Published by The American Physiological Society
Integrating the Life Sciences from Molecule to Organism

The Physiologist

INSIDE

Open Access

Does Open Access Lead to Increased Readership and Citations?

A Randomized Controlled Trial of Articles Published in APS Journals

Philip M. Davis, Cornell University

Introduction

Citations are a measure of scholarly impact in the research community and a basis for scientific reward. Prior studies have suggested that free (or open) access to scientific publications leads to increased citations. Several studies have reported very large citation effects associated with free access (e.g., between two and seven times) (2).

These studies, however, are based on unobtrusive, observational analysis--many without statistical controls. As a result, it has been difficult to determine whether this relationship between access and citations is causal, the direction of causality, or whether the relationship is an artifact of other explanatory variables. Secondly, while readership is implied as an intermediary cause between access and citation, no prior study has investigated the effect of access on article downloads.

In order to isolate the effect of access on readership and citations, we conducted a randomized controlled trial of open access publishing on articles published electronically in 11 APS journals. This report details the findings three years after the commencement of the experiment. Earlier findings of this study may be found in Davis, et al (4).

Methods

Scientific articles, 1,619 from 11 APS journals published between January and April, 2007, formed the study group. Upon electronic publication, articles were randomly selected into either the treatment group (n=247) or the control group (n=1372). Treatment articles received immediate free access; control articles followed their normal publication trajectory (subscription-access for the first 12 months, followed by free access).

A stratified random sample was used to ensure equal representation of articles from each section of APS journals. Only research articles and reviews were included in the study. Details of the sample dataset are provided in Table 1.

The sample size was designed to provide enough statistical power to detect a 25% difference in citations between groups. Since previous studies have reported differences on an order of 200-700%, we should have sufficient statistical power to detect a difference, if one exists.

Usage statistics were gathered on a monthly basis directly from the publisher via HighWire Press. Known robot activity (software robots downloading all free material for indexing purposes, e.g., Google) was removed from the dataset prior to analysis. Citation figures were

(continued on page 200)

Table 1. Description of the American Physiological Society journal dataset.

Journals	Open Access (Total Articles)	% Open Access
AJP: Cell Physiology	36 (155)	23
AJP: Endocrinology and Metabolism	21 (147)	14
AJP: Gastrointestinal and Liver Physiology	22 (134)	16
AJP: Heart and Circulatory Physiology	32 (233)	14
AJP: Lung Cellular and Molecular Physiology	14 (109)	13
AJP: Regulatory, Integrative and Comparative Physiology	34 (195)	17
AJP: Renal Physiology	18 (140)	13
Journal of Applied Physiology	27 (201)	13
Journal of Neurophysiology	39 (278)	14
Physiology	2 (11)	18
Physiological Reviews	2 (16)	13
Total	**247 (1,619)**	15
Categorical Properties (totals)		
Research Articles	228 (1,519)	15
Review Articles	19 (100)	19
Methods Articles	7 (29)	24
Cover article	2 (11)	18
Press release	1 (5)	20
Total	**247 (1,619)**	15

gathered on a monthly basis from ISI's Web of Science.

The researcher was solely responsible for the randomization, data gathering, analysis and reporting of this study.

Results

Open access treatment articles received significantly more article downloads and reached a broader audience, yet were cited no more frequently, nor earlier, than subscription-access control articles.

Article downloads

During the first year of publication, open access articles received more than double the number of full-text downloads (119%, 95% C.I. 100% - 140%) and 61% more PDF downloads (95% C.I. 48% - 74%) from a third more unique visitors (32%, 95% C.I. 24% - 41%). Abstract views were reduced by nearly a third (-29%, 95% C.I. -34% - -24%) signaling a reader preference for the full article when available.

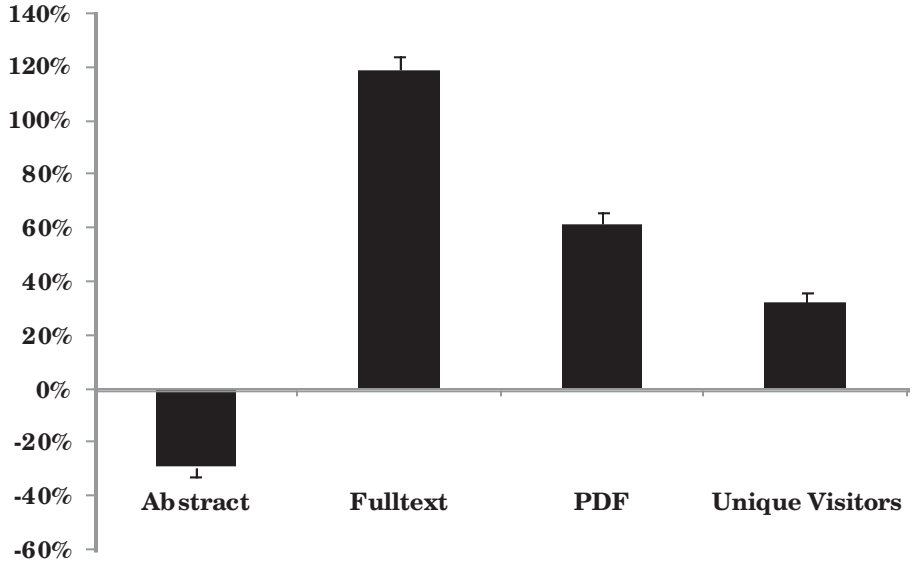

Figure 1. Percent increase (+ S.E.) in article downloads and unique visits to open access treatment articles compared to subscription-access articles published in 11 journals by the American Physiological Society, January-April 2007. Analysis controls for individual journal effects.

Citations

Open access treatment articles were no more likely to be cited in their first year than subscription-access control articles. A total of 71% (175 of 247) of open access articles were cited within their first year compared to 74% (1019 of 1372) of control articles.

Thirty-six months after publication, open access treatment articles were cited no more frequently than articles in the control group (Figure 2). Open access articles received, on average, 10.6 citations (95% C.I. 9.2 - 12.0) compared to 10.7 (95% C.I. 9.6 - 11.8) for the control group. No significant citation differences were detected at 12, 18, 24 and 30 months after publication.

Discussion

The results of this experiment suggest that providing free access to the scientific literature may increase readership (as measured by article downloads) and reach a larger potential audience (as measured by unique visitors), but have no effect on article

citations. These results are consistent with an earlier report of the APS study after one year (4) and the results of other scientific journals after two years (3).

The fact that we observe an increase in readership and visitors for Open Access articles but no citation advantage suggests that scientific authors are adequately served by the current APS model of information dissemination, and second, that the additional readership is taking place outside this core research community (4).

The increase in full text downloads for Open Access articles during their first year after publication (Figure 1) suggests that the primary benefit to the non-subscriber community is in browsing, as opposed to printing or saving, which would have been indicated by a commensurate increase in PDF downloads.

In sum, the real beneficiaries of Open Access may not be the scientific author community, who traditionally have excellent access to the research literature, but communities of practice that consume, but rarely contribute to, the corpus of literature. These individuals may include students, educators, physicians, patients, and researchers employed by private industry who depend on the publication of scientific literature. Further research is required to identify these groups and their use of the scientific literature.

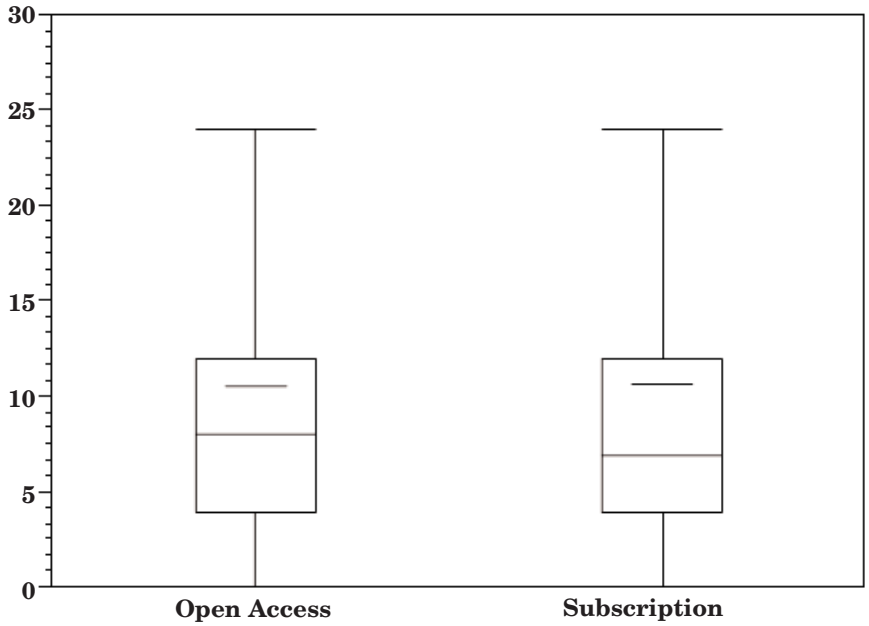

Figure 2. Variability plot of citations to APS articles 36 months after publication. Boxes represent the interquartile range (25th to 75th percentile) and contain the median value (horizontal line) and average value (horizontal dash). "Whiskers" extend 1.5x the length of the interquartile range.

Study Limitations

1. Access is not a necessary precondition to citation. An author may cite from the abstract of an article or simply copy the reference from another paper. The result of this behavior may attenuate any access-citation effect.

2. Readers of scientific articles without access to a journal from the publisher's website may find other avenues of access, such as through colleagues located at other institutions or by contacting the author directly for a copy (6). Authors may self-archive their article by placing it on the public Internet or in an institutional repository. In our study, we were only able to identify 18 instances of self-archiving of APS articles—too few for statistical analysis.

3. ISI's Web of Science was the source of citations in our study. While WoS does not index the entire corpus of research literature, it does provide a reliable and comparative sample of citations to other citation counting services such as Scopus (1, 5).

Acknowledgements

This experiment would not be possible without the help and support from Marty Frank, Rita Scheman, Margaret Reich, Mark Goodwin and Mike Gentry. This study was conducted as part of doctoral research in the Department of Communication at Cornell University. Funding was provided by a grant by the Andrew W. Mellon Foundation under the Scholarly Communications and Technology Program.

References

1. Archambault E, Campbell D, Gingras Y, and Larivière V. Comparing of Science Bibliometric Statistics Obtained From the Web and Scopus. J Am Soc Inf Sci Technol 60: 1320-1326, 2009, http://dx.doi.org/10.1002/asi.21062.

2. Craig ID, Plume AM, McVeigh ME, Pringle J, and Amin M. Do Open Access Articles Have Greater Citation Impact? A critical review of the literature. J Informetr 1: 239-248, 2007, http://www.publishingresearch.net/Citations-SummaryPaper3_000.pdf.pdf.

3. Davis PM. Access, readership, citations: a randomized controlled trial of scientific journal publishing (PhD dissertation). Ithaca: Cornell University, 2010.

4. Davis PM, Lewenstein BV, Simon DH, Booth JG, and Connolly MJL. Open access publishing, article downloads and citations: randomised trial. BMJ 337: a568, 2008, http://dx.doi.org/10.1136/bmj.a568.

5. Falagas ME, Pitsouni EI, Malietzis GA, and Pappas G. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. FASEB Journal 22: 338-342, 2008, http://dx.doi.org/10.1096/fj.07-9492LSF.

6. Gaulé P. Access to scientific literature in India. J Am Soc Inf Sci Technol 12: 2548-2553, 2009, http://dx.doi.org/10.1002/asi.21195. ❖