Article Title: "No comment"?: A study of commenting on PLOS articles

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Abstract

Article commenting functionality allows users to add publicly visible comments to an article on a publisher's website. As well as facilitating forms of post-publication peer review, for publishers of open-access mega-journals (large, broad scope, OA journals that seek to publish all technically or scientifically sound research) comments are also thought to serve as a means for the community to discuss and communicate the significance and novelty of the research, factors which are not assessed during peer review. In this paper we present the results of an analysis of commenting on articles published by the Public Library of Science (PLOS), publisher of the first and best-known mega-journal *PLOS ONE*, between 2003 and 2016. We find that while overall commenting rates are low, and have declined since 2010, there is substantial variation across different PLOS titles. Using a typology of comments developed for this research we also find that only around half of comments engage in an academic discussion of the article, and that these discussions are most likely to focus on the paper's technical soundness. Our results suggest that publishers have yet to encourage significant numbers of readers to leave comments, with implications for the effectiveness of commenting as a means of collecting and communicating community perceptions of an article's importance.

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Keywords

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Introduction

The emergence of online publishing in the academic journal market has undoubtedly revolutionised scholarly communications. As well as facilitating faster publication, wider access, and greater support for supplementary data, digital publishing has stimulated innovations supporting the discussion and evaluation of research output. Article commenting – the ability for readers of an online article to add a comment relating to that article, visible to future readers – represents one such innovation. This feature links closely to developments in online publishing more broadly, as summarised by Shirky:

> The media landscape is transformed, because personal communication and publishing, previously separate functions, now shade into one another. One result is to break the older pattern of professional filtering of the good from the mediocre before publication; now such filtering is increasingly social, and happens quite fast. [1, p. 81]

Comment functionality first appeared in the journal context in the late 1990s [2], but has had a somewhat chequered history. While comment functionality is present on a vast range of systems and platforms, including journal websites, reference management tools, pre-print servers, and academic social networking services, the limited amount of work that has been reported to date has suggested that commenting rates are low [3].

Article commenting assumes particular significance for titles operating as what are now commonly called open-access mega-journals (OAMJs). Mega-journals, of which *PLOS ONE* was the first, have four key characteristics: they have a large publishing output, a broad subject scope, are open access, and operate a peer review policy that seeks only to establish the scientific or technical soundness of an article [4]. It is this last characteristic which has proved most controversial [4], since it foregoes the assessment of significance, novelty, and relevance to a field that has traditionally underpinned peer review and editorial decision-making. OAMJ proponents argue that this approach essentially democratises the dissemination process, since the evaluation of an article's significance is no longer the preserve of small numbers of editors and reviewers, but is instead left to the "community" to decide. As a consequence, Binfield argues:

> If subjective filtering (on whatever criteria) has not happened 'pre-publication' … then clearly the community needs to apply new tools 'post publication' to try to provide these types of signals based on the reception of the article in the real world [5].

In practice these "new tools" have primarily been post-publication metrics, particularly so called alt-metrics, and article commenting. Indeed the *PLOS ONE* website explicitly states that comment functionality is intended to "facilitate community evaluation and discourse around published articles" [6]. More generally, article commenting is closely linked to the notion of post-publication peer review (PPPR). Advocates of PPPR argue that scholarly communication should be a dynamic process, with articles subjected to ongoing scrutiny and quality control [7]. While opinions vary on the degree of formality that should be associated with PPPR reports, many argue that is should be open to all readers, including non-experts [8]. This has led some to conclude that "post publication peer review = online commenting" [3].

Given the significance of article commenting to the mega-journal model and post-publication peer review, it is striking to note the apparently widespread acceptance that commenting rates are generally very low [3]. It is also notable that while some prior work has attempted to characterise and quantify the types of comments left on articles, it has yet to be fully understood the extent to which comments serve to address the key peer review criteria (significance, novelty and interest) eschewed by mega-journals.

In this article we address this gap in the literature with a detailed analysis of comments left on articles published in seven journals published by the Public Library of Science (PLOS). PLOS, a non-profit publisher, launched its first journal in 2003, with a stated goal of facilitating the open access dissemination of scientific research, and their journals provide a particularly interesting subject for a study of commenting. As well as publishing *PLOS ONE*, the first and perhaps best known mega-journal (which operates with the soundness-only review policy described above), PLOS also publishes six journals with traditional and more selective editorial criteria. Of these, *PLOS Biology* and *PLOS Medicine* are recognised as leading journals in these broad fields, while the others (*PLOS Genetics*, *PLOS Computational Biology*, *PLOS Neglected Tropical Diseases*, and *PLOS Pathogens*) are similarly well regarded, albeit in narrower disciplinary areas. Investigating commenting across these journals therefore offers the potential to compare journals of different sizes, scope and selectivity.

Based on an interrogation of a data set comprising all comments left on PLOS articles between 13/10/2003 (the date of the first PLOS article) and 13/12/2016 (when the data were collected), we address the following four research questions:

RQ1. What are the rates of commenting on PLOS articles, and are there variations across users, between journals and over time?

RQ2. Who is commenting on articles?

RQ3. What types of comments are being left?

RQ4. To what extent do comments address fundamental elements of the peer review process?

Related Work

There have been relatively few attempts to analyse article commenting formally. Two studies published as blogs by Adie in 2008 examined commenting rates and the nature of comments left on articles on *BioMed Central* (*BMC*) [9] and *PLOS ONE* [10]. He found that only 2% of *BMC* articles had attracted comments, with around a third of all comments being made by the author of the article. Only 8% of all commenters had commented on more than one paper. *PLOS ONE* was found to have a higher rate of commenting, with 18% of articles accruing at least one author or reader comment – a figure boosted to 39% if editors' comments were included. Adie suggested that the low impact factor of the journals, which he argued indicated the lower significance of the papers, may have been a factor in the low comment rates. A crowd-sourced classification of the comments themselves was also conducted, finding relatively similar distributions for the two data sets. "Interpretation" comments ("Readers suggesting how the results of a paper might be interpreted") were found to be the most common non-author comments (*BMC*=22%, *PLOS ONE* = 17%), closely followed by comments making direct criticism of the article (*BMC* = 17%, *PLOS ONE* = 13%). Other categories included comments providing additional links or citations, requests for clarification, and spam. While these studies provide a useful insight into commenting rates and types, they naturally do not cover the emergence, in the late 2000s, of *PLOS ONE* as the world's largest journal. The classification of comments is also somewhat problematic, since each comment is assigned only one category.

Analysis has also been conducted of the results of a relatively short-lived trial of open-peer review conducted by *Nature* in 2006. Authors were offered the chance for their papers to be posted online before formal review in order to garner comments. 71 papers underwent this process, of which 33 (46%) received no comments. The remaining 38 papers received a combined 92 comments. A *Nature* editorial concluded that researchers "are too busy, and lack sufficient career incentive, to venture onto a venue such as *Nature's* website and post public, critical assessments of their peers' work" [10 p.972].

Neylon and Wu [12,13] recognised the low commenting rates across a number of journal sites, and noted that highly commented-on papers tended to be “front matter” (editorials, perspectives etc.). They suggested that the main reasons for low commenting rates are social: that researchers were unused to critiquing articles in public, and that “junior” researchers may have feared career repercussions for doing so. They also identify the lack of any tangible incentives or rewards for commenting, a point echoed in McCormack’s analysis of the *Nature* trial: “it is simply unrealistic to expect informed, well-argued opinions from those who have not been specifically tasked with the job of supplying them” [12 p.68]. Neylon and Wu also note the relatively small size of the community engaging with an individual paper, citing the “90-9-1 rule” [15]: that 90% of participants in an online community merely observe, 9% make small contributions, and 1% are responsible for a large proportion of all content. Others have also noted that article comments, as with many forms of online engagement, can shift in focus from the article itself to engagement with other comments [16].

It is thus clear that previous attempts to conduct quantitative studies of journal commenting rates are now all somewhat dated, and the vastly greater use of digital tools in the modern world led us to seek to determine whether this has resulted in a corresponding increase in the community’s use of this potentially valuable tool.

Method

Data

The research presented in this paper is based on an analysis of data provided by PLOS, consisting of all comments (and associated metadata) left on articles since the launch of the very first PLOS journal (*PLOS Biology*) in 2003. These data consisted of 30,034 comments associated with 15,362 articles, and included article ID, comment ID, the title of the comment, the comment itself, and the date and time the comment was created. PLOS required that the “display name” (the username created by the individual making the comment) associated with comments be anonymised, and each comment author’s “display name” was therefore converted by them to a unique numeric ID. This meant that while we were able to identify all comments posted by a single commenter ID, we were not able to link these comments to an actual “display name”.

In order to properly address our research questions, we augmented this data in several ways.

Table 1 summarises the final data set, and indicates the fields that we added. In some cases additional data (e.g. article title and publication date) were collected using a web scraping tool, while in others information could be extracted or inferred from the original PLOS data (e.g. publishing journal, and whether the comment was original or a reply to an existing comment). Citation data was gathered from *Scopus*. Full details of how the data were derived can be found in Appendix 1, and the data set itself is available from the University of X research data repository (www.xxx.xxx; Data DOI xxx).

Table 1: Fields in the data set. Starred fields (*) were added by the researchers

Field	Description
article_ID	Unique ID for the article on which the comment was left.
article_title *	Title of the article on which the comment was left.
article_pub_date *	Publication date of the article on which the comment was left.
article_url *	URL of the article on which the comment was left.
Citations	The number of citations the article has received (collected from *Scopus*)
annotation_ID	Unique ID for the comment.
journal *	Journal in which the article was published.
user_ID	Unique ID for the commenter.
comment_title	Title of the comment.
body	Text of the comment.
new_or_reply *	Indicates whether the comment is a new comment, or a reply to an existing comment.
created_date	Date comment created.
created_time	Time comment created.
days_after_pub *	The time in days between the publication of the article, and the publication of the comment.
comment_words *	The number of words in the comment.

Analysis

Analysis was conducted in two stages. The first stage was a standard quantitative analysis of the data, conducted in Excel and SPSS, designed to address RQ1 ("What are the rates of commenting on PLOS articles, and are there variations across users, between journals and over time?"). In order to calculate the proportion of all articles that had received comments, total publishing output was obtained for each of the PLOS titles for the relevant periods from the PLOS website (http://journals.plos.org/plosone/search).

The second stage involved manual coding of comments, and was designed to address RQs 1-3. This coding therefore incorporated three dimensions. The first dimension related to the identity of the commenter, with coders tasked with assigning comments to one of five categories, based on a careful reading of the comment itself:

1. Publisher (the comment is very likely left by a PLOS publisher account)
2. Author (the comment is very likely left by an author of the article)
3. Editor (the comment is very likely left by the academic editor of the article)
4. Reader (the comment is very likely left by a general reader of the article)
5. Unknown (it is unclear from the content of the comment which of the above categories is most appropriate)

Dimension 2 related to the type of comment. While consideration was given to the comment typologies developed by Adie [9,10], we decided that a more detailed typology would yield richer results. Typologies of reasons for citing (e.g. [17,18]) were also reviewed, but were felt to be unsuited to the more informal context of commenting. A random sample of 500 comments was therefore carefully reviewed, and a new typology of comment type developed. Three of the authors then conducted the coding for both commenter identity and comment type, and began by coding a small common sample of comments to test the typologies and the consistency of the coding process. Coding agreement for comment type was found to be low (mean Fleiss' Kappa < 0.5). The authors then met for additional discussion of the coding process, and discussed disagreements within the initial test sample. The coding scheme was simplified, and definitions clarified. A subsequent test of coder agreement on a new sample of comments yielded an acceptable level of agreement (mean Fleiss's Kappa = 0.862 for commenter type, 0.721 for comment type) [19].

Table 2 shows the final coding scheme used for the manual analysis, with codes divided into two sub-categories – Procedural (i.e. comments NOT relating to the substance of the paper, but instead referring to the publication process, language, typesetting, referencing etc.) and Academic (comments that engage in some way with the academic content of the article). Appendix 2 provides examples of comments that were assigned each code. Categories were non-exclusive, meaning comments could be coded with all appropriate codes. The coding was conducted on a sample of the data, this sample representing all comments associated with 10% of articles in the full data set, this 10% being a stratified (by journal and year of publication) systematic sample. Thus a total of 2,888 comments (9.7%) were coded, these representing all comments made on 1,538 articles (10.0%).

Table 2: Typology of comments

Procedural	
Referee comments	The replication of reviewer report(s) as a comment. Also includes author responses to reviewers, and any pre-publication dialogue between author(s) and reviewers.
Media coverage	Comments reporting or pointing readers towards non-academic/media coverage of the article, including blogs and press releases.
Ethical issue	Comments relating to potential or proven conflicts of interest, investigations of author misconduct, unethical research methods etc.
Correction	Comments relating to an issue with the text of the paper and its metadata e.g. typos, missing acknowledgements, incorrect captions, citations etc. This category includes readers highlighting these issues, as well as publishers or authors noting their correction. This code does NOT include comments highlighting issues of research methodology, analysis or argumentation.
Supplementary data	Links to or information about supplementary data i.e. the underlying data or supporting data for the article.
Academic	
Direct criticism	Comment includes direct criticism of the article.
Direct praise	Comment includes direct praise of the article.
Question for the authors	Comment asks a direct question of the authors.
Related material	Comment includes links to or citations of other academic materials that are related to or develop the article in question.
Discussion	Comment includes a discussion of the content of the paper beyond direct praise or criticism. Includes discussion of themes emerging from the article, its potential impact, significance or novelty, suggestions for improvement to the research, and the highlighting of perceived methodological or analytical issues.
Other	Any comment not clearly fitting the definition of any code.

The third dimension for manual coding was intended to address RQ4, and related to whether comments addressed any of the four common elements of peer review. As noted in [20], the peer review process typically evaluates an article against four criteria:

- **Novelty or originality**: the extent to which a paper makes an intellectual advance contributing in an innovative way to knowledge.
- **Significance or importance**: the extent to which a paper adds to the body of knowledge, making an impact by enhancing understanding or practice.
- **Scope or relevance**: the anticipated interest of the article to its readership.
- **Soundness or rigour**: the extent to which the research described in the article demonstrates methodological precision, coherence and integrity and includes the quality of the argumentation, logic of research and the way data are interpreted.

Since any comment addressing these points would have been categorised as "Discussion" as part of the initial coding, the coding for peer review element was limited to this subset of the sample (a total of 1,117 comments on 568 articles). This coding was conducted after the initial coding for commenter and comment type, by members of the research team with particular expertise in the theory and practice of peer review in general, and for mega-journals in particular. We therefore believe that while different coding teams conducted different types of coding, in both cases the results are robust.

Results

Stage 1: Quantitative analysis

An important initial consideration was whether to include comments left by publisher operated accounts in our analysis. The data provided by PLOS included 12,350 unique user IDs, of which seven were found to represent publisher accounts associated with each of the seven journals included in the analysis, initially identifiable from the large number of comments associated with them (the *PLOS ONE* publisher account alone was found to have contributed 7,662 comments). Confirmation that these were publisher accounts was made by viewing comments made by each account on the PLOS website. Earlier studies [9,10] have excluded such comments from their analysis, on the basis that they do not represent reader or author engagement with the article. Given that the primary rationale for our work was to explore the extent to which comments serve as a means of facilitating PPPR, and as a forum for the academic community to determine the significance or importance of an article, our view was that most forms of analysis were best conducted on a data set that excluded comments left by publisher operated accounts. In certain cases, however, we felt it was of interest to present data relating to the volume and nature of publisher comments. In all cases the text, figures and tables clearly state which data are included.

Overall commenting rates by journal

Table 3 shows the commenting rates for each of the seven PLOS journals, the proportion of all articles with at least one comment, and the mean number of comments for each article with a comment. In total, including publisher comments, only 7.4% of articles were found to have received a comment, although there was substantial variation across titles. *PLOS Medicine* (22%) and *PLOS Biology* (13%) were found to have the highest rates of overall commenting, with *PLOS Neglected Tropical Diseases* the lowest (4.5%). However, when comments left by publisher accounts are excluded, these figures drop, for some journals substantially. While 22.2% of *PLOS Medicine* articles have at least one comment, the figure excluding publisher account comments is 10.3%. The figures for *PLOS ONE* are also quite different (7.0% and 4.9%).

Excluding publisher comments, those articles that had been commented on received on average 1.90 comments, with two thirds of these articles (66.0%) receiving a single comment. Just 592 articles were found to have five or more comments, that figure representing 5.5% of articles with comments, and just 0.3% of all articles. *PLOS Medicine* also proved to be an outlier when the length (i.e. the number of words) of comments left for each journal was investigated. Since the mean number of words per comment was heavily skewed by a small number of extremely long comments, we instead report the median number of words per comment. For all journals this was 55, while for *PLOS Medicine* this figure was 126, almost double the next highest (*PLOS Neglected Tropical Diseases* = 66).

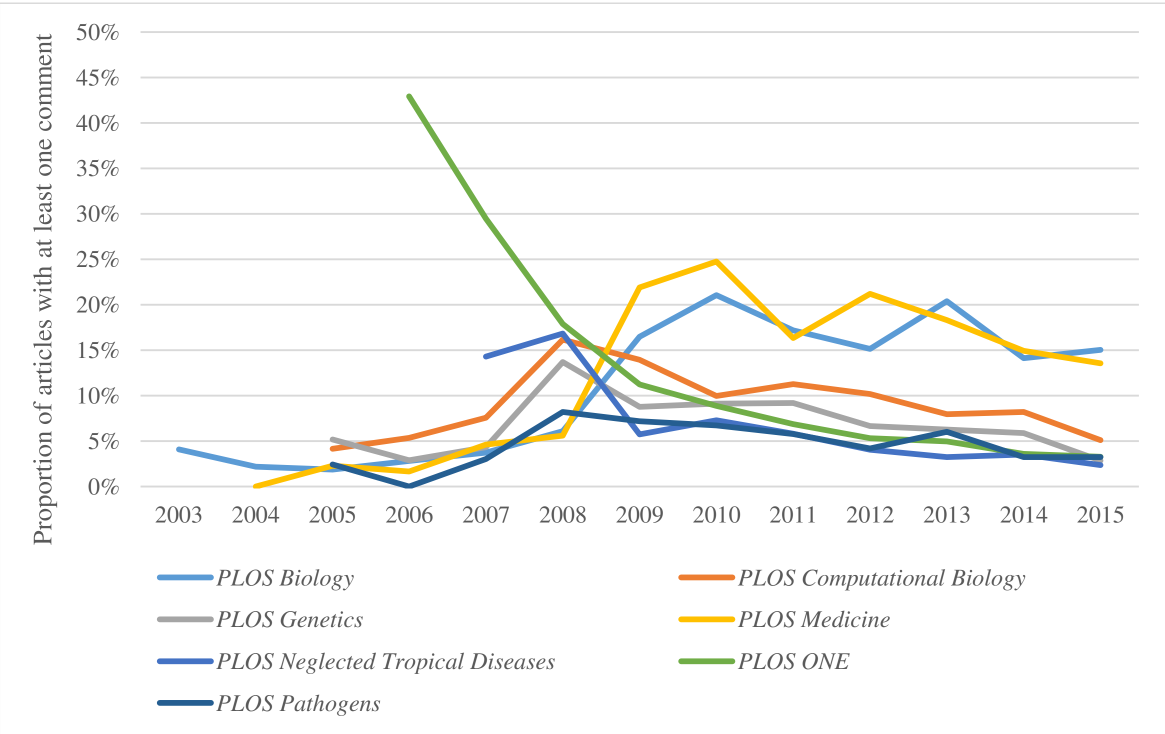
Table 3: Commenting rates for each PLOS journal

Journal	Articles with comments	Total articles published	% articles with comments (inc. publisher accounts)	% of articles with comments (exc. publisher accounts)	Mean number of comments per article with comments (exc. publisher accounts) (Std. dev.)	Median number of words per comment (exc. Publisher accounts)
PLOS Biology	591	4,413	13.4	10.0	1.87 (2.28)	60
PLOS Comp. Biology	573	5,121	11.2	8.4	1.91 (2.01)	49
PLOS Genetics	582	6,710	8.7	6.2	1.66 (1.78)	49
PLOS Medicine	732	3,299	22.2	10.3	2.26 (2.99)	126
PLOS Neg. Trop. Diseases	234	5,253	4.5	3.9	1.44 (0.83)	66
PLOS ONE	12,306	176,087	7.0	4.9	1.92 (3.58)	52
PLOS Pathogens	344	6,113	5.6	4.6	1.53 (1.04)	59
Total	15,362	206,996	7.4	5.2	1.90 (3.34)	55

Commenting rates by year

Commenting rates (excluding comments left by publisher accounts) were also calculated by year, as shown in Figure 1. Commenting rates for most journals show a slight decline over recent years. All journals show their highest rate of commenting in 2010 or earlier. Of *PLOS ONE* papers published in 2007, a year after launch, 29.5% received a comment, compared to just 3.3% of articles published in 2015.. It is also striking to note two outlier journals, *PLOS Medicine* and *PLOS Biology*, both of which have comment rates substantially higher than the other journals since 2009.

Figure 1: Proportion of articles with comments by journal and year (excluding comments left by publisher accounts)



Commenting rates and journal size

Table 3 shows an apparent (negative) association between journal size and the proportion of articles with comments over the data set as a whole. One potential explanation for the decline in commenting for individual journals over time may therefore be that commenting rates are related to the size of journal output. A Spearman's rank-order correlation was run on the data (excluding comments left by publisher accounts) to determine the relationship between the number of articles published by each journal each year, and the proportion of those articles to receive at least one comment. Across all journals a weak, but statistically significant, negative correlation was found ($r_s(77) = -.372$, $p = .001$). Figure 2 shows a scatterplot of these data, with journal size normalised to allow comparison between PLOS ONE and the other much smaller PLOS journals. Results of Spearman rank-order correlations for each journal are also shown. Almost all journals have a wide variation in size, and four journals (PLOS ONE, PLOS Medicine, PLOS Biology and PLOS Neglected Tropical Diseases) show strong statistically significant negative correlations between output and commenting rates. However the fact that the three other journals show no significant correlation, whilst also having considerable variation in size, suggests that size journal size alone does not explain differences in commenting rates.

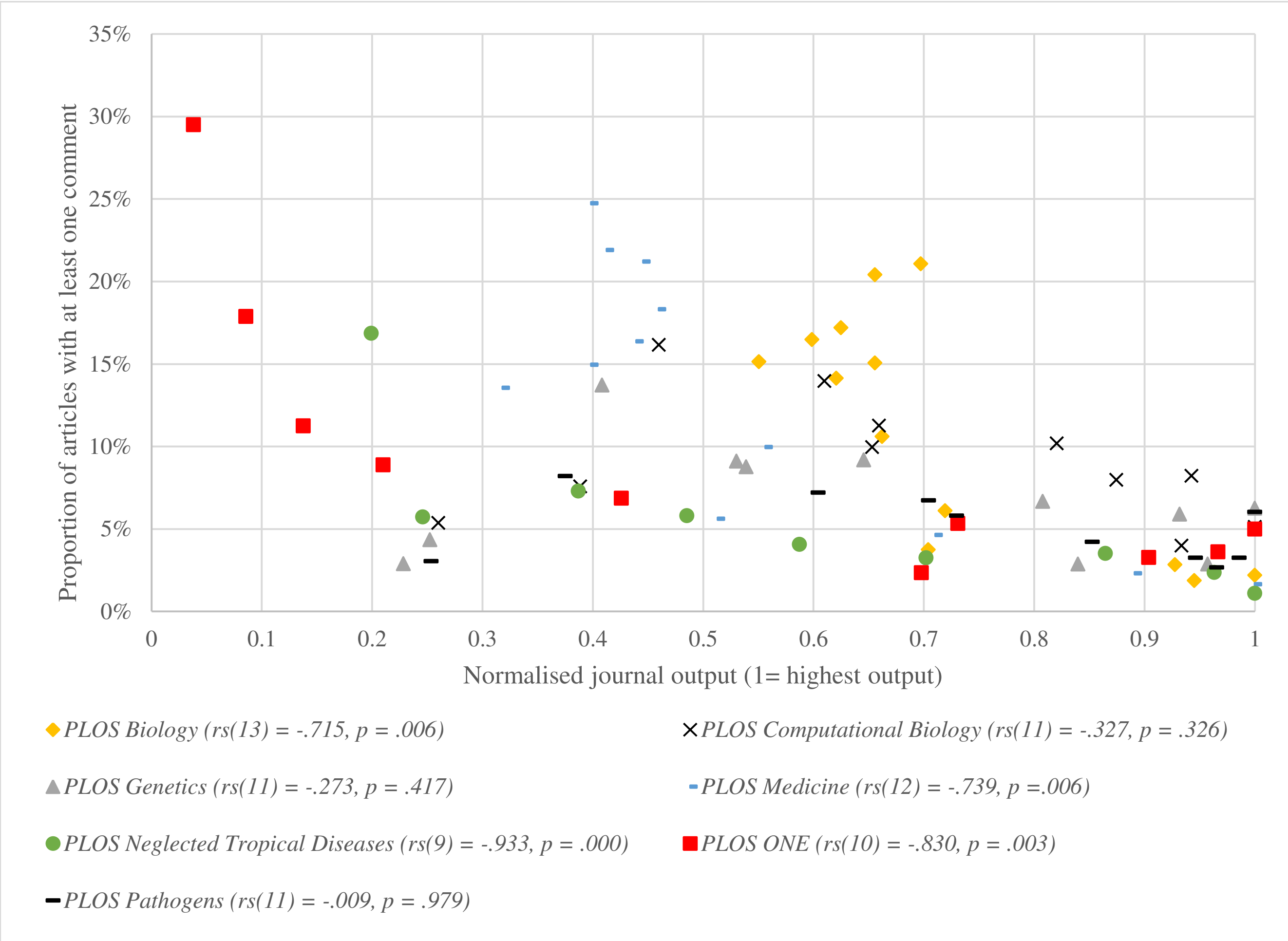


Figure 2: Scatterplot of journal size (by normalised article output) and the proportion of articles with at least one comment. Comments left by publisher accounts are excluded. Results of Spearman rank-order correlation also shown.

Original comments vs. replies

Work was also done to determine the proportion of comments that were new, as opposed to replies to existing comments (see Table 4). Excluding publisher comments, we found 23.5% of comments were replies to other comments, although this figure is skewed somewhat by the relatively high proportion of reply comments for *PLOS ONE* (and the large output of that journal). In fact the proportion of replies is slightly higher for *PLOS ONE* than for any other title.

Table 4: Proportion of new comments and replies, by journal (excluding publisher accounts)

Journal	New	Reply	% Reply
PLOS Biology	675	155	18.7
PLOS Computational Biology	681	140	17.1
PLOS Genetics	550	139	20.2
PLOS Medicine	593	172	22.5
PLOS Neglected Tropical Diseases	252	41	14.0
PLOS ONE	12504	4071	24.6
PLOS Pathogens	353	74	17.3
Total	**15608**	**4792**	**23.5**

Commenting rates over time

We also calculated the proportion of comments (excluding publisher comments) left at weekly intervals since the article's publication, with the results shown in Figure 3. Perhaps unsurprisingly, a very high proportion of comments were found to be left soon after publication: 28.2% within seven days, and 51.4% within four weeks. In total 86.5% of comments were left within a year of publication, with the longest gap between article publication and comment being over 12 years. This distribution was found to be relatively consistent for each journal, and no substantial variation between proportions of new comments and replies over time were found during this analysis.

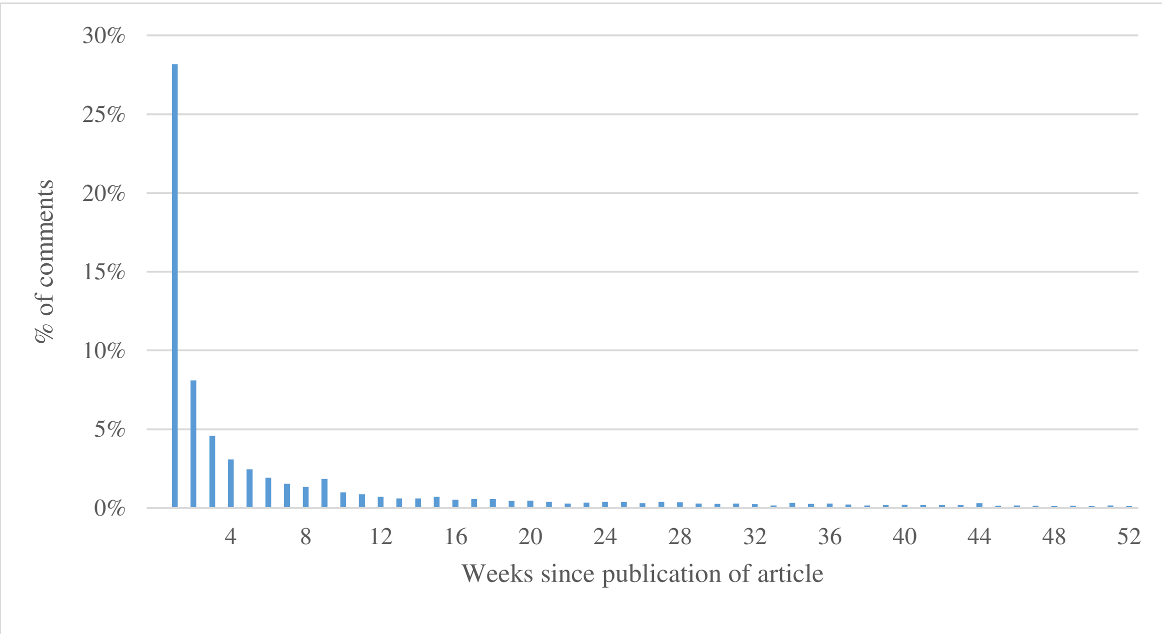


Figure 3: Proportion of comments left at weekly intervals since article publication (excluding publisher comments)

The slight spike in Figure 3 at nine weeks perhaps merits particular mention; upon investigation we found that it was at this point after publication that the controversial aspect of Liu et al.'s now infamous (and subsequently retracted) *PLOS ONE* paper "Biomechanical characteristics of hand coordination in grasping activities of daily living" [21] (which makes a reference to "the Creator") first attracted significant attention in the comments section. The commenting activity for this one article (which now has considerably more comments than any other PLOS article) over a single week was great enough to visibly affect the aggregated view of commenting rates over time.

Frequency of commenting by individual commenters

Attention was also paid to the frequency with which individual users left comments. Table 5 shows a breakdown of commenter numbers by journal, and includes the mean number of comments per commenter (excluding publisher account activity). These means are of course skewed by a small number of prolific commenters, and the median number of comments per commenter was found to be 1 for all journals. Over three-quarters of commenters (75.8%) were found to have left a single comment, and only 4.2% more than 5 comments. As one might expect, commenters were found to focus their attention on a single journal: only 3.1% of commenters have commented on articles in more than one PLOS journal, and only 0.5% in more than two.

Table 5: Number of commenters and mean number of comments, by journal (excluding publisher accounts)

Journal	Total number of unique commenters	Mean number of comments per commenter (exc. publisher accounts) (Std. dev)
PLOS Biology	562	1.5 (2.6)
PLOS Computational Biology	602	1.4 (0.9)
PLOS Genetics	491	1.4 (1.5)
PLOS Medicine	520	1.5 (2.0)
PLOS Neglected Tropical Diseases	234	1.3 (0.6)
PLOS ONE	10,177	1.6 (2.7)
PLOS Pathogens	326	1.3 (0.9)
Total	12,343	1.7 (2.8)

The most commented-upon articles

Finally, given the previous work by Wu & Neylon [12], it was thought useful to identify and evaluate those articles that have accrued the most comments. The ten most commented-upon articles were identified, and full details of these can be found in Appendix 3. In contrast to Wu & Neylon's findings, none of the ten could be described as "front-matter", and all report original research. The article with the most comments (206) is the Liu article referencing "the Creator" (discussed above), while the apparent stimuli for comments on other articles include the alleged refusal of researchers to share underlying data, results that contradict other influential papers, and apparently serious perceived flaws in research methodology and analysis. It is also notable that the article with the eighth highest number of comments (46) has no reader comments whatsoever; all 46 comments are made by the author, and correct the order of references in the article.

Stage 2: Manual coding of comments

Commenter coding

The manual coding of comments was conducted on a sample of 2,888 comments associated with 1,538 articles. Looking first at the type of commenter, we found that in total almost a third (29.1%) of comments were made by a publisher, and around a quarter (23.8%) by the author of the article. Comments left by readers were found to be the most frequent (38.3%). There was, however, substantial variation in these figures across the seven journals (see Table 6), with readers contributing three quarters (74.4%) of all comments on *PLOS Medicine* articles, compared to just 33.0% of *PLOS ONE* comments.

Table 6: Type of commenter by journal. %s refer to the distribution for each title.

	% of comment assigned each Commenter code				
Journal (number of coded comments)	Author	Editor	Publisher	Reader	Unknown
PLOS Biology (86)	14.0	1.2	10.5	60.5	14.0
PLOS Computational Biology (99)	20.2	0.0	26.3	38.4	15.2
PLOS Genetics (105)	15.2	0.0	23.8	49.5	11.4
PLOS Medicine (195)	8.2	0.0	12.8	74.4	4.6
PLOS Neglected Tropical Diseases (29)	13.8	3.4	10.3	58.6	13.8
PLOS ONE (2,326)	26.4	1.1	32.0	33.0	7.5
PLOS Pathogens (48)	8.3	0.0	16.7	72.9	2.1
Total (2,888)	23.8	0.9	29.1	38.3	7.9

It also proved instructive to review the breakdown of commenter types by year (Table 7). The years 2003-2006 are excluded from the table, since the number of comments coded for each was less than 100. It is immediately apparent that there was a general rise in publisher comments up to 2013 (when they represented almost exactly half of all comments), followed by a dramatic decline in 2014, when the publisher accounted for just 6% of comments. A review of comments associated with each of the previously identified publisher accounts reveals that this decline was common to all journals; the *PLOS ONE* publisher account went from 2,094 comments in 2013, to a mere 88 comments in 2014, while the other journals declined by rates between 20% and 80%. Given the scale of this decline in publisher comments, we contacted PLOS to ask whether it might be explained by any change in publisher policy regarding commenting. In response Veronique Kermer, Executive Editor of PLOS, suggested that two changes in journal operations might explain the drop:

> "In 2014, the "Related Content" tab was introduced on the article page, and populated automatically with mentions of media coverage, instead of using the comments. This in itself may explain a large portion of the drop. The second change was an adjustment of the Correction policy, which led to a larger range of corrections being processed as formal Correction articles (linked to the original article) as opposed to a note entered by staff in the comments." [22]

Our coding of publisher-authored comments found that they were almost universally procedural (98.6%), with comments highlighting media coverage of the article (56.9%) or acknowledging corrections (29.2%) the most common types. These findings clearly suggest that the changes implemented by PLOS are likely to explain the dramatic drop in publisher-authored comments.

Table 7: % of comments each year left by each Commenter type. (2007-2016).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Comments	1,418	2,382	1,529	1,856	3,371	5,000	5,261	2,068	1,682	537
Comments coded	121	274	162	196	335	559	537	267	227	145
Author	9.9	19.7	14.2	24.0	20.9	15.7	20.3	39.7	41.4	46.9
Editor	3.3	1.8	1.9	1.0	0.3	0.4	0.9	0.0	1.8	0.7
Publisher	14.0	33.6	16.7	15.3	40.9	42.9	49.5	6.0	3.5	4.8
Reader	56.2	37.6	57.4	50.5	32.2	29.5	22.5	47.6	48.9	44.8
Unknown	16.5	7.3	9.9	9.2	5.7	11.4	6.7	6.7	4.4	2.8

Comment coding

The remainder of the analysis of comment type was conducted on the coded sample minus these 842 publisher comments. As shown in Table 8, across all non-publisher coded comments around two thirds (66.5%) were of an academic nature, and a third (32.9%) procedural. *PLOS Medicine* was found to have the highest proportion of comments that engaged in some discussion of the article's content, while *PLOS ONE* had by far the highest proportion of comments identifying or acknowledging corrections. It is also striking that overall, and for almost all journals, comments including praise were found to be more prevalent than those including some criticism. One explanation for this is the tendency of commenters to begin a comment with a positive statement before addressing issues or weaknesses they see in the work.

Table 8: Comment types by journal (excluding Publisher comments). % indicates proportion of comments from each journal assigned each type of code.

Comment Type [1]	PLOS Biology	PLOS Computational Biology	PLOS Genetics	PLOS Medicine	PLOS Neglected Tropical Diseases	PLOS ONE	PLOS Pathogens	Total
Comments	870	879	798	1,458	285	21,022	403	**25,715**
Comments coded	77	73	80	170	26	1,580	40	2,046
Procedural	**26.0%**	**41.1%**	**22.5%**	**11.2%**	**30.8%**	**36.4%**	**7.1%**	**32.9%**
Referee	1.3%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.7%
Media	11.7%	12.3%	10.0%	4.1%	11.5%	5.2%	3.6%	5.9%
Ethical issue	3.9%	0.0%	1.3%	3.5%	0.0%	0.8%	0.0%	1.1%
Correction	10.4%	15.1%	7.5%	3.5%	15.4%	25.9%	3.6%	21.7%
Supp. data	1.3%	13.7%	3.8%	0.0%	3.8%	3.8%	0.0%	3.7%
Academic	**75.3%**	**58.9%**	**76.3%**	**89.4%**	**76.9%**	**62.7%**	**89.3%**	**66.5%**
Criticism	11.7%	0.0%	2.5%	16.5%	11.5%	5.0%	14.3%	6.2%
Praise	19.5%	8.2%	11.3%	14.1%	46.2%	12.4%	14.3%	13.1%
Question	9.1%	11.0%	15.0%	5.3%	11.5%	10.8%	21.4%	10.6%
Related material	20.8%	16.4%	28.8%	37.1%	26.9%	13.9%	42.9%	17.5%
Discussion	55.8%	41.1%	56.3%	81.2%	46.2%	49.5%	64.3%	52.6%
Other	5.2%	4.1%	6.3%	5.9%	11.5%	4.8%	3.6%	5.0%

[1] Since multiple codes could be assigned to a single comment, the sum of % for each column > 100%.

We also calculated the proportion of articles for each journal found to have comments of various types. As shown in Table 9, just under half of all articles (47.5%) were found to have at least one Academic comment, while almost two-thirds (62.1%) had at least one Procedural comment. Extrapolating these figures to the full data set, and using the overall comment rates established in Table 3, we can estimate the overall proportion of articles published by PLOS that have comments of these types. Once again *PLOS Medicine*, and to a lesser extent *PLOS Biology*, are estimated to have a substantially higher proportion of articles with which the community have engaged on an academic level. The data suggest that only 3% of *PLOS ONE* articles receive a comment relating to the research itself.

Table 9: Proportion of articles in sample with different types of comment, and estimate of overall comment rates

Journal	Articles	% of	% of	Estimated % of	Estimated % of

	in sample	articles in sample with Academic comments	articles in sample with Procedural comments	**all** articles with at least one Academic comment (confidence interval at 95% confidence level)	**all** articles with at least one Procedural comment (confidence interval at 95% confidence level)
PLOS Biology	60	70.0%	43.3%	9.4% (±1.5)	5.8% (±1.7)
PLOS Comp. Biology	57	40.4%	64.9%	4.5% (±1.5)	7.3% (±1.4)
PLOS Genetics	57	59.6%	50.9%	5.2% (±1.1)	4.4% (±1.2)
PLOS Medicine	74	79.7%	32.4%	17.7% (±2.0)	7.2% (±2.4)
PLOS Neg. Trop. Diseases	34	70.6%	32.4%	3.2% (±0.7)	1.5% (±0.7)
PLOS ONE	1233	43.1%	66.4%	3.0% (±0.2)	4.6% (±0.2)
PLOS Pathogens	23	69.6%	39.1%	3.9% (±1.1)	2.2% (±1.1)
Total	1538	47.5%	62.1%	3.5% (±0.2)	4.6% (±0.2)

Coding for peer review elements

The final stage of the manual coding investigated the extent to which comments coded as "Discussion" addressed the core elements of the traditional peer review process: novelty/originality, significance/importance, scope/relevance, and soundness/rigour. 1,117 comments were coded, with multiple codes being applied where appropriate. In a significant number of cases, comments that had been coded as "Discussion" were found not to directly address any of the core peer review elements. While these comments clearly represent academic engagement with the article, they tend to focus on questions for the authors, areas for future work, or debates about definitions and terminology. Clearly this type of discussion is useful and productive, and indeed closely echoes the type of comments often found in peer review reports. They do not, however, represent criteria against which decisions to accept or reject a manuscript are typically made.

The results are shown in Table 10, including a column ("None") to capture comments not assigned any of the four peer review codes. We note that for most journals, the number of comments coded during this stage was relatively small, and we therefore refrain from drawing any conclusions from the figures for these journals. Comments relating to the scientific soundness of the article were most prevalent for *PLOS ONE*, for which 65.2% of discussion comments address issues of soundness or rigour and only 13.6% the significance of the research. Given that the *PLOS ONE* peer review model focuses exclusively on soundness, this appears to be a significant finding.

Table 10: Breakdown of discussion codes by peer review element addressed. %s indicate the proportion of comments for each journal assigned each code.

		% of comments assigned each peer review code				
	Comments coded	Novelty	Significance	Relevance	Soundness	None
PLOS Biology	43	4.7	30.2	30.2	32.6	37.2
PLOS Computational Biology	30	3.3	13.3	6.7	60.0	33.3
PLOS Genetics	45	2.2	8.9	13.3	42.2	46.7
PLOS Medicine	139	7.9	29.5	28.8	50.4	20.1
PLOS Neglected Trop. Dis.	12	25.0	41.7	58.3	50.0	0.0
PLOS ONE	828	6.5	13.6	21.4	65.2	18.7
PLOS Pathogens	20	5.0	5.0	20.0	70.0	15.0
Total	1117	6.5	16.2	22.3	61.0	20.9

Relationship between comments and citations

Some analyses were conducted to investigate the relationship between the number and type of comments left on articles, and the number of citations accrued. Across the comment data set excluding publisher comments, a Spearman's rank-order correlation revealed a statistically significant but extremely weak correlation between the number of comments and number of citations ($r_s(10,741) = .161$, $p < .001$). Further comparisons were conducted between articles in the manually coded sample which were found to have received comments of certain types, and those without such codes (Table 11). Articles with comments of an academic nature, discussion comments, and comments including praise, were all found on average to have received significantly more citations than those without. However, this did not hold for articles with comments including criticism –these articles were on average less frequently cited than articles without critical comments, although the difference was not found to be statistically significant. It is perhaps interesting to note that four of the eleven articles which had received three or more critical comments were found to have received more than 30 citations, while five of the eight articles with more than three praising comments were found to have received fewer than 30.

Table 11: Comparison of mean number of citations for articles with and without comments of certain types (excluding publisher comments). Significance of differences in means tested using the Mann-Whitney U test

	Mean number of citations		
Comment type	Has a comment of this type (number of comments in the sample)	Does not have a comment of this type (number of comments in the sample)	*p* value
Academic	39.7 (725)	24.6 (382)	<0.001
Includes discussion	41.2 (560)	27.5 (547)	<0.001
Includes praise	43.5 (236)	32.0 (871)	<0.001
Includes criticism	29.0 (94)	35.0 (1013)	0.739

Overall it is difficult to draw any meaningful conclusions from this analysis. Most importantly, the raw data alone is not sufficient for us to understand what (if any) causality there is between the relationships. Thus it remains unclear whether the two measures are in fact related at all, and if so whether positive comments drive citations, or vice versa.

Discussion

The results presented here generally confirm earlier findings regarding the low rates of commenting on academic articles. We found lower rates of commenting than those identified by Adie in 2008, and our analysis suggests that commenting rates on PLOS articles have declined slightly over the last decade. Throughout our investigation it was striking that *PLOS Biology* and *PLOS Medicine* were observed to have a different distribution of comments and comment types; they were found to have higher rates of commenting since 2009, and that those comments were more likely than for other journals to be academic in nature. While the number of comments is not high enough to suggest these journals have completely solved the problem of low commenting rates, they do suggest that a significant proportion of a community of readers will publicly engage with research. Although it is beyond the scope of this study to determine why this is the case, we can offer some suggestions. It might be that these journals publish (or are perceived to publish) higher quality papers, which therefore exercise the community to note their importance (or point out their flaws). It is also possible that the reputation of these journals provides some incentive to commenters to publicly post their responses – a kind of prestige by association. Finally we note that these journals remain relatively small (at least in comparison to *PLOS ONE*), and therefore may have cultivated a readership in a way not possible for much larger journals (which in practice operate as article repositories). One might therefore hypothesise that this community is one of journal-readers, rather than article-readers, and as such is more likely to engage with articles than readers of articles in larger journals (who are most likely to have found the article through a database or web search).

It is also instructive to review our results relating to comment type in the context of debates about PPPR, and online engagement and collaboration in science more generally. It is notable that a key rationale for PPPR offered by Teixeira da Silva is the necessity for articles to be subjected to an ongoing quality control process [7], thus making the gatekeeping of scientific publishing a crowdsourced, collective affair [23]. Our findings, in particular those relating to the proportion of comments addressing corrections and discussions of soundness, suggest that comments do serve this purpose, but to a very limited degree. The challenge for journals adopting a PPPR model, and indeed for other services that encourage commenting (for example pre-print servers), is how they can stimulate sufficient reader engagement. Our results provide no evidence of substantial changes in attitude or behaviour in the 10 years since the failed *Nature* open peer review experiment.

One limitation of our approach that might be relevant here relates to the anonymization of "display names" in the PLOS dataset. This meant that we were unable to conduct any analysis relating to whether commenters were anonymous or identifiable, and the extent to which certain types of comment were more likely to come from anonymous commenters. While PLOS publishes the "display name" of commenters alongside their comments, there are no rules or requirements around the creation of this "display name". Thus in practice while many users create "display names" that clearly indicate their identity (such as "JohnSmithSheffield"), others do not ("biologist1975"). Given that previous work has suggested that some (particularly more junior) academics may be reluctant to comment critically about an article in a public forum [12,13], it would be instructive to investigate whether comments left by pseudo-anonymous commenters differ in type to those left by easily identifiable commenters. We believe further work in this area would be useful in informing our understanding of the disincentives to leave public comments, and the benefits and disadvantages of publishers allowing anonymous commenting.

Our results also raise significant questions for mega-journal publishers. The success of the OAMJ model, which aims to publish all scientifically sound papers, relies on there being effective tools to identify important or interesting papers, and to facilitate their discovery. Indeed earlier work investigating researchers' perceptions of OAMJs identified the fear of a form of information overload – large numbers of articles being published with no indication of their quality – as one of the main concerns with the model [24]. While altmetrics offer some support in this regard, both publishers and researchers acknowledge that they remain a work in progress, and they are yet to be viewed as a reliable indicator of the importance of a paper [18]. Our findings suggest that not only are comment rates low for *PLOS ONE* articles, but those comments that are left are most likely to relate to procedural issues with the paper. Even those comments which do engage with the academic content of the paper are most likely to address issues of soundness and rigour – the one element that is evaluated as part of the OAMJ peer review process. Thus while the rhetoric of OAMJ publishers suggests that "the community decides" which papers are significant, an adaptation of Shirky's publish-then-filter model [1], in practice there seems to be no way of effectively aggregating and communicating the views of that community. The result, therefore, is more akin to "the researcher decides", since it is left to individual information seekers to discover and evaluate articles. While overall submission rates to mega-journals show no signs of declining, the mega-journal vision of democratising science relies on these articles being not only published, but read and then publicly acted upon. It therefore seems essential that OAMJ publishers continue to investigate new tools for article evaluation and discovery.

Conclusion

In this paper we have presented the results of the largest and most rigorous analysis of journal article commenting to date. Our findings confirm both prior studies and conventional wisdom on the subject;

rates of commenting on academic articles are low, with the vast majority of articles published by PLOS receiving no comments. We note however that commenting rates vary between journals, and suggest a relationship between journal size and commenting rates. This in turn may be linked to the extent to which particular academic communities engage with journals. The study also found that around a third of all comments are procedural in nature (i.e. relating to the publication process, language, typesetting, referencing etc.), and that comments that do engage with the academic content of the article are most likely to be related to its scientific or technical soundness. We argue that these results present a challenge to mega-journal publishers such as PLOS, who have viewed article comments as a potential forum for the identification and discussion of important or interesting papers (factors that are not considered during the peer review process).

Finally we believe our findings help inform a broader debate relating to the development and adoption of innovation within scholarly publishing. While it is difficult to fault the original rationale for incorporating comment functionality within online journals, it is striking just how little publicly available empirical evidence has appeared regarding the effectiveness of the feature. Although it seems certain that publishers themselves have evaluated their readers' engagement with comments, little appears to have changed either in the comment functionality itself, or in the extent to which readers are encouraged or incentivised to contribute comments. The broader question here is the extent to which this is representative of the treatment of innovations within scholarly publishing, at least with regard to user engagement. We suggest that a number of recently proposed or emerging innovations (for example various peer review models, online article annotation, pre-print servers, and even mega-journals) rely to some extent on researchers understanding their value, and adapting their behaviour in often quite drastic ways at a time when academics everywhere are facing increasing pressure to meet targets (be they for teaching, or the quality or impact of their research). A more comprehensive and up to date evidence base relating to the uptake of these innovations would better serve publishers and researchers, as would further work to understand how such innovations can be more seamlessly embedded into researcher workflows.

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Appendix 1: Detailed description of data set

Field	Description	Example	Method
article_ID	Unique ID for the article on which the comment was left.	pbio.0000009	Included in PLOS data set
article_title	Title of the article on which the comment was left.	Out of the Way	Scraped from PLOS website using Parsehub software.
article_pub_date	Publication date of the article on which the comment was left.	13/10/2003	Scraped from PLOS website using Parsehub software.
article_url	URL of the article on which the comment was left.	https://doi.org/10.1371/journal.pbio.0000008	Created using the *article_ID* value, added to a standard PLOS url prefix (https://doi.org/10.1371/journal.[*article_ID*])
citations	Number of citations the article has received	35	A batch download was conducted of all PLOS articles indexed in Scopus. Article IDs were matched with those in the comment data set, and number of citations extracted.
annotation_ID	Unique ID for the comment.	10.1371/annotation/f6904257-13fd-4dc8-aeb4-cac57f3cc08d	Included in PLOS data set
journal	Journal in which the article was published.	PLOS Biology	The prefix of the *article_ID* value was used to determine the publishing journal. The original data set included 30 comments linked to articles originally published in the journal *PLOS Clinical Trials*. This was a short-lived title (2006-2007) that was subsequently merged into PLOS ONE. On the PLOS website all articles are now catalogued under PLOS ONE, and a similar approach was taken here. All *article_IDs* with the prefix "pctr" were identified, and assigned the value "PLOS ONE".
user_ID	Unique ID for the commenter.	145619	Included in PLOS data set
comment_title	Title of the comment.	Source of the quote	Included in PLOS data set
body	Text of the comment.	This quote is interesting and often cited (with the "[is]" replaced by "was"), yet I could not find its original source. I think it should have been indicated here. Minor correction: Quotation mark before "As we enjoy" is missing.	Included in PLOS data set
new_or_reply	Indicates whether the comment is a new comment, or a reply to an existing comment.	New	For all comments that were made as a reply to an existing comment, the comment title begins with "RE:", followed by the title of the original comment. Therefore all comments with a title beginning "RE:", and including an exact string found in the title of an earlier comment, were identified in Excel and assigned the "Reply" value. All remaining comments were considered "New".

created_date	Date comment created.	29/10/2010	Included in PLOS data set. However we observed that a very large number of comments had been added by publisher operated accounts on 30 and 31 March 2009. Further investigation revealed these comments to all include the line “This comment was originally posted as a ‘Reader Response’” along with metadata relating to the original comment, and the comment itself. Investigation revealed that these comments represented the migration of older comments to a new commenting system. The original creation date of the comment was therefore extracted from the publisher comment in Excel, and used instead of the November 2009 date.
created_time	Time comment created.	12:43:00	Included in PLOS data set
days_after_pub	The time in days between the publication of the article, and the publication of the comment.	2753	Difference between *Created_date* and *article_pub_date*
comment_words	The number of words in the comment.	39	Calculated in Excel using the formula =IF(LEN(TRIM(A1))=0,0,LEN(TRIM(A1))-LEN(SUBSTITUTE(A1," ",""))+1)

Appendix 2: Coding scheme for comment type, with examples

Procedural Codes		
Code	**Description**	**Example**[1]
Referee comments	The replication of reviewer report(s) as a comment. Also includes author responses to reviewers, and any pre-publication dialogue between author(s) and reviewers.	Reviewer 1's Review: “Below I describe a number of issues that should be addressed: 1) The authors seem to detect two classes of small RNA directed against suffix: siRNAs and piRNAs. In the text describing the dicer experiment, the authors seem to take the result as evidence that the suffix siRNAs are dicer dependent [continues]
Media coverage	Comments reporting or pointing readers towards non-academic/media coverage of the article, including blogs and press releases.	There was an article about this paper on June 9, 2006 in the Central Valley Business Times: http://www.centralvalleybusinesstimes.com/stories/001/?ID=2183
Ethical issue	Comments relating to potential or proven conflicts of interest, investigations of author misconduct, unethical research methods etc.	It has come to our attention that the Academic Editor who handled this manuscript, [xxxx], had co-authored publications with [xxx] of the authors of the article in the five years before the submission of this work. In line with the PLOS ONE competing interests policy (http://www.plosone.org/static/competing.action), we consider this as a potential conflict of interest (continues)
Correction	Comments relating to an issue with the text of the paper and its metadata e.g. typos, missing acknowledgements, incorrect captions, citations etc. This category includes readers highlighting these issues, as well as publishers or authors noting their correction. This code does NOT include comments highlighting issues of research methodology, analysis or argumentation.	The sentence ending "..."buyer beware")" should end with reference [8].
Supplementary data	Links to or information about supplementary data i.e. the underlying data or supporting data for the article.	We have provided more detailed methodological detail and background on the use of [X] as an attachment methodology at OpenWetWare (http://xxxx). Please feel free to comment there or add further information or findings.

Academic Codes		
Code	**Description**	**Example**[1]
Direct criticism	Comment includes direct criticism of the article.	The analytical setup of the paper is not scientifically sound as the [xxxx] data demonstrated are not [xxxx] but rather poor full scan data that are not conclusive, and it is clear that the authors have no training in [xxx] and interpretation of data from this methodology.
Direct praise	Comment includes direct praise of the article.	To the authors - My jaw is still on the floor, and head still spinning from the far reaching implications of this work. Wow. Thank you so much - I have a lot to unlearn now!
Question for the authors	Comment asks a direct question of the authors.	I have one question that may lead to others. Trials were terminated when the prey were either captured by the predator or died in the water surrounding the arena. Were both forms of mortality included in the analysis presented in figure 2?
Related material	Comment includes links to or citations of other academic materials that are related to or develop the article in question.	Readers of this article may also be interested in following paper: Dangerfield BC, Fang Y, Roberts CA. 2001. Model-based scenarios for the epidemiology of hiv/aids: The consequences of highly active antiretroviral therapy. System Dynamics Review 17(2): 119-150.
Discussion	Comment includes a discussion of the content of the paper beyond direct praise or criticism. Includes discussion of themes emerging from the article, its potential impact, significance or novelty, suggestions for improvement to the research, and the highlighting of perceived methodological or analytical issues.	This is an important study and highlights the gap often found between evidence and practice. However, it must be emphasised to patients treated with aripiprazole that you should not cease your medication but you are encouraged to discuss this paper with your doctor. The study does not mean aripiprazole will not work for you, but it does not have the same good evidence behind it as other treatment options have. Some treatments e.g. penicillin, really were major breakthroughs but most new medications are not like penicillin. The take home message I think is that new drugs should be properly evaluated and compared directly with long-standing well researched alternatives before being recommended for widespread use.
Other	Any comment not clearly fitting the definition of any code.	All comments must conform to the norms of civilized scientific discussion, our guidelines are here:

		http://www.plosone.org/static/commentGuidelines . Comments not in keeping with these guidelines have been removed from this article, and any future comments that do not meet these standards will be removed.

[1] **Some examples have been partially redacted or otherwise edited**

Appendix 3: Ten most commented-upon articles

Journal	Article	Number of Comments	Scopus citations	Notes
PLOS ONE	Liu, M. J., Xiong, C. H., Xiong, L., & Huang, X. L. (2016). Biomechanical characteristics of hand coordination in grasping activities of daily living. PloS one, 11(1), e0146193.	206	3	Article references "the Creator", which prompted extensive discussion. The article was eventually retracted.
PLOS ONE	McCrone, P., Sharpe, M., Chalder, T., Knapp, M., Johnson, A. L., Goldsmith, K. A., & White, P. D. (2012). Adaptive pacing, cognitive behaviour therapy, graded exercise, and specialist medical care for chronic fatigue syndrome: a cost-effectiveness analysis. PloS one, 7(8), e40808.	87	27	The comments reflect apparent controversy regarding the researchers allegedly refusing to share the underlying data from their study.
PLOS ONE	Erlwein, O., Kaye, S., McClure, M. O., Weber, J., Wills, G., Collier, D., ... & Cleare, A. (2010). Failure to detect the novel retrovirus XMRV in chronic fatigue syndrome. PloS one, 5(1), e8519.	61	174	The findings reported in the paper contradict another important study, with comments primarily concerned with the validity of the results.
PLOS Medicine	Kirsch, I., Deacon, B. J., Huedo-Medina, T. B., Scoboria, A., Moore, T. J., & Johnson, B. T. (2008). Initial severity and antidepressant benefits: a meta-analysis of data submitted to the Food and Drug Administration. PLoS medicine, 5(2), e45.	49	1188	Comments include a range of questions and queries relating to the method and analysis employed in the article, and the validity of its conclusions.
PLOS ONE	Fluge, Ø., Bruland, O., Risa, K., Storstein, A., Kristoffersen, E. K., Sapkota, D., ... & Mella, O. (2011). Benefit from B-lymphocyte depletion using the anti-CD20 antibody rituximab in chronic fatigue syndrome. A double-blind and placebo-controlled study. *PloS one*, *6*(10), e26358.	47	77	6 comments are by the publisher and relate to media coverage of the article. The remainder represent detailed discussion of the content of the paper and its implications.
PLOS ONE	de la Riva, G. T., Hart, B. L., Farver, T. B., Oberbauer, A. M., Messam, L. L. M., Willits, N., & Hart, L. A. (2013). Neutering dogs: effects on joint disorders and cancers in golden retrievers. *PloS one*, *8*(2), e55937.	47	27	10 comments are made by the publisher and relate to media coverage of the article. The remainder consist of a number of queries and questions for the author, and their responses. It is notable that a number of comments are apparently left by non-academics who are interested in the subject.
PLOS ONE	Cui, Q. (2010). A network of cancer genes with co-occurring and anti-co-occurring mutations. *PLoS One*, *5*(10), e13180.	46	22	A majority of comments question the validity or accuracy of sections of the paper, or make suggestions for improved wording or referencing. The author has

				replied to most comments.
PLOS ONE	Nakajima, H., Nakajima-Takagi, Y., Tsujita, T., Akiyama, S. I., Wakasa, T., Mukaigasa, K., ... & Kobayashi, M. (2011). Tissue-restricted expression of Nrf2 and its target genes in zebrafish with gene-specific variations in the induction profiles. *PloS one*, *6*(10), e26884.	46	22	All comments relate to correcting reference numbers in the article.
PLOS Medicine	Ioannidis, J. P. (2005). Why most published research findings are false. *PLoS medicine*, *2*(8), e124.	42	2692	Comments almost entirely relate to discussion of the article's argument that a majority of scientific research findings are false.
PLOS ONE	Nilsson, R. H., Ryberg, M., Kristiansson, E., Abarenkov, K., Larsson, K. H., & Kõljalg, U. (2006). Taxonomic reliability of DNA sequences in public sequence databases: a fungal perspective. PloS one, 1(1), e59.	42	261	29 comments are from the author, and link to papers citing the article. 5 comments link to blogs covering the research. 8 comments discuss the conlcusions of the paper and their significance.