* 50 percent or more of the articles cited were published in the journal over 10 years ago. Thus, it could be argued that the journals with longer half-lives are more likely to publish the "classics" that are cited continuously, while shorter half-lives indicate journals that publish current data.

Table 1: 2004 Citation Data from the Journal Citations Record for Journals Publishing Archaeological Research.

Journal Title	Total Citations	2004 Articles	Impact Factor	Immediacy Index	Cited Half-Life
American Anthropologist	1,629	56	0.952	0.161	>10.0
American Antiquity	1,436	38	1.254	0.184	>10.0
Annual Review of Anthropology	929	25	1.833	0.160	9.6
Archaeometry	708	42	0.842	0.190	>10.0
Arctic Anthropology	117	6	0.094	0.167	>10.0
Current Anthropology	1,643	43	1.800	0.279	9.5
Evolutionary Anthropology	631	18	1.360	0.333	5.6
International J of Osteoarchaeology	280	37	0.625	0.000	6.2
J of Anthropological Archaeology	372	19	1.103	0.263	>10.0
J of Anthropological Research	277	15	0.643	0.267	>10.0
J of Archaeological Science	1,918	137	1.186	0.234	6.9
J of Human Evolution	2,563	50	2.767	0.680	8.2
J of the Polynesian Society	126	10	0.107	0.000	>10.0
Plains Anthropologist	195	11	0.347	0.273	>10.0
Nature	36,3374	878	32.182	6.089	7.2
Science	33,2803	845	31.853	7.379	7.0

Citation Data from the Web of Science

Unfortunately, given the selective nature of the JCR database, the citation measures described above are not available for many archaeological journals. These include journals that are broad in scope, such as *Antiquity, World Archaeology*, and *Journal of Archaeological Method and Theory,* as well as regional or specialized journals such as *North American Archaeologist* or *Historical Archaeology.* Citation data can be generated for journals not in the JCR by mining data from the Web of Science database within the Web of Knowledge. The JCR measures are difficult to duplicate using the Web of Science data because JCR looks at the citation rate or impact of a journal at a particular point in time. In the case of Table 1, the year is 2004. The data available from the Web of Science are cumulative up until the present, which was July 2005 when the data were downloaded for this analysis. Thus, I was unable to extract data comparable to the 2004 data in the JCR analysis. Instead, I developed two measures, *citations per article* and *percentage of articles cited in a volume*, to measure journal quality using the Web of Science data. Data were collected on 23 journals in which archaeologists publish—an additional nine journals not covered in JCR. Even so, there are still a number of prominent regional and technical journals, such as *The Kiva* or *Lithic Technology*, for which data are not available.

The measure of *citations per article* is similar to the impact factor measure in JCR. Both measures capture the general impact of articles in a journal by dividing the overall number of citations by the number of articles published in a year. The JCR impact factor measured the 2004 impact factor by calculating this number for the articles published in 2002–2003. The data I generated were the citations per article for articles published within each calendar year. Data were collected for articles published in a 10-year period from 1995–2004 (Table 2). Data are missing for some years because the journal was not included in the database in those years or had a lapse in publication; thus, no articles were published in such years. As a result, the number of years represented for each journal varies.

As would be expected, citation frequency tends to increase over time. However, yearly citation rates for each journal also depend on the articles published. For example, *Evolutionary Anthropology* in 2000 and the 1997 volume of *Journal of Human Evolution* have higher citation rates than expected given the temporal trend. In both cases, one article was cited more than 100 times, which dramatically increased the citation rate for those volumes.

Table 2: Average Citations per Article Generated from Data in the Web of Science.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	AVG
American Anthropologist	9.43	7.95	5.39	5.98	3.56	2.65	2.55	2.29	0.98	0.39	4.12
American Antiquity	10.55	7.82	6.8	6.05	7.12	6.23	4.49	3.05	1.05	1.75	5.28
Annual Review of Anthropology			12	12	9.87	7.56	6.21	5.57	3.4	0.53	7.14
Antiquity	4.33	4.86	4.15	2.82	3.29	1.45	0.96	0.75	0.87	1.73	2.24
Archaeometry			6	4.71	5.26	2.75	2.55	2.52	0.96	1.91	2.82
Arctic Anthropology	4	2.43	1.15	1.93	3.1	0.93	0.53	0.5	0.07	1	1.38
Current Anthropology	11.87	5.76	7.47	7.55	6.39	4.77	3.93	2.37	1.08	1.57	5.38
Evolutionary Anthropology				13.91	7.18	16.37	6.63	1.53	3.45	1.5	5.72
Historical Archaeology	1.69	2.95	2.72	1.13	1.89	0.93	0.29	0.1	0.21	0	0.97
International J of Osteoarchaeology	3.47	2.94	2.2	2.18	1.51	2.26	2	0.98	1.3	0.08	1.95
J of Anthropological Archaeology	6.58	5.47	8.36	5.36	2.72	5.19	3.17	2.53	1.39	1.43	3.79
J of Anthropological Research	6	5.17	4.94	2.61	4.13	3.07	1.28	0.23	0.73	0.53	2.87
J of Archaeological Method Theory			6.79	8	6.25	5.38	2.55	2.8	0.44	1.33	3.99
J of Archaeological Science	9.38	6.88	5.48	5.94	6.6	4.86	2.79	2.48	1.68	1.55	4.43
J or Archaeological Research			9.38	5.44	7.5	7.14	5.14	2.75	0.83	1.67	5.03
J or Field Archaeology	3.5	5.38	3.46	2.21	2.04	1.38	0.35	0.04			2.39
J or Human Evolution	12.4	12.23	18.18	12.73	13.18	10.13	6.65	3.78	3.2	1.84	9.31
J of the Polynesian Society	3.28	1.71	1.79	1.5	1.58	2	0.77	0.57	0.15	0.2	1.35
J of World Prehistory	16.1	6.22	8.25	8.63	9.88	4.86	7	4.88	1.57		7.42
Lat in American Antiquity			4.17	3.94	3.91	5.32	3.19	1.45	0.71	1	2.88
North American Archaeologist			0.87	0.84	0.62	0.53	0.15	0.14	0.17		0.46
Plains Anthropology	2.35	2.13	1.35	1.88	1.1	0.82	1.1	0.79	0.31	1	1.22
World Archaeology	3.96	4.22	3.93	3.79	2.28	1.41	0.97	2.37	0.58	1	2.15

To examine how journals compare to one another, the citations per article index for each year was averaged across two time periods: 1995–2004 and 1995–2000 (Table 3). These two time spans were chosen to examine how time affects citations for each journal. The articles in some journals may have a short half-life with an initial high citation frequency that diminishes significantly over time. Other journals may have articles that are cited at a consistent rate across time. In the JCR analysis, this difference in citation rates across time is measured by the cited half-life. As Table 3 illustrates, the overall ranking of journals does not appear to be significantly affected by time lags in citation rates, suggesting that time since publication does not affect relative citation frequencies among journals.

The second measure I calculated was the *percentage of articles* within a volume that have been cited (Table 4). A high percentage of articles cited suggests high impact of the journal. As with the citations per article, the percentage of articles cited tends to increase over time. Some journals, such as the *Annual Review of Anthropology*, *Journal of Archaeological Method and Theory*, and *Journal of World Prehistory,* have nearly all of their articles cited within a few years. These journals tend to publish review articles. This trend can also be seen when data are averaged across two time spans (Table 5). While the rank for most journals does not significantly differ between the datasets, there are a couple of exceptions. One is the *Journal of Archaeological Method and Theory*, for which all articles are eventually cited after five years. The other exception is the *Journal of Human Evolution*, for which a larger proportion of recent articles are cited, indicating that the articles in this journal are of more immediate relevance. Given the volatile nature of hominid studies, where new data can have a significant impact, this pattern is not unexpected.

When data for the two measures are compared, some interesting patterns emerge. Some journals such as *Journal of Human Evolution* and *Journal of World Prehistory* have a high percentage of articles cited and those articles are also cited heavily. Journals such as *Evolutionary Anthropology* and *Current Anthropology* have fewer articles per volume cited, but those that are cited are cited heavily. The opposite trend is seen for the *Journal of Archaeological Method and Theory*, which has a lower citation rate per article than other journals but a vast majority of the articles are cited.

Table 3: Average Citations per Article for the Years 1995–2004 and 1995–2000.

	1995–2004		1995–2000
J of Human Evolution	9.3	*J of Human Evolution*	13.1
J of World Prehistory	7.4	*Evolutionary Anthropology*	12.5
Annual Review of Anthropology	7.1	*Annual Review of Anthropology*	10.4
Evolutionary Anthropology	5.7	*J of World Prehistory*	9.0
Current Anthropology	5.4	*American Antiquity*	7.4
American Antiquity	5.3	*J of Archaeological Research*	7.4
J of Archaeological Research	5.0	*Current Anthropology*	7.3
J of Archaeological Science	4.4	*J of Archaeological Method and Theory*	6.6
American Anthropologist	4.1	*J of Archaeological Science*	6.5
J of Archaeological Method and Theory	4.0	*American Anthropologist*	5.8
J of Anthropological Archaeology	3.8	*J of Anthropological Archaeology*	5.6
Latin American Antiquity	2.9	*Archaeometry*	4.7
J of Anthropological Research	2.9	*J of Anthropological Research*	4.3
Archaeometry	2.8	*Latin American Antiquity*	4.3
J of Field Archaeology	2.4	*Antiquity*	3.5
Antiquity	2.2	*World Archaeology*	3.3
World Archaeology	2.1	*J of Field Archaeology*	3.0
International J of Osteoarchaeology	2.0	*International J of Osteoarchaeology*	2.4
Arctic Anthropology	1.4	*Arctic Anthropology*	2.3
J of the Polynesian Society	1.4	*J of the Polynesian Society*	2.0
Plains Anthropologist	1.2	*Historical Archaeology*	1.9
Historical Archaeology	1.0	*Plains Anthropologist*	1.6
North American Archaeologist	0.5	*North American Archaeologist*	0.7

Table 4: Percentage of Articles Cited per Volume Generated from Data in the Web of Science.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	AVG
American Anthropologist	100	95	89.5	88.2	58.5	57.7	57.7	60.7	53.6	30.4	69.1
American Antiquity	96.8	95.5	94.4	94.6	92.7	88.4	90.2	83.3	61	29.3	82.8
Annual Review of Anthropology			100	90.9	91.3	100	91.7	90.5	80	31.6	84.5
Antiquity	68.5	73.5	72.8	64.5	69	51.2	39	31.6	43.3	17.7	52
Archaeometry			93.9	96.4	74.1	71.9	63.6	67.3	46	25.6	64.1
Arctic Anthropology	70.6	57.1	57.7	64.3	70	50	21.1	37.5	7.4	13	44
Current Anthropology	76.6	57.3	75.6	68.7	66.7	74.3	70.9	54.4	37.8	37.5	62.2
Evolutionary Anthropology				74.3	64.4	84.2	75	49.4	71	26.7	59.9
Historical Archaeology	68.8	81	71.8	44.7	65.7	60.9	24.1	8.3	13.2	0	47.8
International J of Osteoarchaeology	76.6	73.6	73.4	71.1	54.9	71.4	57.9	51.1	40.9	7.9	59.8
J of Anthropological Archaeology	100	73.3	100	100	77.8	87.5	83.3	70.6	56.5	35	76
J or Anthropological Research	80	94.4	94.4	77.8	93.3	66.7	55.6	23.1	53.3	26.7	66.5
J of Archaeological Method and Theory			100	100	100	100	90.9	90	22.2	21.4	77.3
J of Archaeological Research			100	88.9	100	100	85.7	50	50	42.9	78.3
J of Archaeological Science	72.2	77	74.6	87.2	80.6	85.9	69.7	74.8	62.9	37.1	71.1
J of Field Archaeology	75	92.3	76.9	75.9	66.7	54.2	26.1	4.2			60.6
J of Human Evolution	93.1	93.5	92.4	98.6	100	84.5	85	87.5	77.5	48.5	86.4
J of the Polynesian Society	83.3	52.9	64.3	50	66.7	69.2	61.5	42.9	15.4	20	52.6
J of World Prehistory	100	100	100	100	100	85.7	100	75	57.1		86.8
Latin American Antiquity			94.4	87.5	82.6	94.7	76.9	70	50	14.3	72.5
North American Archaeologist			46.7	52.6	53.8	35.3	15.4	14.3	16.7		31.6
Plains Anthropology	80	79.2	65.2	80.8	38.7	46.4	45	58.3	11.5	15.4	52.8
World Archaeology	82.1	88.9	92.6	82.1	86.2	62.1	58.6	63.3	39.5	9.3	62.3

Table 5: Average Percentage of Articles Cited per Volume for the Years 1995–2004 and 1995–2000.

	1995–2004		1995–2000
J of World Prehistory	86.8	*J of Archaeological Method and Theory*	100.0
J of Human Evolution	86.4	*J of World Prehistory*	97.6
Annual Review of Anthropology	84.5	*J of Archaeological Research*	97.2
American Antiquity	82.8	*Annual Review of Anthropology*	95.6
J of Archaeological Research	78.3	*American Antiquity*	93.7
J of Archaeological Method and Theory	77.3	*J of Human Evolution*	93.7
J of Anthropological Archaeology	76.0	*Latin American Antiquity*	89.8
Latin American Antiquity	72.5	*J of Anthropological Archaeology*	89.8
J of Archaeological Science	71.1	*J of Anthropological Research*	84.4
American Anthropologist	69.1	*Archaeometry*	84.1
J of Anthropological Research	66.5	*World Archaeology*	82.3
Archaeometry	64.1	*American Anthropologist*	81.5
World Archaeology	62.3	*J of Archaeological Science*	79.6
Current Anthropology	62.2	*Evolutionary Anthropology*	74.3
J of Field Archaeology	60.6	*J of Field Archaeology*	73.5
Evolutionary Anthropology	59.9	*International J of Osteoarchaeology*	70.2
International J of Osteoarchaeology	59.8	*Current Anthropology*	69.9
Plains Anthropologist	52.8	*Antiquity*	66.6
J of the Polynesian Society	52.6	*Historical Archaeology*	65.5
Antiquity	52.0	*Plains Anthropologist*	65.0
Historical Archaeology	47.8	*J of the Polynesian Society*	64.4
Arctic Anthropology	44.0	*Arctic Anthropology*	61.6
North American Archaeology	31.6	*North American Archaeology*	47.1

Based on the two measures, it appears that archaeological journals can be divided into two groups. The journals with the highest citation rates are broad theoretical or methodological journals, many of which are heavily cited because they publish review articles and have a larger audience. The technical or regional journals tend to have lower citation rates because they cover more specific topics and thus have a smaller audience. It is difficult to subdivide journals further because the field is relatively small and most journals fill a specific niche.

Article Citation Data

In addition to documenting journal citation rates, another way to demonstrate research impact is to determine the citation frequency for an individual article. Citation data for individual articles can be extracted from the Web of Science. The number of times your article has been cited can then be compared to the citations per article for that year or to the average citations per article for the journal. For example, Table 6 lists the top ten most cited articles in *American Antiquity* for 2001. The average citation rate for *American Antiquity* articles published in 2001 is 4.49. Thus, these 10 articles have a higher-than average citation rate for the journal in that year and across all years. In fact, many of these articles are cited more than the average across all journals (see Tables 2 and 3). The data suggest that these articles are making significant impact on the discipline because they are frequently cited articles in a highly cited journal. Even if you have published in a "smaller" journal, you can still make a case that your article has made a significant impact on the discipline by comparing your article citation frequency to the average for the journal.

Summary

Citation data are just one way to document the impact that journals and their articles have on a discipline. This article provides just a brief overview of some simple ways to examine citation data. Like any type of dataset, citation data have their limitations. The databases contain errors; for example, occasionally references are incorrectly cited, or authors with similar names are confused for one another. These

Table 6: Ten Most Cited Articles Published in 2001 in *American Antiquity*.

Author(s)	Article Title	Times Cited
Richerson, P. J. et al.	Was Agriculture Impossible during the Pleistocene but Mandatory during the Holocene? A Climate Change Hypothesis	25
Rick, T. C. et al.	Paleocoastal Marine Fishing on the Pacific Coast of the Americas: Perspectives from Daisy Cave, California	13
Peregrine, P. N.	Matrilocality, Corporate Strategy, and the Organization of Production in the Chacoan World	13
Shennan, S. J.; Wilkinson, J. R.	Ceramic Style Change and Neutral Evolution: A Case Study from Neolithic Europe	12
Gamble, L. H. et al.	An Integrative Approach to Mortuary Analysis: Social and Symbolic Dimensions of Chumash Burial Practices	10
Renfrew, C.	Production and Consumption in a Sacred Economy: The Material Correlates of High Devotional Expression at Chaco Canyon	10
Nelson, M. C.; Hegmon, M.	Abandonment is Not as It Seems: An Approach to the Relationship between Site and Regional Abandonment	9
Erlandson, J. M.; Moss, M. L.	Shellfish Feeders, Carrion Eaters, and the Archaeology of Aquatic Adaptations	9
Waters, M. R.; Ravesloot, J. C.	Landscape Change and the Cultural Evolution of the Hohokam along the Middle Gila River and Other River Valleys in South-Central Arizona	8
Windes, T. C.; McKenna, P. J.	Going against the Grain: Wood Production in Chacoan Society	7

errors are more likely to have a greater impact on citation numbers for individual papers than on journals. The databases also include self-citations, or the number of times you cited your own article in other publications, since citation numbers may reflect how many articles an author has published and how often the author references those articles rather than how the article has influenced other researchers. In addition, there is an extensive debate on the value and accuracy of the JCR's impact factor as the standard measure for journal performance. This debate is beyond the scope of this article, but the Auburn University Libraries websites listed below are an excellent source of information on this debate.

Even given these problems, citation data can provide a valuable line of evidence to document research impact for any level of job performance review. While I did not discuss the exact methods for using the JCR or Web of Science databases, any university reference librarian will be able to assist researchers in using these and other databases to document and analyze journal or article impact.

Relevant Web Pages

- Auburn University Libraries, Assessing Journal Quality (http://www.lib.auburn.edu/socsci/asj.htm)
- Auburn University Libraries, Citation Analysis Debate (http://www.lib.auburn.edu/socsci/citationdebate.htm)
- American Psychological Association, Journal Statistics and Operations Data (http://www.apa.org/journals/statistics/)
- Thomson Scientific, ISI Web of Knowledge (http://www.thomsonisi.com)
- Thomson Scientific, The ISI Database: The Journals Selection Process (http://scientific.thomson.com/knowtrend/essays/selectionofmaterial/journalselection/)