

Microsoft Academic: is the Phoenix getting wings?

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Abstract

In this article, we compare publication and citation coverage of the new Microsoft Academic with all other major sources for bibliometric data: Google Scholar, Scopus, and the Web of Science, using a sample of 145 academics in five broad disciplinary areas: Life Sciences, Sciences, Engineering, Social Sciences, and Humanities. When using the more conservative linked citation counts for Microsoft Academic, this data-source provides higher citation counts than both Scopus and the Web of Science for Engineering, the Social Sciences, and the Humanities, whereas citation counts for the Life Sciences and the Sciences are fairly similar across these three databases. Google Scholar still reports the highest citation counts for all disciplines.

When using the more liberal estimated citation counts for Microsoft Academic, its average citations counts are higher than both Scopus and the Web of Science for *all* disciplines. For the Life Sciences, Microsoft Academic estimated citation counts are higher even than Google Scholar counts, whereas for the Sciences they are almost identical. For Engineering, Microsoft Academic estimated citation counts are 14% lower than Google Scholar citation counts, whereas for the Social Sciences this is 23%. Only for the Humanities are they substantially (69%) lower than Google Scholar citations counts.

Overall, this first large-scale comparative study suggests that the new incarnation of Microsoft Academic presents us with an excellent alternative for citation analysis. We therefore conclude that the Microsoft Academic Phoenix is undeniably growing wings; it might be ready to fly off and start its adult life in the field of research evaluation soon.

Microsoft Academic: Is the Phoenix getting wings?

Introduction

The bibliometrics literature is awash with articles reviewing and comparing (the coverage of) the Web of Science, Scopus, and Google Scholar, often in the context of research evaluation (for the latest examples see e.g. Delgado-López-Cózar & Repiso-Caballero, 2013, Wildgaard, 2015, Harzing & Alakangas, 2016). However, so far the bibliometric research community has paid little attention to the fourth data-source in this landscape: Microsoft Academic (Search). Although a Google Scholar search with the words Google Scholar, Web of Science, or Scopus in the title results in hundreds of journal articles for each of these three databases, the same search for Microsoft Academic delivers only six published journal articles (see Harzing, 2016).

A comprehensive analysis of Microsoft Academic Search coverage was published in 2014 by Orduña-Malea, Martín-Martín, Ayllon, & Delgado Lopez-Cozar (2014). This showed that almost no new material had been added since 2012. Microsoft Academic Search was proclaimed all but dead by the bibliometric community. However, in March 2016 Microsoft officially launched a new service: Microsoft Academic. In May 2016, Harzing (2016) provided - for her own publication record - a detailed comparison of coverage of the new Microsoft Academic with Google Scholar, Scopus, and the Web of Science, and proclaimed it to be “a Phoenix arisen from the ashes”. Harzing (2016) showed that Microsoft Academic significantly outperformed the Web of Science in terms of both publication and citation coverage, and could also be considered to be at least an equal to Scopus on both counts. Only Google Scholar outperformed Microsoft Academic. However, Harzing’s study only looked at a single academic’s publication record and as such its results might be idiosyncratic. The recent review published in D-lib Magazine’s Sept/Oct issue by Herrmannova and Knoth (2016) presented a high-level comparison of the key entities in the Microsoft Academic database with other publicly available databases, but did not include Google Scholar, Scopus, or the Web of Science, nor compared individual academics’ records.

In this article, we thus compare publication and citation coverage of the new Microsoft Academic with Google Scholar, Scopus, and the Web of Science for a sample of 145 academics in five broad disciplinary areas: Life Sciences, Sciences, Engineering, Social Sciences, and Humanities. This comparison will be conducted at a fairly high level of aggregation; unlike Harzing (2016) we will not compare each academic’s individual publication record across databases. Instead, we will look at how Microsoft Academic compares with the three other data sources in terms of the average number of papers, citations, h-index and h1a (see Harzing, Alakangas & Adams, 2014) for the 145 academics in our sample. We first conduct our analysis for the sample as a whole, and subsequently explore the differential coverage across disciplines and individuals. Finally, we investigate the extent to which our findings change if we use the more liberal “estimated citation count” in Microsoft Academic rather than the more conservative “linked citation count”.

Methods

Sample

Our sample consists of 145 Associate Professors and Full Professors at the University of Melbourne, Australia. Constraining our sample to a single university allows us to control for extraneous variability and thus concentrate on the differences between the four databases. Full details of the selection procedures can be found in Harzing and Alakangas (2016). In brief, our sample included all 37 disciplines represented at the University of Melbourne, grouped into five major disciplinary fields:

- Humanities: Architecture, Building & Planning; Culture & Communication; History; Languages & Linguistics; Law (19 observations),
- Social Sciences: Accounting & Finance; Economics; Education; Management & Marketing; Psychology; Social & Political Sciences (24 observations),
- Engineering: Chemical & Biomolecular Engineering; Computing & Information Systems; Electrical & Electronic Engineering; Infrastructure Engineering; Mechanical Engineering (20

- observations),
- Sciences: Botany; Chemistry; Earth Sciences; Genetics; Land & Environment; Mathematics; Optometry; Physics; Veterinary Sciences; Zoology (39 observations),
 - Life Sciences: Anatomy and Neurosciece; Audiology; Biochemistry & Molecular Biology; Dentistry; Obstetrics & Gynaecology; Ophthalmology; Microbiology; Pathology; Pharmacology; Physiology; Population Health (43 observations)¹.

Table 1 provides the descriptive statistics for our sample. As is clearly apparent, there are large variations both across individuals and across databases.

Table 1: Descriptive statistics: number of papers and citations, h-index and hla index for 145 academics across Google Scholar, Microsoft Academic, Scopus, and Web of Science

	N	Minimum	Maximum	Mean	Std. Deviation
Papers Google Scholar	145	21	541	155	102
Papers Microsoft Academic	145	12	556	137	99
Papers Scopus	145	3	381	96	76
Papers Web of Science	145	3	413	96	82
Citations Google Scholar	145	76	20427	3982	3614
Citations Microsoft Academic	145	14	10779	2336	2328
Citations Scopus	145	2	15121	2413	2626
Citations Web of Science	145	0	14019	2168	2566
H-index Google Scholar	145	4	71	29	14
H-index Microsoft Academic	145	2	56	22	12
H-index Scopus	145	1	60	22	14
H-index Web of Science	145	0	58	20	14
hla index Google Scholar	145	.08	1.86	.59	.26
hla index Microsoft Academic	145	.07	1.38	.42	.20
hla index Scopus	145	.04	1.12	.42	.20
hla index Web of Science	145	.00	1.13	.38	.19

Data sources and procedures

All data were collected in the first week of October 2016. We used Publish or Perish (Harzing, 2007) to conduct searches for Google Scholar and Microsoft Academic. Traditionally, Publish or Perish has been used primarily in conjunction with Google Scholar, but version 5 of the software has implemented Microsoft Academic support through Microsoft's API. As PoP 5 also provides support for Google Scholar Citation Profiles, we used those for the academics in our sample that had created such a profile (just over 50%). Publish or Perish also offers extensive data import facilities, thus providing the ability to import Scopus and Web of Science data. Searches for Scopus and the Web of Science were therefore conducted in their native interfaces, exported and subsequently imported into Publish or Perish to allow for calculation of the various citation metrics. Final statistics of our 145 academics for all four databases were then exported to Excel, allowing for comparison of paper and citations counts, as well as the h-index and hla.

Search queries for individual authors were refined on an iterative basis through a detailed comparison of the results for the four databases (for details regarding Google Scholar, Scopus, and Web of Science, see Harzing & Alakangas, 2016). For Microsoft Academic, this involved some experimentation, as there did not seem to be a uniformly "best" way to define queries. For some authors, queries with the full given name worked best, for other authors searches with one or more initials provided the best results. Given that Microsoft Academic has not implemented a NOT search, which would allow the exclusion of namesakes, we had to search with a combination of author name and keywords for some authors. The relevant keywords were identified by reviewing the authors' publication records in other databases. This procedure was needed for five authors, making data collection for these authors quite time-consuming (30-60 minutes).

¹ Earlier articles on the same dataset (Harzing, Alakangas & Adams, 2014; Harzing & Alakangas, 2016) included an error in the number of observations by discipline, which were reversed for the Sciences and Life Sciences. This did not impact on any of the articles statistics or conclusions, but the error was corrected for this paper. Furthermore, we had to remove one academic in the Life Sciences from the original sample of 146 academics as his name was so common that it was impossible to achieve reliable search results.

Metrics

The following metrics were included in our comparisons:

- *Publications*: Total number of publications per academic
- *Citations*: Total number of citations per academic
- *H-index*: An academic with an index of h has published h papers each of which has been cited in other papers at least h times (Hirsch, 2005)
- *hIa*: $hI_{\text{norm}}/\text{academic age}$ (see Harzing, Alakangas & Adams, 2014), where:
 - hI_{norm} : normalize the number of citations for each paper by dividing the number of citations by the number of authors for that paper, and then calculate the h-index of the *normalized* citation counts
 - academic age: number of years elapsed since first publication

Results

First, we note that Microsoft Academic coverage has improved substantially in the 5.5 month since we first studied this new data source. Table 2 provides a longitudinal comparison of the first author's citations counts in Microsoft Academic with citation counts from the three other databases. A comparison on a publication-by-publication basis showed that citations for all publications had increased in Microsoft Academic for the 5.5. month period. The biggest increase, however, was found for several books or book chapters, as well as some publications in minor journals. In addition, the Publish or Perish software now appeared in Microsoft Academic whereas it didn't before.

Table 2: Increase of citations over time for an individual academic, comparison across Microsoft Academic, Google Scholar, Scopus and Web of Science

Date	MA citations	GS citations	Scopus citations	WoS citations
16 May 2016	3424	10409	2946	1844
MA cites as % of other sources		33%	116%	186%
1 Oct 2016	5237	11177	3271	2012
MA cites as % of other sources		47%	160%	260%
Monthly increase	9.6%	1.4%	2.0%	1.7%
1 Nov 2016	5420	11345	3330	2044
Monthly increase	3.5%	1.5%	1.8%	1.6%

Overall, with an average growth of nearly 10% per month, citations increased much more significantly in Microsoft Academic than in any of the other databases, most likely reflecting a significant increase in coverage for the former. At 1.4%-2.0%, monthly increases in citation counts for the three other databases were much more modest, and are very much in line with those reported in Harzing and Alakangas (2016) for a much larger sample.

We also reran our searches for the first author early November, just before submitting this article. The monthly increase for Microsoft Academic had declined to 3.5%, whereas the increases for the other databases remained at a similar level (1.5%-1.8%). This suggests that whilst Microsoft Academic is still expanding its coverage, it is getting closer to a steady-state citation growth. Finally, we reran both Microsoft Academic and Google Scholar searches for the full sample of 145 academics. As Scopus and Web of Science searches are considerably more time-consuming than searches for Microsoft Academic and Google Scholar, we did not rerun searches for the two former databases.² The results showed that, for the overall sample, Microsoft Academic results increased by 2.4% in the last month, compared to an increase for Google Scholar of 1.2%.

² Once queries were defined, repeating Microsoft Academic searches took less than 10 minutes for the *entire* sample of 145 academics. Due to the much longer necessary delays between requests, Google Scholar searches took several hours, but did not require continuous attention. Scopus and Web of Science searches took up to a full day and required continuous attention as searches involved quite a number of steps for each individual academic.

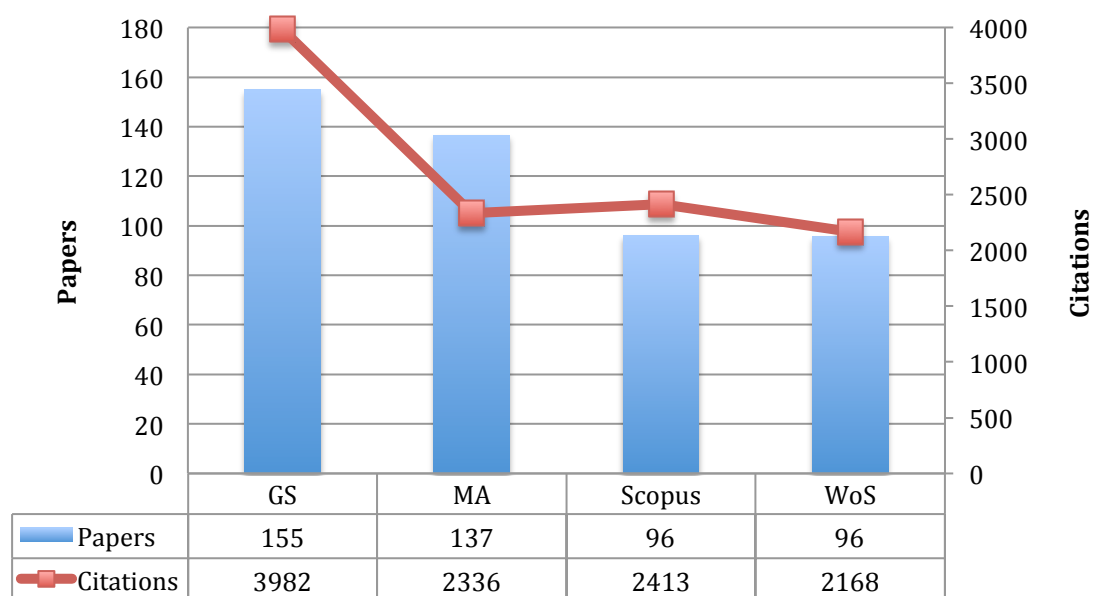
Again, this suggests that further expansion of Microsoft Academic coverage has slowed down, but that it might still be catching up with Google Scholar.

In terms of data quality, we note that the issues highlighted in Harzing (2016) – namely several erroneous year allocations, and citations that were split between a version of the publication with the main title only and a version with both the main title and a sub-title – have not yet been resolved, although the Microsoft Academic team have indicated they are working on a resolution.

Key metrics across the entire sample

Figure 1 compares the average number of papers and citations across the four databases. On average, Microsoft Academic reports more papers per academic than Scopus and Web of Science and less than Google Scholar. However, in addition to covering a wider range of research outputs (such for instance as books), both Google Scholar and Microsoft Academic also include so-called “stray” publications, i.e. publications that are duplicates of other publications, but with a slightly different title or author variant.³ Hence, a comparison of papers across databases is probably not very informative. However, citations can be more reliably compared across databases as stray publications typically have few citations. As Figure 1 shows, on average Microsoft Academic citations are very similar to Scopus and Web of Science citations and substantively lower only than Google Scholar citations. On average Microsoft Academic provides 59% of the Google Scholar citations, 97% of the Scopus citations and 108% of the Web of Science citations.

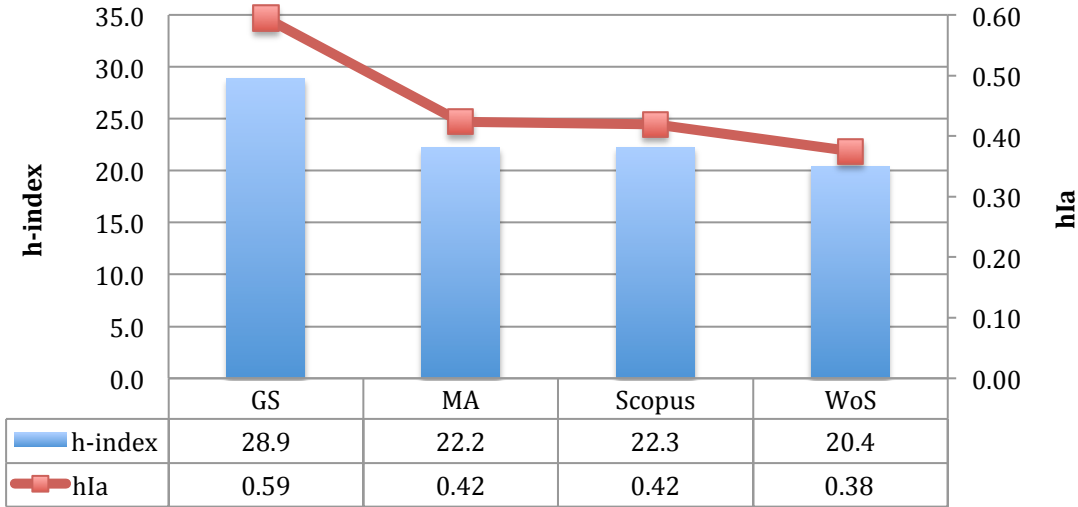
Figure 1: Average number of papers and citations for 145 academics across Google Scholar, Microsoft Academic, Scopus and Web of Science



The aforementioned differences in citation patterns are also reflected in the differences in the average h-index and h1a (individual annual h-index) for our sample (see Figure 2). On average, the Microsoft Academic h-index is 77% of the Google Scholar h-index, equal to the Scopus h-index, and 108% of the Web of Science h-index. The Microsoft Academic h1a-index is on average 71% of the Google Scholar index, equal to the Scopus index and 113% of the Web of Science index. Again Microsoft Academic, Scopus and Web of Science present very similar metrics.

³ Scopus and the Web of Science also contain stray publications, and often – especially for authors with non-journal publications – a far larger number than Google Scholar and Microsoft Academic. However, strays are not shown when using the general search options, most commonly employed for bibliometric studies. For the first author, Scopus reports no less than 442 secondary documents, in addition to the 71 documents shown in the general search. The Web of Science Cited Reference Search *would* have shown a similar number if she had not submitted weekly data change reports for years, requesting the merging of stray publications into their respective master records. For the first author’s record, both databases thus have more stray publications than either Google Scholar or Microsoft Academic.

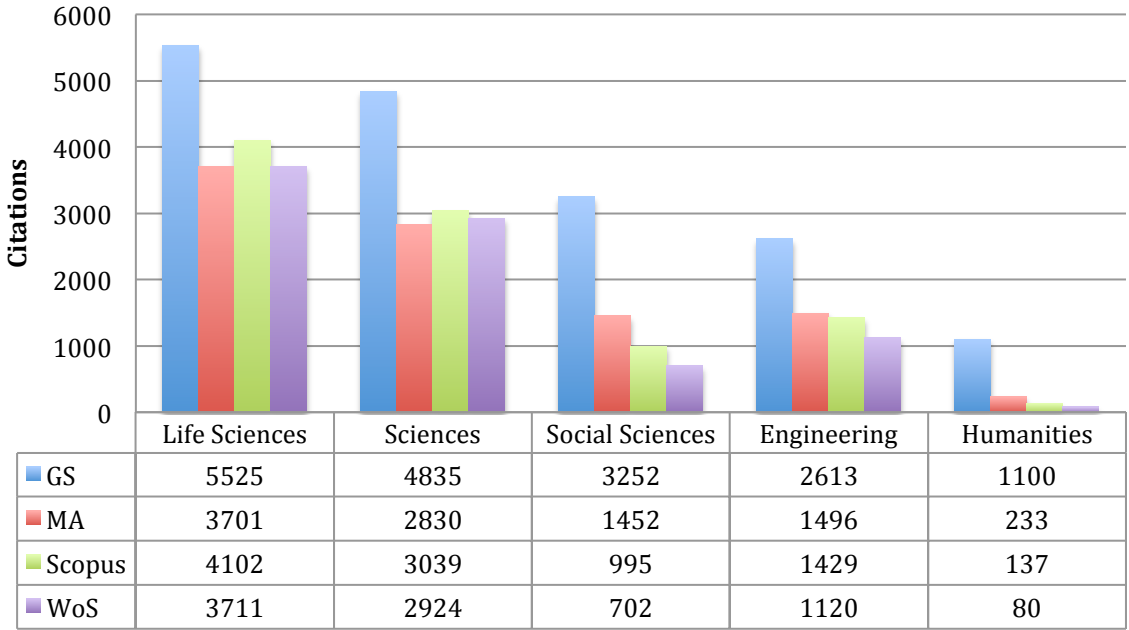
Figure 2: Average h-index and hIa for 145 academics across Google Scholar, Microsoft Academic, Scopus and Web of Science



Disciplinary comparisons

This aggregate picture hides quite a lot of differences, both between disciplines and between individuals. As to disciplines, Microsoft Academic has fewer citations than Scopus and, marginally, than Web of Science for the Life Sciences and Sciences (see Figure 3). However, overall citation levels for the Life Sciences and Sciences are fairly similar across three of the four databases. To a lesser extent this is true for Engineering as well. For three of our five disciplines, Microsoft Academic thus differs substantially in citation counts only from Google Scholar, providing between 57% and 67% of Google Scholar citations.

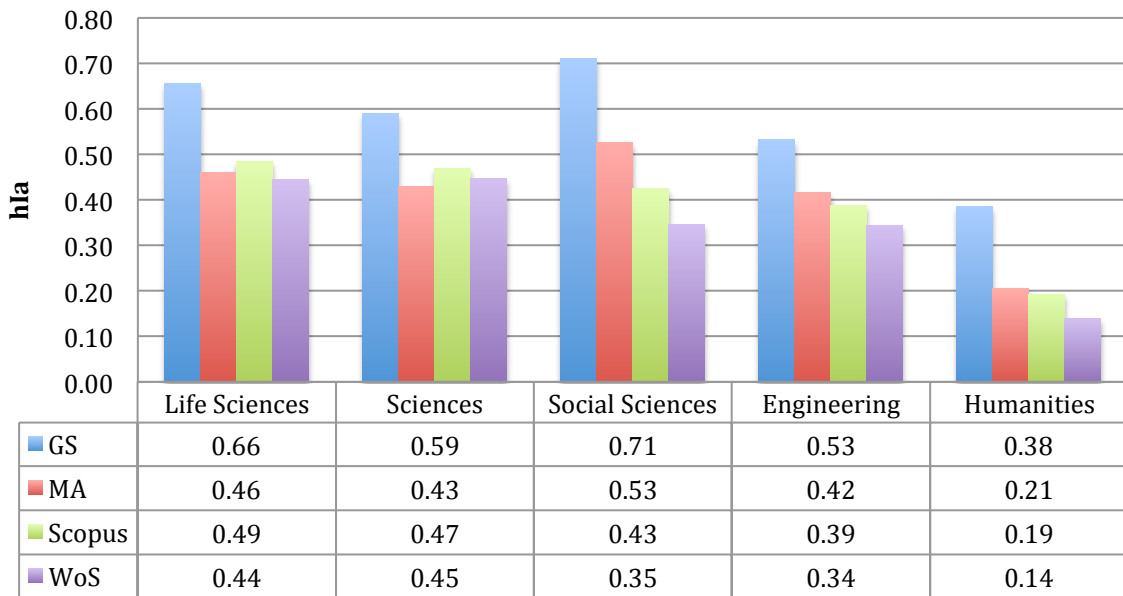
Figure 3: Average citations for 145 academics across Google Scholar, Microsoft Academic, Scopus and Web of Science, grouped by five major disciplinary areas



In the Social Sciences, however, Microsoft Academic has a clear advantage over both Scopus and Web of Science, providing 1.5 to 2 times as many citations for our sample. The difference is even starker for the Humanities, where Microsoft Academic has a coverage that is 1.7 to nearly 3 times as high. In both disciplines however, Microsoft Academic provides fewer citations than Google Scholar, less than half for the Social Sciences and only about a fifth for the Humanities.

Confirming our earlier study based on the same sample of academics (Harzing & Alakangas, 2016), the differences between disciplines are much smaller when considering the hIa, which was specifically designed to adjust for career length and disciplinary differences (see Figure 4). Apart from the Humanities, the average hIa for the four disciplines does not differ significantly for any of the four databases when using a more conservative Tukey B test.

Figure 4: Average hIa for 145 academics across Google Scholar, Microsoft Academic, Scopus and Web of Science, grouped by five major disciplinary areas



Again we see that Microsoft Academic provides metrics that are very similar to Scopus and Web of Science for the Life Sciences and the Sciences. For Engineering and the Humanities, the Microsoft Academic hIa is very similar to the Scopus hIa, whereas it is 1.2 (Engineering) to 1.5 times (Humanities) as high as the Web of Science hIa. Only for the Social Sciences is the Microsoft Academic hIa substantially higher than both the Scopus and the Web of Science hIa. The Google Scholar hIa is higher for all disciplines than the Microsoft Academic hIa, from 1.3 times as high for Engineering to 1.9 times as high for the Humanities.

Individual comparisons

The coverage of the respective databases differs substantially by individual (See Table 3). Google Scholar citations were higher than Microsoft Academic citations for all but one individual in our sample. Although on average Microsoft Academic reports a very similar level of citations to Scopus and the Web of Science, it has a higher level of citations for 55% of the academics than Scopus does, and a higher level for 72% of the academics when compared with Web of Science. Among the 8-10% of the academics who have substantially lower citation levels in Microsoft Academic than in Scopus and Web of Science are several academics whose older publications (30+ years old) cannot be found in Microsoft Academic. Others have publications with many (500-1500) co-authors that cannot be found in Microsoft Academic when searching for their name.

Table 3: Individual comparisons of Microsoft Academic citation counts with Google Scholar, Scopus and Web of Science

Data source	Number of academics (out of 145) for whom citation counts are lower or higher than Microsoft Academic citation counts				
	Lower than MA	< 5% higher	5%-10% higher	10%-25% Higher	>25% Higher
Google Scholar	1*	-	-	10	134 (92%)
Scopus	80 (55%)	13	13	25	14 (10%)
Web of Science	105 (72%)	7	8	13	12 (8%)

* This concerned a Google Scholar search problem, where - as the academic's last name was very common - we were forced to search with 2 initials, thus missing some citations. The overall citation count was 8% lower than in Microsoft Academic

MAS estimated citation counts

Microsoft Academic only includes citation records if it can validate both citing and cited papers as credible. Credibility is established through a sophisticated machine learning based system and citations that are not credible are dropped.⁴ The number of dropped citations, however, is used to estimate “true” citation counts.⁵ These estimated citation counts were added to the Microsoft Academic database in July/August 2016. In our sample, Microsoft Academic estimated citation counts (API attribute ECC) were on average 66% higher than Microsoft Academic linked citation counts (API attribute CC). This hides large differences between individuals though. Around 10% of the academics have estimated citation counts that are identical to their linked citation counts or are at most 25% higher, whereas another 20% see an increase of between 25% and 50%. The largest group of academics (60%) experiences increases of between 50% and 75%, whereas the remaining 10% see increases over 75%, some seeing their citation counts double or more than double.

Replicating our detailed study of the first author’s publication record (Harzing, 2016), we find that for all but one of the 40 journal articles included in her h-index of 49, the Microsoft Academic estimated citation count is within -24%/+20% of the Google Scholar citation count, with absolute differences ranging from -34 to +42 citations. More than half of the absolute differences are in a range of -/+ 10 citations. The overall citation count for these 40 journal articles is 8060 in Google Scholar and 8198 in Microsoft Academic, i.e. there is less than 2% difference overall between the two databases. It appears as if – at least for the first author’s own record – the two data-sources achieve convergent results. The main remaining difference between the two data-sources concerns non-journal publications. However, even in this category two publications (a research monograph and the Publish or Perish software) achieve very similar citation levels across the two databases, whereas obviously neither research output is covered in Scopus or Web of Science.

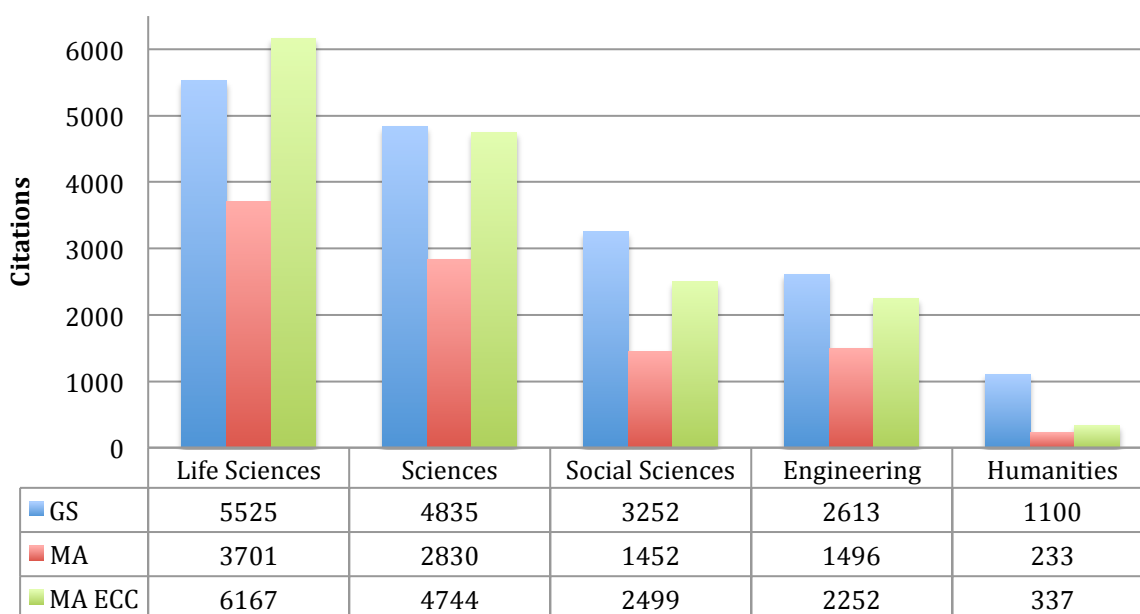
Taking Microsoft Academic estimated citation counts rather than linked citation counts as our basis for the comparison with Scopus, Web of Science, and Google Scholar does change the comparative picture quite dramatically. Looking at our overall sample of 145 academics, Microsoft Academic’s average estimated citation counts (3873) are much higher than both Scopus (2413) and Web of Science (2168) citation counts. This is also true when we compare the average citation counts by discipline. Microsoft Academic estimated citation counts are 1.5 times as high as Scopus counts for the Life Sciences, Sciences, and Engineering and 2.5 times as high for the Social Sciences and Humanities. When comparing Microsoft Academic estimated citation counts with Web of Science citation counts, we find them to be 1.6-1.7 times as high for the Sciences and Life Sciences, twice as high for Engineering, 3.5 times as high for the Social Sciences, and more than 4 times as high for the Humanities. It is clear that in terms of estimated citation counts, Microsoft Academic provides a significantly broader coverage than the two commercial databases, especially for the Social Sciences and Humanities.

⁴ Since MA sources publication records from the entire web, it often finds multiple versions of the same article, and in many cases, they don’t agree on the details. A machine learning based system corroborates multiple accounts of the same publication, and only if a confidence threshold is passed does MA deem the record credible and assigns a unique “paper entity ID” to it. A citing paper can fail the test and not get an entity ID if MA cannot verify its claimed publication venue, or authorships. The same verification is conducted on each referred article as well. A citation can fail the test for the same aforementioned reasons, or if the paper title is changed. If the test fails because of the publication date, the system can self-correct as more corroborative evidence is observed from the web crawl. [Wang, 2016]

⁵ Estimated citation counts are using a technique statisticians have developed to estimate the true size of a population if one can only observe a small portion, but can afford to sample multiple times. The math allows taking a portion of the data, counting how many “new” items are not seen before, and inferring how small a portion was sampled. MA’s “linked” citations are a statistical sample of the true citations each paper receives. MA can also find other samples from the web, including GS, other publishers’ websites, etc. MA combines all these as multiple samples and applies the size estimation formula on them. The estimation quality is better if the statistics from samples agree more with one another. As a result, the variance in the estimated counts is not uniform. For fields that have done a better job to put publications online, there are smaller differences between MA and GS results. [Wang, 2016]

However, Microsoft Academic average estimated citation counts (3873) are also very similar to Google Scholar’s average counts (3982); presenting a difference of less than 3%. Again though, this does obscure rather large differences in comparative citations counts between disciplines and individuals. With regard to disciplines, Figure 5 shows that although Microsoft Academic estimated citation counts are closer to Google Scholar citation counts for all disciplines, Microsoft Academic gets closer for some disciplines than for others. For the Life Sciences Microsoft Academic estimated citation counts are in fact 12% higher than Google Scholar counts, whereas for the Sciences they are almost identical. The availability of repositories such as PubMed reliably informs Microsoft Academic how many papers are behind pay walls that neither Microsoft nor Google have been able to crawl. For Engineering, Microsoft Academic estimated citation counts are 14% lower than Google Scholar citations, whereas for the Social Sciences this is 23%. Only for the Humanities are they substantially (69%) lower than Google Scholar citations. This is most likely caused by Google Books providing Google with an edge over Microsoft Academic for the Social Sciences and Humanities.

Figure 5: Comparison of average Microsoft Academic estimated citation counts with Google Scholar citation counts and Microsoft Academic linked citation counts, grouped by five major disciplinary areas



Looking at individual academics, Table 4 shows that Microsoft Academic estimated citation counts are higher than Web of Science citation counts for 96% of the academics and higher than Scopus citation counts for 94% of the academics. Of the six academics with lower citation counts in Microsoft Academic than in Web of Science, two had very few citations overall and thus the very small difference of respectively 6 and 24 citations between Microsoft Academic and Web of Science made up between 6 and 10% of their citation record. Two other academics, working in Molecular Biology and Astrophysics, had missing publications in Microsoft Academic, resulting in substantially lower citation counts. In the first case, this concerned the academic’s two mostly highly cited papers, co-authored respectively with 250+ and 1500+ academics. In the second case, half of the academic’s papers and three quarters of his citations concerned papers from large consortia with 500-1000 authors, none of which were found in Microsoft Academic for the author in question. Two further academics had published a very significant number of articles in the 1960s, 1970s, and 1980s that were generally highly cited in Web of Science; Microsoft Academic citations for these older publications, however, were very low. This might be due to more limited coverage in Microsoft Academic in the early years. Herrmannova and Knoth (2016) showed that Microsoft Academic coverage lies below 1 million documents a year before 1980, increasing to 3 million a year around 2000, with a further increase to around 7 million a year in recent years.

Table 4: Individual comparisons of Microsoft Academic estimated citation counts with Google Scholar, Scopus and Web of Science

Data source	Number of academics (out of 145) for whom citation counts are lower or higher than Microsoft Academic Estimated Citation Counts				
	Lower than MA	< 5% higher	5%-10% higher	10%-25% Higher	>25% Higher
Google Scholar	60 (41%)	9	6	27	43 (30%)
Scopus	136 (94%)	-	3	3	3 (2%)
Web of Science	139 (96%)	-	2	-	4 (3%)

Of the nine individuals with lower citation counts in Scopus, four had very few citation counts overall (37-168 Scopus citations), so that relatively small differences between Microsoft Academic and Scopus made up 6-19% of their citation count. One further academic in the Sciences had only 85 fewer citations in Microsoft Academic (6% lower) as some of his older publications had low citation counts, even though citation counts in Microsoft Academic for his recent publications were generally higher than in Scopus. The remaining four academics with lower estimated citation counts in Microsoft Academic were identical to the four we discussed above, suffering from missing publications and lower citation levels for publications before 1985.

Microsoft Academic estimated citation counts are higher than Google Scholar citation counts for 41% of the academics in our sample. Differences are generally not very large though, only 15% of the academics have Microsoft Academic ECCs that are more than 25% higher than Google Scholar citations. For nearly 60% of the academics in our sample, Microsoft Academic estimated citation counts are *lower* than their Google Scholar citation counts. This includes *all* of the Humanities scholars, all but *two* of the Social Scientists, and all but *three* of the Engineering academics. Closer inspection revealed, however, that the two Social Scientists in question were Neuro-psychologists. Hence, even though we classified the four Psychology academics in our sample as Social Scientists, publication patterns for two of them were in fact much closer to the Life Sciences. Likewise, two of three Engineering academics were in Molecular and Chemical Engineering and had publication patterns that were arguably closer to the Sciences. Thus it appears that, both at an overall and at an individual level, Microsoft Academic estimated citation counts are still lower than Google Scholar citation counts for the three disciplines that in previous studies have been shown to benefit most from the expanded coverage of Google Scholar (Harzing & Alakangas, 2016): Engineering, the Social Sciences, and Humanities. This is not the case for the Sciences and the Life Sciences, however. Nearly 60% of the academics in the Sciences have higher Microsoft Academic estimated citation counts than Google Scholar citation counts; for the Life Sciences the proportion was even 75%.

Discussion and Conclusion

In this article, we compared publication and citation coverage of the new Microsoft Academic with all other major sources for bibliometric data: Google Scholar, Scopus, and the Web of Science, using a sample of 145 academics in five broad disciplinary areas: Life Sciences, Sciences, Engineering, Social Sciences, and Humanities. We showed that Microsoft Academic compares well with both Scopus and the Web of Science in terms of coverage. When using the more conservative linked citation count for Microsoft Academic, this data-source provided higher citation counts than Scopus and the Web of Science for Engineering, the Social Sciences, and the Humanities, whereas citation counts for the Life Sciences and the Sciences were fairly similar across the three databases. Google Scholar still provided the highest citation counts for all disciplines. At an individual level Microsoft Academic presented higher citation counts for 55% of the academics when compared to Scopus and for 72% of the academics when compared with the Web of Science. Google Scholar, however, still provided the highest citation counts for all but one of the academics in our sample.

When using the more liberal estimated citation counts for Microsoft Academic its average citations counts were higher than both Scopus and the Web of Science for *all* disciplines. For the Life

Sciences, Microsoft Academic estimated citation counts are even higher than Google Scholar counts, whereas for the Sciences they are almost identical. For Engineering, Microsoft Academic estimated citation counts are 14% lower than Google Scholar citations, whereas for the Social Sciences this is 23%. Only for the Humanities are they substantially (69%) lower than Google Scholar citations. At an individual level, Microsoft Academic had higher citation counts for virtually all academics than Scopus and the Web of Science. However, academics in Engineering, the Social Sciences and Humanities still had higher citation counts in Google Scholar, reflecting the latter's more comprehensive coverage of books and non-traditional research outputs.

Overall, this first large-scale comparative study suggests that the new incarnation of Microsoft Academic presents us with an excellent alternative for citation analysis. This verdict would be strengthened further if coverage for books and non-traditional research outputs could be improved and the remaining data quality issues regarding year allocation and main/subtitle split could be resolved. Our limited comparison of citation growth over the last 6 months also suggests that Microsoft Academic is still increasing its coverage. We therefore conclude that the Microsoft Academic Phoenix is undeniably growing wings; it might be ready to fly off and start its adult life in the field of research evaluation soon.

References

- Delgado-López-Cózar, E., & Repiso-Caballero, R. (2013). El impacto de las revistas de comunicación: comparando Google Scholar Metrics, Web of Science y Scopus. *Comunicar: Revista Científica de Comunicación y Educación*, 21(41), 45-52.
- Harzing, A. W. (2007) *Publish or Perish*, available from <http://www.harzing.com/pop.htm>
- Harzing, A.W. (2016) Microsoft Academic (Search): A Phoenix arisen from the ashes?, *Scientometrics*, 108(3), 1637-1647.
- Harzing, A.W., & Alakangas, S. (2016) Google Scholar, Scopus and the Web of Science: A longitudinal and cross-disciplinary comparison, *Scientometrics*, 106(2), 787-804.
- Harzing, A.W., Alakangas, S. & Adams, D. (2014) hIa: An individual annual h-index to accommodate disciplinary and career length differences, *Scientometrics*, 99(3), 811-821.
- Herrmannova, D., & Knoth, P. (2016). An Analysis of the Microsoft Academic Graph. *D-Lib Magazine*, 22 (9/10).
- Hirsch, J.E. (2005) An index to quantify an individual's scientific research output, [arXiv:physics/0508025](https://arxiv.org/abs/physics/0508025) v5 29 Sep 2006.
- Orduña-Malea, E., Martín-Martín, A., M. Ayllon, J., & Delgado Lopez-Cozar, E. (2014). The silent fading of an academic search engine: the case of Microsoft Academic Search. *Online Information Review*, 38(7), 936-953.
- Wang, K. (2016) Personal communication with Kuansan Wang, Managing Director at Microsoft Research Outreach, 31 October 2016.
- Wildgaard, L. (2015). A comparison of 17 author-level bibliometric indicators for researchers in Astronomy, Environmental Science, Philosophy and Public Health in Web of Science and Google Scholar. *Scientometrics*, 104 (3), 873-906.