An altmetric attention advantage for open access books in the humanities and social sciences

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Abstract
The last decade has seen two significant phenomena emerge in research communication: the rise of open access (OA) publishing, and the easy availability of evidence of online sharing in the form of altmetrics. There has been limited examination of the effect of OA on online sharing for journal articles, and little for books. This paper examines the altmetrics of a set of 32,222 books (of which 5% are OA) and a set of 220,527 chapters (of which 7% are OA) indexed by the scholarly database Dimensions in the Social Sciences and Humanities. Both OA books and chapters have significantly higher use on social networks, higher coverage in the mass media and blogs, and evidence of higher rates of social impact in policy documents. OA chapters have higher rates of coverage on Wikipedia than their non-OA equivalents, and are more likely to be shared on Mendeley. Even within the Humanities and Social Sciences, disciplinary differences in altmetric activity are evident. The effect is confirmed for chapters, although sampling issues prevent the strong conclusion that OA facilitates extra attention at the whole book level, the apparent OA altmetrics advantage suggests that the move towards OA is increasing social sharing and broader impact.

Keywords Open access · Altmetrics · Scientometrics · Monographs · Scholarly books · Social impact

Introduction
Two important recent phenomena in scientific communication have been the rise of Open Access (OA) journal publications, and—in the last decade—the widespread availability of altmetrics. OA publications are those that are available on the internet, without charge. Altmetrics report the attention paid to research publications through online platforms. Books and book chapters are under-represented in the growing corpus of research on OA and altmetrics, with almost nothing investigating the combination. This is an important limitation because arts, social science and humanities disciplines tend to favour books as their...
preferred channel for publishing research, and tend to cover topics with a public interest dimension, such as law, cultural studies, and socio-economic policies.

In general, the absence of reliable public sales figures, rich and open metadata, download figures and the relatively slow citation performance of books make a comparative study of OA versus non-OA books and chapters challenging. A growing literature examining the effect on social sharing and broader impact on OA journal articles offers some methodological insights but, given the known differences between journal articles and books, does not offer any results that may be extrapolated to books.

This research uses two new data sources (Unpaywall, Dimensions) that contain more data about books and chapters than have been readily available before, to analyse the extent to which OA and non-OA books and chapters might differ in social sharing and broader impact, as reported by the Altmetric.com service and Mendeley, a research bookmarking system.

**The growth of open access**

The OA movement began in 2001 (Suber 2012), and recognises several different classes of OA publishing. OA journal article types are usually identified by colour:

- **Gold OA**, where authors are usually charged to make content available freely on the journal’s website, with an Open Access license that permits reuse.
- **Bronze OA** applies to documents that are freely available on a publisher’s website, but without any license being made available (Piwowar et al. 2018).
- **Hybrid OA** applies to journals that are usually accessible only by paying subscribers, but also publish articles OA, if the author pays an optional OA fee.
- **Green OA** applies when an article other than the version published in a journal is saved in an OA repository, whether being the final, published article, the accepted version or the submitted version.

There has been a sustained growth in reported rates of OA article publishing in journals, from 20% in 2009 (Björk et al. 2010), to 45% in 2015 (Piwowar et al. 2018). The number of OA scholarly books has not shown similar levels of growth, with only 7165 OA books being reported by the scholarly database Dimensions for 2013,¹ from an estimated total 86,000 monographs being published that year (Grimme et al. 2019).

The nature of an OA book maybe considerably more complex than that of an OA journal. A book that is freely available for download (with a supporting license) from a publishers’ website may also be available to buy as a printed copy. Rights may differ between printed and online rights, including the secondary, inherited rights to illustrations and photography (Moore et al. 2020). An otherwise non-OA book may contain OA chapters, each of which may have a different license. Therefore, the ‘colour scheme’ approach to classifying OA books and chapters may not be directly transferable from the journal approach. Nevertheless, researchers have used this scheme—albeit with caveats—to understand some

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¹ [https://app.dimensions.ai/discover/publication?or_facet_publication_type=monograph&or_facet_publication_type=book&or_facet_year=2013&or_facet_open_access_status_free=oa_all](https://app.dimensions.ai/discover/publication?or_facet_publication_type=monograph&or_facet_publication_type=book&or_facet_year=2013&or_facet_open_access_status_free=oa_all) Retrieved, December 19, 2019.
of the issues facing book authors when they are choosing whether or not to publish an OA book (Cheshire 2014).

That current models for funding OA were not well suited for books was recognized in 2012 (Pinter and Thatcher 2012). The same concerns were still being addressed by Grimm et al. half a decade later.

The growth in OA journal publishing seems to have occurred primarily because of mandates and policies. Since 2006, there have been a succession of initiatives to implement OA mandates: most notably in Canada, the European Union, and the USA (Canadian Institutes of Health Research 2006; European Commission 2008; National Institutes of Health 2009). Plan S is a later initiative (Schilz 2018), organized by a group of governments, funders and other institutions, with the stated ambition of making all research publications funded or supported by them OA by 2021 (Coalition 2018). Policies aimed at increasing the rate of OA publishing in journals have been criticized for not taking into consideration certain issues of particular concern to the Arts, Humanities and Social Sciences (Frantsvåg and Strømme 2019). Plan S has also been criticized for failing to adequately address the issue of OA publishing for books (Science Europe 2019).

The size of the academic book market is considered to be stable although the rate of metadata deposition with Crossref is increasing (Grimme et al. 2019). Many academic publishers support OA for books and chapters; with Gold OA being achieved via the payment of a Book Processing Charge (BPC). Self-archiving in Green repositories is commonly permitted, often featuring an embargo period of between 12 and 24 months (OAPEN 2020). Taylor and Francis, Springer-Nature, OUP and several small presses are signatories to the OAPEN list of compliant publishers. Wiley supports Green self-archiving (Wiley 2020). Elsevier—in common with most book publishers—offers a Gold/Hybrid route, but unlike other major scholarly book publishers, has no published policy on Green self-archiving (Elsevier 2020b).

In addition to these moves by established publishers, a number of novel channels have been developed, including Open Humanities Press (launched in 2006), Open Book Publishers (2008), Knowledge Unlatched (2016) and TOME (2018). These feature a number of new business models, including crowdsourcing, volunteerism and direct funding.

Altmetrics and scholarly communication

Social media has become an important part of scholarly communications (Sugimoto et al. 2017b), and has been studied under the term ‘altmetrics’, which was introduced in 2010 (Priem et al. 2010) to bring together a number of discrete and disparate social web attention sources under one umbrella to “reflect the broad, rapid impact of scholarship”. Many of the areas of focus contained within altmetrics had already been studied for over the preceding decade, under the name of ‘webometrics’ (Almind and Ingwersen 1997), which, in itself had emerged from the field of bibliometrics and scientometrics. Pioneers in this emergent field had been explicitly analysing web-traffic, usage and content to understand the emerging online world in the context of research evaluation and scientometrics since the late-90s (Bar-Ilan 2000; Thelwall 2000). The initially distinctive feature of altmetrics was its focus on social web services with application programming interfaces (API), although the term now also encompasses traditional webometrics.

The field is supported by four providers of altmetrics data. Altmetric.com and Plumx were both launched in 2011, followed by Crossref Event Data in 2016 and Cobalt Metrics in 2018. Altmetrics have been collected for many parts of the web, including Wikipedia,
news and broadcast media, blogging platforms, social and scholarly networks (Thelwall et al. 2013), policies (McLeish 2016) and patents (Altmetric 2018). Altmetrics have been studied with a view to understanding future citation rates (Eysenbach 2011), non-scholarly usage (Mohammadi et al. 2015) and social impact (Bornmann 2014).

Although altmetrics might reflect public engagement with research, they might also reflect communication within academia that is merely happening within a public arena (Sugimoto and Larivière 2017). For example, about half of the tweets mentioning journal articles are from academics (Mohammadi et al. 2018), despite them forming a small minority of social web users. Policy makers and funders have increasingly required researchers to plan for broader impact (Bornmann 2013), requiring them to hone their impact management plans (Britt Holbrook and Frodeman 2011), and this may include promoting their work online.

Tracing social impact is complex, and requires more dynamic solutions than usual bibliometric approaches (Holmberg et al. 2019). Nevertheless, researchers have found evidence of social impact in social media (Pulido et al. 2018), and have discussed the importance of positioning argument correctly in policy documents to optimize social impact (Williams 2018). Fostering the use of Wikipedia as a medium to inform patients (Heilman et al. 2011) and respond to their concerns (Didegah et al. 2018) is an example.

The use of altmetrics to understand societal impact, and as a method to compare open and non-open research outputs was identified in a report by the European Commission (Wilsdon et al. 2017).

**OA altmetrics advantage**

Understanding usage of OA books via downloads is not trivial, as OA books may be shared on and downloaded from numerous sites, and no centralized model for collecting, collating and analysing download data is available (Watkinson et al. 2017). Increased downloads, citations and online mentions have been reported for OA books and chapters by Springer-Nature (Emery et al. 2017), although no large-scale and systematic investigation has previously been undertaken.

The phenomenon of a potential increased rate of citation for OA research outputs is known as an OA Citation Advantage (OACA), so the term *OA Altmetrics Advantage* (OAAA) is used here to describe the potential correlation between OA books and chapters and higher levels of altmetric activity.

Research has confirmed the existence of a persistent OACA for most types of OA article, the exception being Gold, where an early OACA disappears (Piwowar et al. 2018). An important methodological issue is that it is difficult to prove cause-and-effect. All journals are unique, so it is impossible to have a controlled experiment comparing Gold and non-Gold OA journals. For Green OA, if OA articles are more cited than non-OA articles, this could be because researchers are more likely to post their own articles online if they believe them to be important. Thus, a simple comparison of citation rates does not allow a conclusion that OA causes additional citations.

Research into an OAAA for journal articles is much more developed. The presence of an advantage for the volume of attention on both Twitter and Mendeley for a number of articles in a single hybrid journal has been reported (Adie 2014), who additionally identified an absence of an OAAA for blogs and news sources. These negative findings would have been expected, as the research used mean and median values, an approach not well-suited to the analysis of low-frequency indicators, such as news and blogs.
The presence of an OAAA for Wikipedia has been reported at a journal-level (Teplitskiy et al. 2017)—albeit as a secondary factor to the journals’ academic status. This finding was potentially weakened, as it only considered the OA status at a journal level, and many journal articles are made OA at an article level, for example through funder mandates and researcher self-archiving.

A study of Finnish papers confirmed the existence of an OAAA for certain fields and attention sources, but a disadvantage for other fields and attention sources (Holmberg et al. 2020). This research focused largely on the most populous altmetric indicators (Twitter and Mendeley), plus citations from the Web of Science. Other altmetric indicators (news, blogs, Wikipedia and Facebook) were compounded. This research used the OA journal-status, as defined by the Directory of Open Access Journals (DOAJ), meaning that OA articles in hybrid journals, and Green OA articles would have been treated as non-OA. Three social sciences were analysed at a journal-level, with both Psychology, Educational Sciences and Social and Economic Geography having an OAAA for the compounded indicator. Mendeley having a negative effective for Psychology.

The impact of the scholarly book

Understanding the impact of books has been hindered in several ways. Both book and chapter citations behave differently, both from each other and from journal articles (Chi 2016). Usage is more heterogeneous and is potentially harder to capture, and hence is less well covered by the tools used in mainstream scientometric analysis (Halevi et al. 2016). Nevertheless, there have been attempts to increase the detection and reporting of book-specific impact by Springer (Hawkins 2016), Altmetric.com (Torres-Salin et al. 2018) and PlumX (Torres-Salinas et al. 2017). Additional sources have been investigated, and the disproportionate importance of books to the Arts, Social Sciences and Humanities has been reported, with the caveat that only a relatively small proportion of scholarly books are available for analysis in the major abstract and indexing databases (Kousha and Thelwall 2015).

The metadata infrastructure for books offers a significant challenge to researchers. The almost universal ISBN system does not support the free and open distribution of metadata in a manner analogous to Crossref and Datacite (O’Leary and Hawkins 2019). The likely disproportionate prevalence of Digital Object Identifiers (DOIs) for book chapters by OA publishers influences DOI-based altmetrics and citations gathered for books, making comparisons between OA and non-OA difficult. This may have been the cause of an OACA found for book chapters in Conservation Biology (Calver and Bradley 2009).

Few studies have investigated OACA or OAAA for books, perhaps as a result of the lack of systematically available metadata. Snijder (2016) found a slight OACA and Twitter OAAA for OA books over a five-year time span for 400 monographs, of which 271 were OA and 129 non-OA. The researchers, noting that this corpus was only identifiable using ISBN, and that (at that time) ISBNs weren’t being tracked by Altmetric.com, were obliged to use a combined heuristic and manual approach to identify tweets to the books in their dataset.

In an exploratory paper (Wennström et al. 2019) studied a very limited number of OA books ($N=22$), highlighting disciplinary differences across all metrics for open monographs, the potential for altmetric data, and the need for more research into both the metrics and author attitudes towards book metrics.

Objectives
The following research questions address the identified need for systematic research into OAAA for books. The choice of altmetric to investigate is driven by prevalence (Twitter, Mendeley) and apparent relevance to books (Wikipedia, news, blogs, policy sources).

- Are OA books and chapters more likely to receive attention from news, blogs, Wikipedia, Twitter, Mendeley and policy documents than non-OA ones?
- Is there a Twitter or Mendeley OAAA for OA books and chapters?
- Is the rate of OA publishing increasing for books and chapters?
- How significant are variations in OAAA between the disciplines that make up the arts, humanities and social sciences?

Methods

The research design was to gather a large sample of books and book chapters with Altmetric.com records and to compare the altmetric data between the OA and non-OA subsets.

Data

Digital Science’s Dimensions platform (Hook et al. 2018) was used as the book source, because it has indexed over 1 M monographs and edited volumes, and over 9 M chapters, making it the largest index of its type. In contrast, Clarivate’s Book Citation Index contains 60,000 books (Clarivate 2020) and Elsevier’s Scopus contains 120,000 (Elsevier 2020a).

All monographs and edited books (collectively referred to as books), and individually indexed chapters that had been assigned a minimum of one Field of Research (FoR) category in Dimensions (Herzog et al. 2016), covering Humanities and Social Sciences were extracted as the initial sample. Some are OA, and some are non-OA.

Dimensions’ content discovery and indexing process starts with harvesting metadata from Crossref, Pubmed and Pubmed Central. In order to apply a FoR category using a machine-learning process, the full text needs to be available: in 2019, Digital Science reported that over 100 of the largest scholarly publishers had supplied full-text for indexing, permitting classification for over two-thirds of the entire dataset (Bode et al. 2019).

Records for 32,222 books and 204,538 chapters were retrieved (Taylor 2020), fitting the criteria of:

1. Published between 2013 and 2016,
2. Providing a minimum of 500 data points for each year and discipline and
3. Having been assigned a category from: Studies in Human Society (FoR code 16), Psychology (FoR code 17, ‘Psychology and Cognitive Studies’), Philosophy & Religion (FoR code 22), Law (FoR code 18, ‘Law and Legal Studies’), Language (FoR code 20, ‘Language, Communication and Culture’), Education (FoR code 13), Economics (FoR code 14), and Commerce (FoR code 15, ‘Commerce, Management, Tourism and

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2 The Fields of Research system was developed in Australia and New Zealand and provides 22 major and 157 sub-divisions to enable the classification of a broad range of research output. https://dimensions.freshdesk.com/support/solutions/articles/23000018820-what-are-fields-of-research-and-other-classification-systems-and-how-are-they-created–https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1297.0Main+Features12008.
Disciplines that contained fewer than 10 OA books were discarded (e.g., Planning and Creative Arts).

Several OA status classifications are provided by Dimensions but all (Gold, Hybrid, Green, Bronze) were treated as a common OA indicator. Dimensions uses data from Unpaywall\(^3\), the most comprehensive OA database available (Piwowar et al. 2018), to classify its books and chapters.\(^4\)

Data from Altmetric.com was incorporated from a static dataset provided by Altmetric under a research license, with data covering up to October 2019. Mendeley readership counts were accessed during October 19–20, 2019, using DOI searches with the Mendeley API.

To enable a comparison of book and chapter performance against journal articles, data from sets of journal articles—matching subject area, publishing year and OA status at article level—were retrieved from Dimensions on December 19, 2019.

**Analysis**

To make comparisons between OA and non-OA books and OA and non-OA chapters, and to enable a comparison with previously reported trends, coverage indicators were calculated for all attention sources, and average values were obtained for Mendeley and Twitter. To answer the research questions, these values were calculated across time, by each subject area, separately for books and chapters, and separately by OA status.

The proportion of books or chapters with non-zero attention was analysed because, with the exception of Mendeley and Twitter, the great majority of data points associated with books and chapters are zero. In particular, Policy documents, Wikipedia, News and Blogs were typically non-zero for fewer than 2% of chapters (Table 1) and fewer than 5% of books. Values based on geometric means were calculated for Twitter (unique accounts) and Mendeley readers since these sources were usually non-zero (see paragraph below for details). OAAAs were then estimated by dividing either the proportion or average for a particular OA subset by the global proportion or average. This generates a normalised Attention Factor (AF) that quantifies any OA advantage (above 1.00) or disadvantage (1.00).

Extreme, outlying values for citations and altmetrics can skew values based on arithmetic means (Hammarfelt 2014; Ottaviani 2016; Thelwall 2017); to minimise this phenomena, this paper focusses on the proportions of the populations that have any altmetric activity for the six attention sources, and reports only average values for the two most populous indicators (i.e., Mendeley and Twitter); using values based on a geometric mean (Thelwall and Fairclough 2015) rather than the common arithmetic mean. Accordingly, all Twitter and Mendeley values were incremented by 1, and the natural log calculated. These are then averaged, with the exponential of the total being calculated, and decreased by 1. The effect of averaging the natural log is to decrease to influence of any extreme outlying values.

Fisher Exact 2×2 tests—a test optimized for non-parametric and unequal set of populations—were used to calculate the statistical significance of coverage. This tests whether

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\(^3\) [https://unpaywall.org/](https://unpaywall.org/).

\(^4\) ‘Hybrid’ books, i.e. Gold books in otherwise non-OA book series were treated as Gold. Further information on the integration of Unpaywall data into Dimensions may be found here: [https://dimensions.freshdesk.com/support/solutions/articles/23000018863-where-does-the-definition-of-open-access-come-from-in-dimensions-what-does-it-include-](https://dimensions.freshdesk.com/support/solutions/articles/23000018863-where-does-the-definition-of-open-access-come-from-in-dimensions-what-does-it-include-).
there is a significant difference between the expected and the observed frequencies with populations with one or more categories. A statistically significant result gives evidence that the OA scores tend to differ, on average, to the non-OA scores. Two sample t-tests applied to the logged values were used to assess whether the rates for the OA and non-OA sets were statistically significantly different.

**Results**

**Growth in OA books and chapters**

Data retrieved from Dimensions (Table 2) suggests that there is no evidence of an increase in OA books in all fields between 2013 and 2015, with a rise indicated between 2015 and 2016. In contrast, the volume of OA chapters increases across the sampling period.

The eight disciplines have significant populations of books and chapters (Table 3). The two most populous are Studies in Human Society which contains 9675 books and 54,440 chapters (of which 4.6% and 6.8% respectively are OA) and Language with 7915 books, of which 4.3% are OA, and Psychology, with 39,477 chapters (of which 7.6% are OA).

The rate of OA publishing for books and chapters in the eight Humanities and Social Sciences fields covered by this paper is considerably lower in all subject areas than an equivalent set of journal articles retrieved from Dimensions (Fig. 1). In contrast, the

| Table 1 | Proportion and volume of books and chapters published in all FoR codes (Dimensions, retrieved October 22, 2019) |
|---------|--------------------------------------------------------------------------------------------------|
| Publication year | 2013 | 2014 | 2015 | 2016 |
| | OA(%) | Non-OA (%) | OA (%) | Non-OA (%) | OA (%) | Non-OA (%) | OA (%) | Non-OA (%) |
| Books | | | | | | | | |
| | 4.0 (379) | 96.0 (9107) | 4.8 (324) | 95.2 (6489) | 6.6 (349) | 93.4 (4939) | 4.5 (480) | 95.5 (10,155) |
| Chapters | 6.6 (3260) | 93.4 (46,476) | 6.9 (3333) | 93.1 (44,664) | 6.5 (4043) | 93.5 (58,361) | 8.9 (5353) | 91.1 (55,037) |

| Table 2 | Proportion and volume of books and chapters by discipline and OA status (Dimensions, retrieved October 22, 2019) |
|---------|--------------------------------------------------------------------------------------------------|
| Discipline | Books | Chapters |
| | OA(%) | Non-OA (%) | OA (%) | Non-OA (%) | OA (%) | Non-OA (%) |
| Commerce | 5.1 (83) | 94.9 (1536) | 7.3 (1773) | 92.7 (22,427) |
| Economics | 7.0 (134) | 93.0 (1775) | 10.4 (2816) | 89.6 (24,306) |
| Education | 7.8 (187) | 92.2 (2213) | 7.1 (1276) | 92.9 (16,773) |
| Language | 4.3 (337) | 95.7 (7578) | 6.1 (518) | 93.9 (25,409) |
| Law | 4.4 (97) | 96.6 (2111) | 6.6 (366) | 93.4 (14,233) |
| Philosophy and religion | 3.3 (110) | 96.7 (3175) | 5.0 (751) | 95.0 (14,168) |
| Psychology | 4.5 (143) | 95.5 (3068) | 7.6 (3004) | 92.4 (36,473) |
| Studies in human society | 4.6 (441) | 95.4 (9234) | 6.8 (3691) | 93.2 (50,749) |
The proportion of OA journal articles in these fields range from 22.8 to 41.9% in 2013 to 47.6% and 57.1% in 2016 (Philosophy and Economics, respectively). Economics and Psychology show the highest rates of OA publishing in both journals and books; Philosophy and Language show the lowest rates of OA publishing in both forms.

As classified by Unpaywall and presented on Dimensions, the proportions of OA type differ for books and chapters, when contrasted with the equivalent set of journal articles. Books and chapters have low levels of Gold publishing. ‘Green (Submitted)’ is the largest classification for both books and chapters (Fig. 2).

**Altmetrics for OA and non-OA books and chapters**

The proportion of books with any altmetric attention (a minimum of one Tweet, Blog, News, Wikipedia or Policy Citation, or one Mendeley reader) remains stable over the four years (Fig. 3), with no OAAA apparent for books. The proportion of OA chapters
with any altmetric attention is consistently higher for all years, having an absolute OAAA over non-OA chapters of 17% in 2013 and 6% in 2016.

OA books published in 2016 are more likely to get attention than non-OA books for all disciplines, with coverage falling into a similar range as that reported by journal articles published in the same disciplines and year. OA chapters get consistently more altmetric attention than their non-OA equivalents. The OAAA for a comparable set of journal articles is not consistent for all disciplines, with altmetric attention coverage higher for Economics and Psychology, but lower for Education and Studies in Human Society (Fig. 4).

Five of the eight indicators suggest an OAAA for books: News, Blog, Policy and both Twitter coverage and Twitter rate have an AF of between 2.4 and 3.2. Wikipedia coverage has no difference in coverage between OA books and non-OA books. Mendeley coverage is lower for OA books than non-OA books, although the average number of Mendeley readers is slightly higher.

All eight indicators have a positive OAAA for chapters, although coverage is generally lower for chapters than books (Table 1). The only exception is for Mendeley coverage, where the proportion of OA chapters with Altmetric Attention is higher than for OA books,
and the number of Readers higher for all books and OA chapters. Other than Mendeley, Wikipedia has the smallest AF for chapters (1.7), and News has the highest (4.1).

### Twitter

Field differences in Twitter coverage and the average number of Twitter accounts linking to the books and chapters are apparent in the data (Table 4). In general, an OAAA AF of 2 applies to chapters. Both OA books and non-OA books get substantially higher rates of Twitter attention than their chapter equivalents.

The average number of Tweets is also higher for OA books and OA chapters (Table 5). Although the rate is low—with a geometric mean of > 1.00 for all cohorts, OA books received higher rates of attention on Twitter than non-OA books. OA chapters have a
There are some disciplinary differences between books and chapters: Law and Language have the highest rates of Twitter coverage for books, but the same subjects are amongst the lowest for chapters, for both coverage and geometric mean.

Mendeley

Mendeley coverage of OA books is consistently lower than non-OA books for all disciplines, however Mendeley coverage of OA chapters is consistently higher (Table 6). Coverage for books (both OA and non-OA) shows a low rate of variation, with the highest coverage demonstrated by Education non-OA books (64.3%), and the lowest by Economics OA books (47.0%). More variation is shown by chapter coverage. The lowest rates of coverage
are shown by Law non-OA chapters (41.5%), the highest coverage is nearly twice as much: Psychology OA chapters (80.8%).

The geometric mean for Mendeley readers for books shows no difference between OA and non-OA, however, an OAAA for OA chapters is shown, with a typical AF of 2. A low level of discipline variation is shown for books, with a much higher variation for chapters. Law and Philosophy & Religion have an average below two for books and chapters of all types. Psychology shows an average Mendeley readership of 2.9 for non-OA chapters and 5.4 for OA chapters (Table 7).

Other altmetrics

The non-zero proportions for News, Blogs, Wikipedia and Policy Documents are low, at around or below 2% for all indicators. Although the coverage is at a low level, a clear OAAA Attention Factor for chapters is shown for News, Blogs and Policy Documents. Wikipedia is the exception, where a low to moderate OAAA AF is shown for both chapters and books. Books have higher rates of coverage than chapters for the majority of indicators. Since the number of publications with attention from these four attention sources are much lower than Mendeley and Twitter, the Attention Factor is much more prone to being skewed by exceptions.

News coverage (Table 8) varies greatly by discipline, with attention for all chapters and non-OA books being around 1%. In general, Psychology and Studies in Human Society have higher values than other disciplines, for both books and chapters. A moderate OAAA for books is suggested, in contrast, OA chapters have strong OAAA, with an AF ranging from 2.9 (Philosophy & Religion) to 7.3 (Commerce).

Blog coverage (Table 9) also shows disciplinary differences, although different from News coverage. Blogging coverage for chapters is low, corresponding with News coverage, being at or around 1%. Nevertheless, with the exception of Philosophy & Religion, the OAAA AF is relatively large: between 2.8 (Studies in Human Society) and 4.7 (Education).

Wikipedia coverage (Table 10) typically shows no OAAA for OA books, but does have an OAAA for OA chapters. Books in the disciplines of Language, and Philosophy & Religion have high rates of coverage on Wikipedia, for both OA books and non-OA books.

Table 7 Geometric mean Mendeley activity of books and chapters

| Discipline                | Books |         |        |         |         |         |        |         |
|---------------------------|-------|---------|--------|---------|---------|---------|--------|---------|
|                           | OA    | Non-OA  | OAAA AF| OA      | Non-OA  | OAAA AF|
| Commerce                  | 2.75  | 2.45    | 1.12   | 3.53+   | 1.65+   | 2.01    |
| Economics                 | 1.96  | 1.97    | 1.00   | 2.50+   | 1.19+   | 1.92    |
| Education                 | 2.25  | 2.38    | 0.95   | 3.67+   | 2.26+   | 1.57    |
| Language                  | 1.42  | 1.57    | 0.91   | 2.54+   | 1.05+   | 2.27    |
| Law                       | 1.89  | 1.46    | 1.28   | 1.38+   | 0.84+   | 1.58    |
| Philosophy and religion   | 1.61  | 1.56    | 1.03   | 1.90+   | 0.88+   | 2.06    |
| Psychology                | 2.77  | 2.49    | 1.11   | 5.44+   | 2.88+   | 1.80    |
| Studies in human society  | 2.09  | 1.99    | 1.05   | 2.24+   | 1.23+   | 1.74    |

+Significant at $p = 0.05$ using Student T-Test
### Table 8 Percentages of books and chapters with non-zero Altmetric.com news activity

| Discipline                      | Books OA (%) | Books Non-OA (%) | Books OAAA AF | Chapters OA (%) | Chapters Non-OA (%) | Chapters OAAA AF |
|--------------------------------|--------------|-----------------|---------------|----------------|---------------------|-----------------|
| Commerce                       | 2.4          | 1.2             | 2.0           | 1.9*           | 0.1*                | 7.3             |
| Economics                      | 3.7          | 1.4             | 2.4           | 1.3*           | 0.2*                | 4.2             |
| Education                      | 2.1          | 0.9             | 2.1           | 0.9*           | 0.2*                | 3.8             |
| Language                       | 4.8*         | 1.6*            | 2.8           | 1.1*           | 0.2*                | 4.2             |
| Law                            | 5.2*         | 1.9*            | 2.5           | 1.0*           | 0.2*                | 4.5             |
| Philosophy and religion        | 0.9          | 1.8             | 0.9           | 0.5*           | 0.2*                | 2.9             |
| Psychology                     | 3.5          | 1.4             | 2.3           | 2.3*           | 0.5*                | 3.7             |
| Studies in human society       | 7.3*         | 2.3*            | 2.9           | 1.4*           | 0.3*                | 3.5             |

*Significant at $p = 0.05$ using Fisher Exact Test

### Table 9 Percentages of books and chapters with non-zero Altmetric.com blog activity

| Discipline                      | Books Oa_all (%) | Books Non-OA (%) | Books OAAA AF | Chapters Oa_all (%) | Chapters Non-OA (%) | Chapters OAAA AF |
|--------------------------------|-----------------|-----------------|---------------|---------------------|---------------------|-----------------|
| Commerce                       | 3.9%            | 1.2             | 2.7           | 0.3*                | 0.1*                | 3.8             |
| Economics                      | 6.7%            | 4.9             | 1.4           | 0.9*                | 0.2*                | 3.9             |
| Education                      | 3.21*           | 1.3*            | 2.3           | 0.9*                | 0.1*                | 4.7             |
| Language                       | 6.23*           | 1.6*            | 3.5           | 1.1*                | 0.2*                | 4.4             |
| Law                            | 12.4            | 2.6*            | 4.1           | 0.9*                | 0.2*                | 3.8             |
| Philosophy and religion        | 2.73            | 1.8             | 1.5           | 0.1                 | 0.2                 | 0.7             |
| Psychology                     | 3.5%            | 1.9             | 1.8           | 0.5*                | 0.1*                | 4.7             |
| Studies in human society       | 9.8%*           | 3.5*            | 2.6           | 0.6*                | 0.2*                | 2.8             |

*Significant at $p = 0.05$ using Fisher Exact Test

### Table 10 Percentages of books and chapters with non-zero Altmetric.com Wikipedia activity

| Discipline                      | Books OA (%) | Books Non-OA (%) | Books OAAA AF | Chapters OA (%) | Chapters Non-OA (%) | Chapters OAAA AF |
|--------------------------------|--------------|-----------------|---------------|----------------|---------------------|-----------------|
| Commerce                       | 3.6          | 2.3             | 1.5           | 0.2            | 0.1                 | 2.6             |
| Economics                      | 1.5          | 1.5             | 1.0           | 0.3*           | 0.1*                | 2.8             |
| Education                      | 1.1          | 1.0             | 1.1           | 0.3            | 0.1                 | 2.7             |
| Language                       | 9.8          | 7.2             | 1.4           | 0.2            | 0.3                 | 1.0             |
| Law                            | 5.2          | 3.5             | 1.5           | 0.3            | 0.1                 | 2.9             |
| Philosophy and religion        | 9.1          | 6.4             | 1.4           | 0.3            | 0.3                 | 1.0             |
| Psychology                     | 1.4          | 1.9             | 0.8           | 0.6            | 0.3                 | 1.8             |
| Studies in human society       | 5.2          | 5.5             | 1.0           | 0.3*           | 0.2*                | 1.6             |

*Significant at $p = 0.05$ using Fisher Exact Test
Both have a marginal OAAA. Chapter coverage on Wikipedia is much lower, with all cohorts showing coverage of less than 1%.

Policy coverage of books shows significant disciplinary differences (Table 11). Three fields (Philosophy & Religion, Psychology, and Language) receive negligible amounts of attention. Although chapters generally receive less than 1% coverage—for both OA and non-OA—OA chapters universally receive higher rates of coverage than non-OA.

Discussion

An important limitation of this paper is that it only examines the OAAA across a range of disciplines within the Humanities and Social Sciences; another limitation is that in general, the number of OA books is low, forming a small percentage of the overall population of books and chapters sampled. Furthermore, the nature of the Dimensions database means that only books and chapters with DOIs are included. Approximately half of academic books have DOIs, and these may be disproportionately derived from large commercial publishers (Grimme et al. 2019), thus small presses are under-represented.

The proportion of OA books and chapters is much smaller than for the corresponding set of journal articles from the same field and year. In contrast with journal articles, books and chapters show no clear increasing trend. There are, however, some consistencies shown in terms of overall trend, with Philosophy and Language showing the lowest rates of OA publishing in both books and journals; and Psychology and Economics being highest for both. This suggests that the cultural preferences and practices towards OA are shared between book and journal publishing. The two highest fields have well-established archiving practises, with Psychology often being archived alongside life science and medical science materials, and with Economics having RePEc.org, a dedicated repository for economics and related sciences.

Trends in the altmetrics of books and chapters

Not all altmetric attention sources have been examined: with lower-frequency indicators (e.g. Facebook, Reddit) being discarded, as well as sources that weren’t being captured by

| Discipline                  | Books OA(%) | Books Non-OA (%) | Books OAAA | Chapters OA(%) | Chapters Non-OA (%) | Chapters OAAA |
|----------------------------|-------------|------------------|------------|----------------|---------------------|--------------|
| Commerce                   | 4.8*        | 0.8*             | 4.9        | 0.6*           | 0.1*                | 5.2          |
| Economics                  | 5.2         | 3.0              | 1.6        | 1.1*           | 0.2*                | 3.6          |
| Education                  | 2.1         | 0.7              | 2.7        | 0.5*           | 0.1*                | 4.5          |
| Language                   | 0.3         | 0.1              | 2.4        | 0.1            | 0.0                 | 1.8          |
| Law                        | 4.1*        | 1.2*             | 3.0        | 0.4*           | 0.0*                | 6.1          |
| Philosophy and religion    | 0           | 0.1              | 0          | 0.3*           | 0.0*                | 5.7          |
| Psychology                 | 0.7         | 0.2              | 3.7        | 0.1            | 0.0                 | 2.5          |
| Studies in human society   | 2.7*        | 0.6*             | 3.8        | 0.4*           | 0.1*                | 2.8          |

*Significant at $p=0.05$ using Fisher Exact Test
Altmetric throughout 2013–2016 (e.g. Patents, Sina Weibo). The figures for overall coverage in Fig. 3 may be contrasted with previous findings that reported Altmetric coverage for journal articles published between 2011 and 2013 as rising from 10.8% of publications in 2011, 23.8% in 2012 and over 25% in 2013, (Costas et al. 2014).

Care needs to be taken in the interpretation of this data:

- The number of OA books presented in this study is low, and at a discipline level, differences are not always significant.
- The books and chapters analysed in this paper—and the journal articles shown in Fig. 4 have had between 3 and 6 years to accrue attention. Journal articles analysed by Costas et al. and Taylor had had 2–4 years (Costas et al. 2014) and 1 year (Taylor 2015), respectively.
- All of the books and chapters in this study have been registered with Crossref and have a DOI, addressing previous suggestions that the presence of a DOI might explain higher rates of activity for OA publications (Calver and Bradley 2009).

The relative difference in population sizes suggests some difficulties in making like-for-like comparisons. Nevertheless, this data gives statistically significant evidence for an OAAA for books and chapters across several of altmetric indicators.

The proportion of OA books getting attention is higher on Twitter (by a factor of 2.4), News (2.5), Blogs (2.4) and Policies (3.2). OA books also get attention from more Twitter accounts (3.1). The proportion of OA chapters getting attention on Twitter compared to non-OA chapters is higher by a factor of 2.1, News (4.1), Blogs (3.1), Wikipedia (1.7) and Policies (4.0). OA chapters get attention from more Twitter accounts (2.4) and more Mendeley readers (1.9). No OAAA is found for books on Wikipedia, books and chapters on Mendeley, and average Mendeley readership for books. In general, therefore, there is a strong, but not universal, tendency that the OAAA previously observed for journal articles also applies to books and chapters. The magnitude of OAAA for both books and chapters varies across the disciplines studied, however, for both the overall proportion of altmetric attention, and by attention source.

The OAAA for Mendeley in all disciplines is either non-existent or relatively small, suggesting that academic users of books are relatively unaffected by OA status at a book level; although there is a general chapter-level OAAA. The Mendeley results are similar for Wikipedia coverage: whereas book-level citations are largely unaffected by OA status, a significant range of OAAAs found at a chapter level. The potential importance of exogenous agents that may affect Wikipedia coverage—for example, Oabot,\(^5\) that creates links to OA articles—has been discussed in recent research looking at journal articles (Holmberg et al. 2019). Nevertheless, there is no evidence to suggest that this software either leads Wikipedia editors to preferentially use OA materials, or for the citations to be preferentially discovered by altmetric suppliers. Indeed, the similarity with the trends for Mendeley—which is largely used by academics—suggests a shared lack of importance in OA status at the book level, but a marginally increased use at the chapter level.

The disciplines examined here have marked disciplinary differences, extending earlier observations of the altmetrics of journal articles. This emphasizes the importance of either normalizing for discipline, or taking care to only compare sets of documents on a

\(^5\) https://en.wikipedia.org/wiki/Wikipedia:OABOT.
like-for-like basis. This should be extended to include normalizing for publication type: chapters, books, and journal articles show different trends, and their expected performance may not be easily extrapolated.

The absent, or reduced OAAA for the two attention sources that might be considered to be closest to the academic ecosystem (Mendeley and Wikipedia) reinforces the mixed results found by earlier research for journals, and suggests that OA status may not be an important factor when academics choose publications on these platforms. However, the significant OAAA shown by the more broadly used and authored attention sources, suggest that OA status has a significant effect on this broader impact, and suggests that OA policies might be broadly successful in expanding the impact of research beyond academia.

This research does not attempt to investigate the underlying causes of the OAAA, indeed there has been little causative analysis on the underlying mechanisms of OA for journals, with a general assumption being made that ‘more access allows more people to read’ (Piwowar et al. 2018).

Craig et al. (2007) summarized three possible underlying mechanisms to explain the OACA:

- That more access allows more people to read (the OA postulate),
- That authors choose to make their best work available freely (the selection bias postulate),
- That OA articles get attention earlier (the early view postulate).
- Fourth and fifth possible postulates would be that the growth of OA:
  - Is disproportionately growing scholarship (an output inflation postulate),
  - Is increasing rates of citation or sharing behaviour (a usage inflation postulate).

Early research (Moed 2007) concluded that postulates 2 and 3 were likely to be the mechanisms by which the OACA was effected, with there being no clear evidence of a general OA effect. There should be no assumption that any postulate that is true for citation behaviour should be the same for that measured by altmetrics, or that altmetrics share a common underlying cause. Although there has been research into why people believe some outputs are shared disproportionately on social media (Holmberg and Vainio 2018) and into the use of Mendeley (Mohammadi et al. 2015) this area, in general, remains unexplored.

### Potential causes of OAAAs

The growth of OA publishing has provoked some research into the nature of the published corpus, and how it might change over time. As OA has developed over the subsequent years, the publishing environment has evolved to accommodate the new business model, with both author, institutional and reader behavioural changes.

The behaviour of OA books and chapters may shed light on the potential underlying mechanisms of OAAAs: and that this is particularly important as evidence for an OAAA may be used as evidence to increase rates of OA publishing for books and chapters.

Interpretation of these varied results supports us to explore how the different postulates could be applying for different attention sources and fields of study. The most populous indicator (Mendeley) is highly integrated into scholarly research workflows, and is largely pre-populated with metadata from both users and Scopus. The findings suggest that selection process may be driven by the relevance of the research.
In contrast, the other attention sources presented here are not integrated into the infrastructure of scholarship: publications need to be introduced into these networks by an agent in order to be shared, and it is here where either infrastructure (e.g., Twitter or Wikipedia bots), agency (e.g., researchers promoting publications to bloggers), or existing practise (e.g., widespread adoption of subject repositories such as Repec) are likely to play a role in bringing people’s attention to research.

As seen in this research, the rate of Gold OA publishing is very low but books, with ‘Submitted Green’ being the dominant route to OA, so a key driver behind the access of books would appear to be whether an author chooses to make their outputs available via repositories, and whether a publisher permits this action. It is not unreasonable to suggest that there is, therefore, a sense of agency behind the selection that supports an author to act. This may, itself, have a number of components: an author may be obliged by an institution or funder; an author may believe this book to be of a particularly high quality, and therefore more deserving of a wider audience. Finally, an author may be a student of bibliometrics, and conclude that the best way to optimize citation rates is to make a book available on repositories.

Conclusions

The reported OAAA for both books and chapters confirms both the importance of promoting OA for books and chapters, especially to reach non-academic audiences, and the utility of using altmetric data to measure this phenomenon.

Examining the possible causes of the OAAA gives new insights into the potential complexities of information behaviour and access, and how these may shift over time as the various stakeholders in the community adapt their performance.

The complexities suggest firstly, that there is no simple, ‘fixed view’ of any OA advantage, and that behaviour and performance needs to be periodically benchmarked in order to understand objective academic performance: and that this is all the more important if this citation and sharing performance are being taken into account by the stakeholders involved in moving the research ecosystem towards a world more dominated by OA research.

Secondly, the lack of research into the underlying mechanisms that produce the OACA and OAAA implies that these decisions are, effectively, ‘black boxes’, where the only observations are the inputs and the outputs. Additional research into the mechanisms and causes are required.

The observation that the OAAA apparently exists for both books and chapters, despite having largely different routes to OA when compared to journal articles, suggests that all routes are successful in attracting attention and impact, as reflected through altmetrics; and that advocates of OA books and chapters could prefer either the Gold/Bronze route or the self-archiving Green route and expect to see increased rates of social use, share and impact.

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Data availability

Author is employed by Digital Science, who own Altmetric.com and Dimensions. Data is available on Figshare, https://doi.org/10.6084/m9.figshare.11527962.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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