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Section 5:
Behind the Data

Party papers or policy discussions: an examination of highly shared papers using altmetric data

Mike Taylor, BSc and Dr. Andrew Plume

Which scientific stories are most shared on social media networks such as Twitter and Facebook?

Research on human health and social issues are often perceived as being the most shared scientific stories on social media networks such as Twitter and Facebook and – given their mainstream appeal – are often suggested to dominate the popular discussion around scholarly research online, but skeptics, such as David Calquhoun argue for their irrelevance: “Scientific works get tweeted about mostly because they have titles that contain buzzwords, not because they represent great science” (1).

So which is it to be? And do articles attracting social media attention also get the attention of scholars and the mass media? In this article, we seek to provide an approach to answering these questions.

With the rise of online scholarly publishing and the concomitant rise in the desire to create indicators of online attention to research articles and related outputs have come a number of providers of article-level data. A leading commercial provider of such data - collectively known as ‘altmetrics’ - is Altmetric.com, which tracks a variety of different indicators in four broad groups: Social Activity (e.g. Tweets and Facebook mentions), Mass Media (e.g. mentions on news sites such as BBC and CNN), Scholarly Commentary (e.g. mentions in scientific blogs), and Scholarly Activity (e.g. articles in reader libraries such as Mendeley). The overall collection and analysis of these references are brought together under the label “altmetrics”.

In terms of the volume of online mentions of scholarly articles, Twitter and other social networks provide by far the largest number of data points. However, given Twitter’s broad user base (the majority being non-academics) and limited information content (being restricted to 140 characters per tweet), other indicators may be more significant in terms of understanding scholarly usage (2). For example, [Mendeley](#) and [CiteULike](#) are examples of sharing and collaboration platforms used predominantly by researchers, while the mass media and scientific blogs tracked by Altmetric.com are written by professional science journalists or researchers themselves.

Methodology

Data were collected from the Altmetric.com API over four months ending January 17th, 2014. On this date, the latest altmetric indicator data for all papers published in a selection of journals in 2013 with any online mentions captured by Altmetric.com were downloaded for analysis; in total, 13,793 articles with at least one altmetric indicator datapoint were included in this study. Please note, the actual Journals monitored are detailed in the raw dataset, which is published on Figshare.

The Altmetric.com data includes counts of online attention at article level from across a variety of different data sources. In order to simplify data analysis, we aggregated data counts into the four classes as defined above: Social Activity, Mass Media, Scholarly Commentary, and Scholarly Activity. For each class, articles were assigned to predefined percentile ranges (cohorts) based on the frequency of online mentions (see [Table 1](#)).

Cohorts	Number of articles included
0.5%	69
1%	138
2.5%	347
5%	691
7.5%	1,045
10%	1,384
15%	2,095
20%	2,775
25%	3,539
30%	4,332
100%	13,793

Table 1: Cohorts of articles based on the frequency of online attention within each class.



Journal	Article title	DOI
Nature	Cerebral organoids model human brain development and microcephaly	10.1038/nature12517
Nature Comment	Climate science: Vast costs of Arctic change	10.1038/499401a
Nature Comment	Neuroscience: My life with Parkinson's	10.1038/503029a
Nature Editorial	Nuclear error	10.1038/501005b
Nature Editorial	Science for all	10.1038/495005a
Nature Letter	No increase in global temperature variability despite changing regional patterns	10.1038/nature12310
Nature Letter	Attractive photons in a quantum nonlinear medium	10.1038/nature12512
Nature News	Brazilian citation scheme ousted	10.1038/500510a
Nature News	Half of 2011 papers now free to read	10.1038/500386a
Nature News	World's slowest-moving drop caught on camera at last	10.1038/nature.2013.13418
Nature News	Genetically modified crops pass benefits to weeds	10.1038/nature.2013.13517
Nature News	NSF cancels political-science grant cycle	10.1038/nature.2013.13501
Nature News	Deal done over HeLa cell line	10.1038/500132a
Nature News	Antibiotic resistance: The last resort	10.1038/499394a
Nature News	Cosmologist claims Universe may not be expanding	10.1038/nature.2013.13379
Nature News	Zapped malaria parasite raises vaccine hopes	10.1038/nature.2013.13536
Nature News	See-through brains clarify connections	10.1038/496151a
Nature News	Dolphins remember each other for decades	10.1038/nature.2013.13519
Nature News	Researchers turn off Down's syndrome genes	10.1038/nature.2013.13406
Nature News	Astrophysics: Fire in the hole!	10.1038/496020a
Nature News	Giant viruses open Pandora's box	10.1038/nature.2013.13410
Nature News	Quantum gas goes below absolute zero	10.1038/nature.2013.12146
Nature News	Stem cells reprogrammed using chemicals alone	10.1038/nature.2013.13416
Nature News	Whole human brain mapped in 3D	10.1038/nature.2013.13245
Nature News	Father's genetic quest pays off	10.1038/498418a
Nature News	Tracking whole colonies shows ants make career moves	10.1038/nature.2013.12833
Nature News	Pesticides spark broad biodiversity loss	10.1038/nature.2013.13214
Nature News	Animal-rights activists wreak havoc in Milan laboratory	10.1038/nature.2013.12847
Nature News	Silver makes antibiotics thousands of times more effective	10.1038/nature.2013.13232
Nature News	Methane leaks erode green credentials of natural gas	10.1038/493012a
Nature News	When Google got flu wrong	10.1038/494155a
Nature News	First proof that prime numbers pair up into infinity	10.1038/nature.2013.12989
Nature News	Global carbon dioxide levels near worrisome milestone	10.1038/497013a
Nature News	Underwater volcano is Earth's biggest	10.1038/nature.2013.13680
Nature News	Did a hyper-black hole spawn the Universe?	10.1038/nature.2013.13743
PNAS	Private traits and attributes are predictable from digital records of human behavior	10.1073/pnas.1218772110
Nature News	How to turn living cells into computers	10.1038/nature.2013.12406
Nature News	Small-molecule drug drives cancer cells to suicide	10.1038/nature.2013.12385
Nature News	Brain-simulation and graphene projects win billion-euro competition	10.1038/nature.2013.12291
Nature News	Rewired nerves control robotic leg	10.1038/nature.2013.13818
Nature News	US government shuts down	10.1038/502013a
Lancet Letter	Open letter: let us treat patients in Syria	10.1016/s0140-6736(13)61938-8
Nature News	Blood engorged mosquito is a fossil first	10.1038/nature.2013.13946
BMJ	Cancer risk in 680 000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians	10.1136/bmj.f2360
Nature News	NIH mulls rules for validating key results	10.1038/500014a
PNAS	Impact of insufficient sleep on total daily energy expenditure, food intake, and weight gain	10.1073/pnas.1216951110
Nature News	Red meat + wrong bacteria = bad news for hearts	10.1038/nature.2013.12746
Nature News	Who is the best scientist of them all?	10.1038/nature.2013.14108
Nature News	Four-strand DNA structure found in cells	10.1038/nature.2013.12253
Nature News	Weak statistical standards implicated in scientific irreproducibility	10.1038/nature.2013.14131
Nature News	Mathematicians aim to take publishers out of publishing	10.1038/nature.2013.12243
BMJ	Bicycle helmets and the law	10.1136/bmj.f3817
Nature News	Barbaric Ostrich: 27th June 2013	10.1038/nature.2013.12487
American J of M	The Autopsy of Chicken Nuggets Reads "Chicken Little"	10.1016/j.amjmed.2013.05.005
Nature News	Stem cells mimic human brain	10.1038/nature.2013.13617
Nature News	Mystery humans spiced up ancients' sex lives	10.1038/nature.2013.14196
BMJ	The future of the NHS--irreversible privatisation?	10.1136/bmj.f1848
Nature News Feature	Archaeology: The milk revolution	10.1038/500020a
Nature News Feature	Neuroscience: Solving the brain	10.1038/499272a
Nature News Feature	Tissue engineering: How to build a heart	10.1038/499020a
Nature News Feature	Theoretical physics: The origins of space and time	10.1038/500516a
Nature News Feature	Online learning: Campus 2.0	10.1038/495160a
Nature News Feature	Open access: The true cost of science publishing	10.1038/495426a
Nature News Feature	Inequality quantified: Mind the gender gap	10.1038/495022a
Nature News Feature	Voyager: Outward bound	10.1038/497424a
Nature News Feature	Mental health: On the spectrum	10.1038/496416a
Nature News Feature	Brain decoding: Reading minds	10.1038/502428a
Nature News Feature	Fukushima: Fallout of fear	10.1038/493290a
Nature News Feature	The big fat truth	10.1038/497428a

Table 2: Full list of the 69 articles belonging to the 0.5% cohort in the Social Activity class including journal, article title, and DOI. Articles highlighted in orange are those representing full-length articles reporting the results of original research. <https://www.researchtrends.com/researchtrends/vol1/iss36/14>

For example, the 69 papers comprising the top 0.5% of social activity comprise 91,470 social actions, 445 mass media mentions, 540 scholarly comments and 1,571 scholarly actions, whereas the top 69 papers comprising the top 0.5% of mass media activity comprise 2,638 mass media mentions, 16,221 social actions, 779 scholarly comments and 4,856 scholarly actions.

Analysis

Headline-grabbers: Which articles got most social media attention in 2013?

Of the 69 articles belonging to the 0.5% cohort in the Social Activity class (i.e. those articles most frequently mentioned in social media such as Twitter and Facebook, for example), just 8 of them are full-length articles reporting the results of original research. The remainder are typically editorial features or news items from leading weekly journals such as The Lancet, BMJ and Nature; see Table 2 for the complete list. The original research articles cover topics in the popular consciousness including climate change, human health and diet, and online information and privacy: intuitively, the sort of articles one might expect to see attracting broad popular attention online. However, one article appears to have a less obvious popular slant (the Nature letter “Attractive photons in a quantum nonlinear medium”) but closer examination shows that it describes a novel technique for forcing photons to interact in a quantum nonlinear medium which may have applications in quantum processing, where the ability to have photons ‘see’ each other could overcome present technological limitations.

The remaining 61 articles (almost exclusively news and editorial features about original research reported elsewhere) cover a variety of topics including several on topics close to the heart of the academy: research careers, science funding, the future of higher education and scholarly publishing. The preponderance of items in this group from Nature (primarily the Nature News and Nature News Feature sections of the publication) suggest that Social activity may be more likely to reflect attention to short journalistic versions of current research results rather than the original research articles themselves; a worthy follow-up to this study would be to track the variation in performance across altmetric indicator classes of an original research article and the current awareness ‘news-worthy’ version of the same research.

	Mass media	Scholarly activity	Scholarly commentary	Social activity
Mass media		11	31	5
Scholarly activity			14	2
Scholarly commentary				15
Social activity				

Table 3: Co-occurrence counts of articles comprising the top 0.5% of articles in each class, where n varies between classes owing to tied rankings at the 0.5% cutoff between 69 and 76.

Social media attention: An indicator of scholarly impact or simply newsworthiness?

The articles which appear in the top 0.5% cohort in each of the four classes defined in this study are typically not the same ones: just 2 articles appear in all 4 lists. This suggests that the correlation between these 4 classes of altmetric indicators may not be very high. These two articles are both original research articles, one reporting the development of a method for creating human brain-like structures (called “cerebral organoids”) in cell culture and using these to study the basis of brain development and disease (Nature article “Cerebral organoids model human brain development and microcephaly”); the other correlating online behaviour (in this case, Facebook ‘likes’) with personal information such as sexual orientation, ethnicity and political views, to create a model to predict such traits based solely on Facebook activity (PNAS article “Private traits and attributes are predictable from digital records of human behavior”).

Further analysis of the overlap between the top 0.5% cohorts in each altmetric class is shown in Table 3: by far the greatest overlaps occur between the Mass media and Scholarly commentary classes, the lowest between Social activity and Mass media or Scholarly activity, and a moderate degree of overlap for the remaining pairwise combinations. Taken together, this suggests that - at least amongst this handful of articles receiving the most online attention – articles attracting a high degree of Social activity attract relatively little attention from the Mass media or from Scholarly activity and only a moderate degree of scholarly commentary. Conversely, there is a very high co-occurrence of articles receiving Mass media attention and Scholarly commentary. Taken together, these observations suggest that Social activity in particular is an indicator of a very different kind of online attention than the other three classes.

Figure 1 shows how this correlation varies across all percentile cohorts for articles with Social activity. Note that approximately 90% of social activity is constrained to 15% of articles, which is a significantly more skewed distribution than that of citations across articles within a journal (where some 90% of citations are to 50% of the articles; (3)). This implies a scarce attention economy in the Social activity spectrum, with many articles competing for a rare resource (reader attention). The only altmetric class with a distribution of attention across articles similar to that of citations across articles is Scholarly activity (which correlates very poorly with Social activity), where approximately 90% of Scholarly activity is represented by some 30-40% of articles (data not shown). The convergence of the curves in Figure 1 around the 15% cohort implies that at this point attention in all 4 classes is equally scarce, while in the cohorts above this point the only class showing a considerable degree of co-occurrence with Social activity is Scholarly commentary (also borne out by the Table 3 for the 0.5% cohort).

Conclusions

It is clear from this exploratory work that altmetrics hold great promise as a source of data, indicators and insights about online attention, usage and impact of published research outputs. What is currently less certain is the underlying nature of what is being measured by current indicators represented within the four broad classes analysed here, and what can (and cannot) be read into them for the purposes of assigning credit or assessing research impact at the level of individual researchers, journals, institutions or countries.

What is strikingly clear from the qualitative analysis of the top 0.5% of papers for Social Activity is the lack of mentions of titles that have particularly titillating or eye-catching keywords: although most of the links are to summaries of research, rather than primary research articles themselves, they all contains serious scientific material.

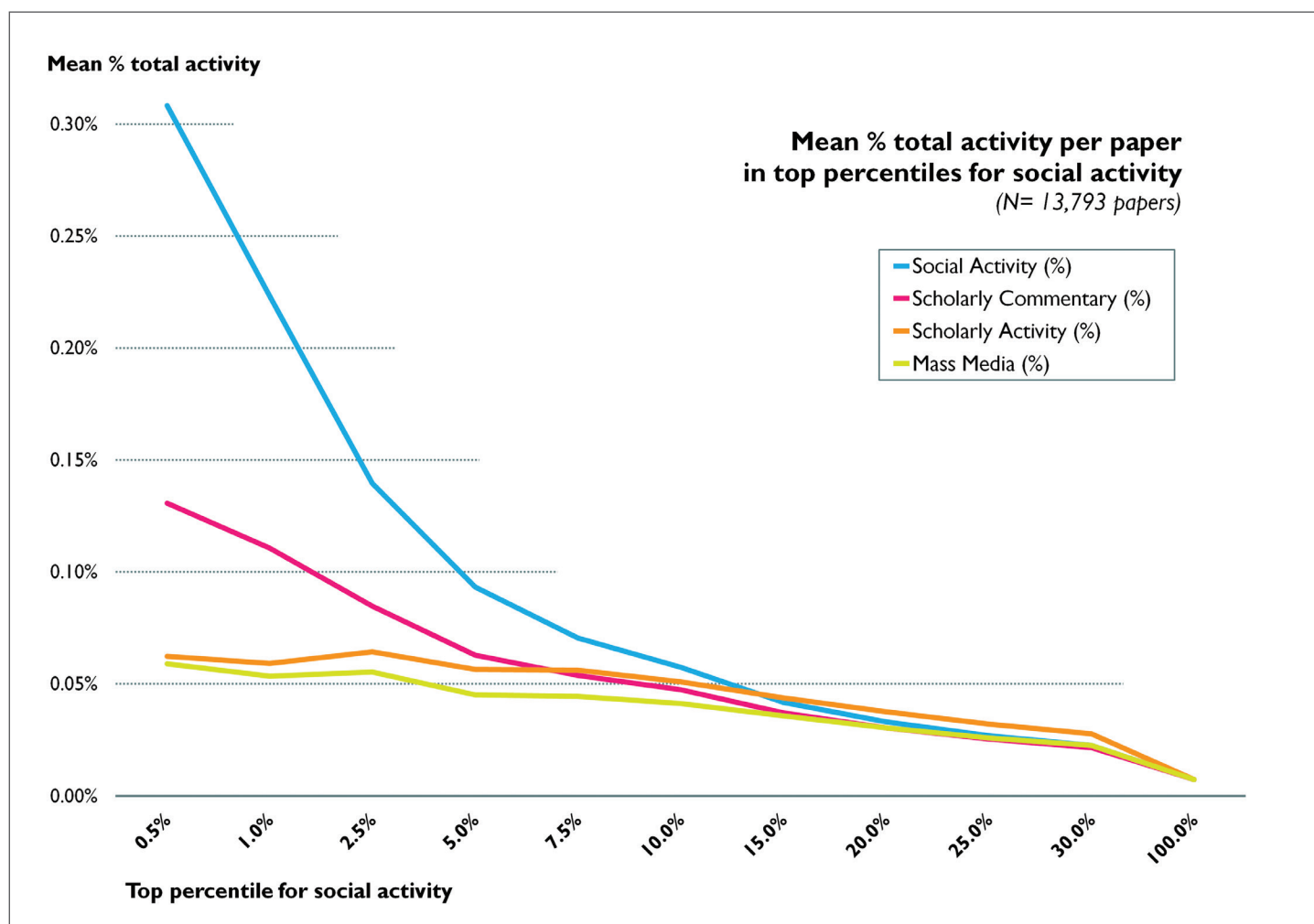


Figure 1: Proportion of total activity per article across predefined percentile ranges (cohorts) for social activity.

On the basis of this preliminary study, we urge caution in characterizing all altmetric indicators in a similar way, as it is likely that different indicators may measure different types of online attention from different types of readers. This finding is similar to that reported by Priem, Piwowar and Hemminger in 2012 (4). We also suggest that careful delineation of document types (as long used for citation-based indicators) must be applied to correctly evaluate (for example) the relative social activity attracted by a news or editorial item versus an original research article; these values are likely to be the inverse of their usual relationship in citation terms. In short, in the excitement and promise of this burgeoning new field of Informetrics, we must be sure to ask ourselves: what is it that we are measuring, and why?

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