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Exploring the relationship between research funding and social media: disciplinary analysis of the distribution of funding acknowledgements and Twitter mention in scientific publications[1]

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Introduction

In the most recent years a wide range of studies have been conducted exploring the relationship between research outputs and financial support (Zaho, 2010; Wang & Shapira, 2011; Gok, Rigby & Shapira, 2015), as well as identifying the main research funders by countries (Ubfal & Maffioli, 2011; Helene & Ribeiro, 2011) and across fields (Abad-García, González-Teruel & Solís-Sánchez, 2016). At the same time, the potential of social media metrics for evaluating the results of funding schemes has been recently investigated (Thelwall, Kousha, Dinsmore & Dolby 2016). Also, funding organizations like The Wellcome Trust being increasingly aware of the possibilities of social media metrics for research funding assessment (Dinsmore, Allen & Dolby, 2014).

This article presents an exploratory analysis of which disciplines acknowledge more financial support (through funding acknowledgments - FA) and those whose publications attract more attention on Twitter. We argue that such a combined approach can provide interesting information for both funding bodies and policy makers about how funding activities and the attention in social media of scientific research relate to each other.

Methodology

All Science Citation Index Expanded (SCIE) publications with a DOI published in the period 2012-2016 were selected from Web of Science (WoS). Only articles and reviews written in English were considered, FAs from non-English papers are not indexed in WoS (Paul-Hus, Desrochers & Costas, 2016; Alvarez-Bornstein, Morillo & Bordons, 2017). Publications were linked with the Altmetric.com database through the DOI, identifying those publications mentioned on Twitter at least once.

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A core database was created including publications from the SCIE and whether they were mentioned on Twitter or not (1=yes; 0=no). Additionally the country of affiliation, subject category, and presence of FAs (1=yes; 0=no) were also recorded. Publications from Spain, South Africa and Brazil were selected (in addition to the whole world) as case studies in order to conduct a comparative analysis. The selection of these countries was based on the expectation that differences in their funding and tweeting patterns may exist due to their geographical, cultural and economic characteristics.

Four specific indicators were calculated for each subject category and country: the proportion of papers with FAs (% of FA), the proportion of papers with Twitter mentions (% Tw mentions), the proportion of papers acknowledging financial support from national sponsors—i.e. the same country of publication— (% National FA) and the proportion of papers with Twitter mentions from users from the same country of publication (% Nat. Tw. Mentions). The geographical location of the Twitter users is available in Altmetric.com whenever it is included in their profiles (Haustein & Costas, 2015; Haustein, 2018). The proportions of national FA and Twitter mentions from the same country of publication were calculated considering the total scientific production of each country. Papers belonging to several WoS subject categories were counted as many times as subject categories in which they were assigned (i.e. following a multiplicative approach – Herranz & Ruiz-Castillo, 2012).

Results

Table 1 shows funding rates and percentages of Twitter mentions, both for all papers published in each country and those with national financial support and Twitter mentions. Spain is the country with the highest proportion of FA (82%), followed by Brazil (76.5%) and South Africa (73.7%). On the other hand, the % of publications with Twitter mentions ranged from 29% to around 39%. Spanish papers received higher percentages of Twitter mentions than South Africa and Brazil, the latter ranking below the world average (31%).

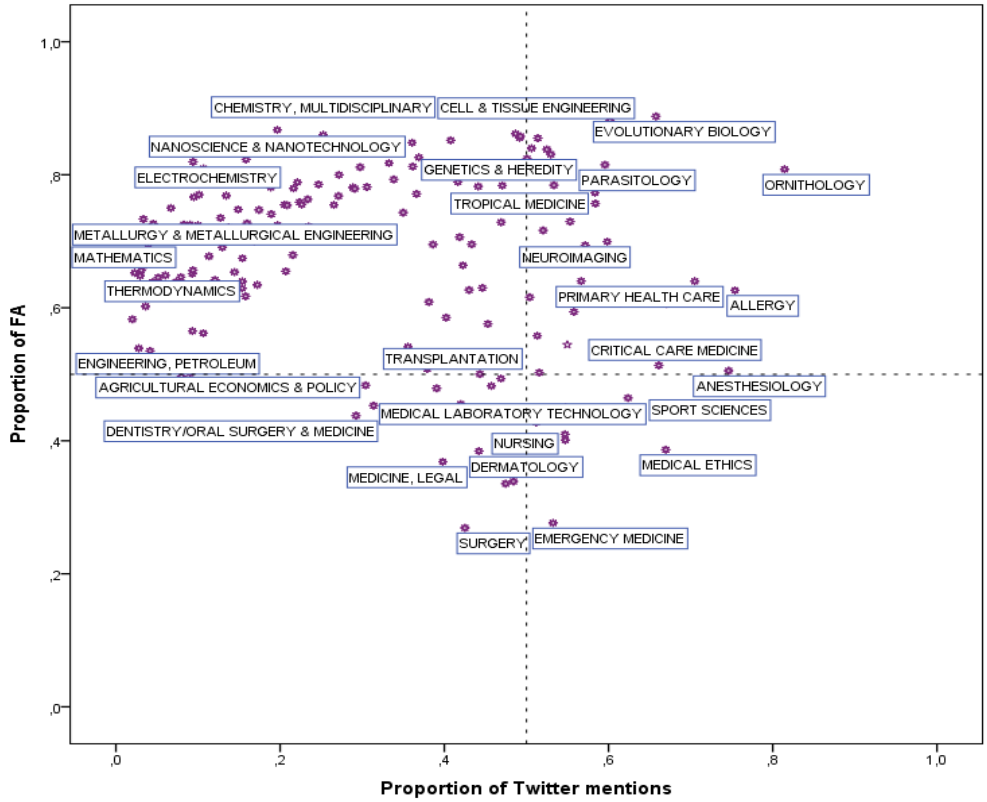
Table 1.Overview of the presence of funding acknowledgements and Twitter mentions across publications

	World	Brazil	South Africa	Spain
N. Docs	6,212,993	164,219	46,787	237,355
N. Docs with FA (% FA)	4,369,188 (70.32%)	125,690 (76.54%)	34,489 (73.71%)	194,644 (82%)
N. Docs with Tw (% Tw. mentions)	1,924,443 (30.97%)	47,933 (29.19%)	18,373 (39.27%)	88,627 (37.33%)
N. Docs nat. FA (% National FA)	--	107,561 (65.50%)	14,113 (30.16%)	143,053 (60.27%)
N. Docs with nat. Tw (% Nat. Tw. Mentions)	--	4,012 (2.44%)	3,999 (8.55%)	25,866 (10.90%)

National financial support is lower in every country, especially in South Africa, where only 30% of the papers acknowledged funding from South African organizations. On the other hand, Brazil shows the highest rate of national funding, since around 65% of Brazilian papers received financial support from their own country, followed by Spain, with 60% of papers funded by national agencies.

Concerning Twitter mentions, a low proportion of the papers were tweeted by users from the same country of publication. Spain shows the highest percentage (11% of its production), while only the 2.4% of Brazilian papers were mentioned on Twitter by users from Brazil. The proportion of FAs and Twitter mentions by subject category, considering the world production (Figure 1), and the selected countries (Figures 2 to 7) are shown as scatter plots.

Figure 1. Proportion of papers with FA and Twitter mentions by subject category (World)



Most fields are at the upper left part of the scatter plot (Figure 1), meaning that more than 50% of the papers belonging to these disciplines included FAs, but attracted less attention on Twitter (<50%), since less than half of them were mentioned in this platform. In general terms, the subject categories with higher funding rates and lower proportion of Twitter mentions are those related with *Biology*, *Chemistry* and *Physics*, with the exception of *Ornithology* with more than 80% of papers including FAs and also mentioned on Twitter. Other disciplines, such as *Allergy* and *Primary health care*, have both high proportions of Twitter mentions (>70%) and funding rates (>60%); while other such as *Emergency medicine*, *Nursing* or *Sport science* (bottom right) received Twitter attention in about more than 50% of their papers, although they acknowledged external financial support in less than half.

In general terms, *Biology*, *Chemistry* and *Physics* acknowledged funding more often (Table 2), while biomedical and clinical medicine papers, attracted more attention on Twitter. As can be seen in table 3, eight out of ten subject categories with the highest proportion of Twitter mentions are related to medicine.

Table 2. List of the 25 subject categories with higher funding rates*

	WORLD		BRAZIL		SOUTH AFRICA		SPAIN	
		%FA		%FA		%FA		%FA
1	**Evolutionary biology**	88.78	**Ornithology**	94.94	Engineering, marine	100	**Evolutionary biology**	94.78
2	**Multidisciplinary sciences**	88.12	Physics, particles & fields	94.90	Physics, particles & fields	93.02	Astronomy & astrophysics	94.70
3	Nanoscience & nanotechnology	86.74	Geology	94.58	Astronomy & astrophysics	92.87	Physics, particles & fields	94.12
4	Cell & tissue engineering	86.17	Astronomy & astrophysics	93.77	**Cell & tissue engineering**	92.31	Physics, atomic, molec. & chemical	94.04
5	Chemistry, multidisciplinary	85.99	**Evolutionary biology**	93.73	Limnology	91.80	**Multidisciplinary sciences**	93.76
6	Virology	85.78	Physics, fluids & plasmas	93.65	**Evolutionary biology**	91.20	**Chemistry, inorganic & nuclear**	93.75
7	Cell biology	85.56	Crystallography	92.88	Biochem. &molec. biology	89.77	Chemistry, organic	93.63
8	Ecology	85.50	Ecology	92.25	Chemistry, organic	89.58	Nanoscience & nanotechnology	93.51
9	Biochem. &molec. biology	85.19	Chemistry, organic	92.18	Oceanography	89.20	Chemistry, multidisciplinary	93.30
10	Astronomy & astrophysics	84.89	Chemistry, multidisciplinary	91.71	Microbiology	88.94	Paleontology	93.15
11	Oceanography	84.82	Nanoscience & nanotechnology	91.27	Horticulture	88.04	Cell & tissue engineering	92.77
12	Biodiversity conservation	83.99	Materials science, ceramics	90.71	Chemistry, inorganic & nuclear	87.75	Ecology	92.67
13	Developmental biology	83.81	Oceanography	90.59	Chemistry, medicinal	87.56	Physics, mathematical	92.50
14	Biophysics	83.78	Physics, nuclear	90.41	Paleontology	87.33	Geology	92.40
15	Materials science, biomaterials	83.70	Biochem. &molec. biology	90.05	Genetics & heredity	87.00	Crystallography	92.26
16	Chemistry, physical	83.33	Paleontology	90.02	**Ecology**	86.93	Biochemistry & molecular biology	92.17
17	Limnology	83.30	Physics, mathematical	89.82	Marine & freshwater biology	86.86	Limnology	91.32
18	Physics, atomic, molecular & chemic	83.24	Limnology	89.52	**Multidisciplinary sciences**	86.48	Chemistry, physical	91.14
19	Genetics & heredity	83.08	Behavioral sciences	89.43	Biophysics	86.41	Biophysics	90.96
20	Marine & freshwater biology	82.60	Physics, condensed matter	89.31	**Biology**	85.86	Biodiversity conservation	90.87
21	Microbiology	82.39	Mining & mineral processing	89.29	Spectroscopy	85.81	Cell biology	90.83
22	Chemistry, organic	82.31	Biodiversity conservation	89.12	Entomology	85.03	Virology	90.76
23	Electrochemistry	81.94	Physics, atomic, molecular & chemic	89.06	**Biodiversity conservation**	84.50	Physics, condensed matter	90.73
24	Plant sciences	81.75	Biophysics	88.93	Physics, nuclear	84.45	Optics	90.45
25	Parasitology	81.50	Optics	88.93	Geochemistry & geophysics	84.38	**Genetics & heredity**	90.44

*Subject categories highlighted in bold are those that are also among the 25 disciplines with higher proportions of Twitter mentions (table 3)

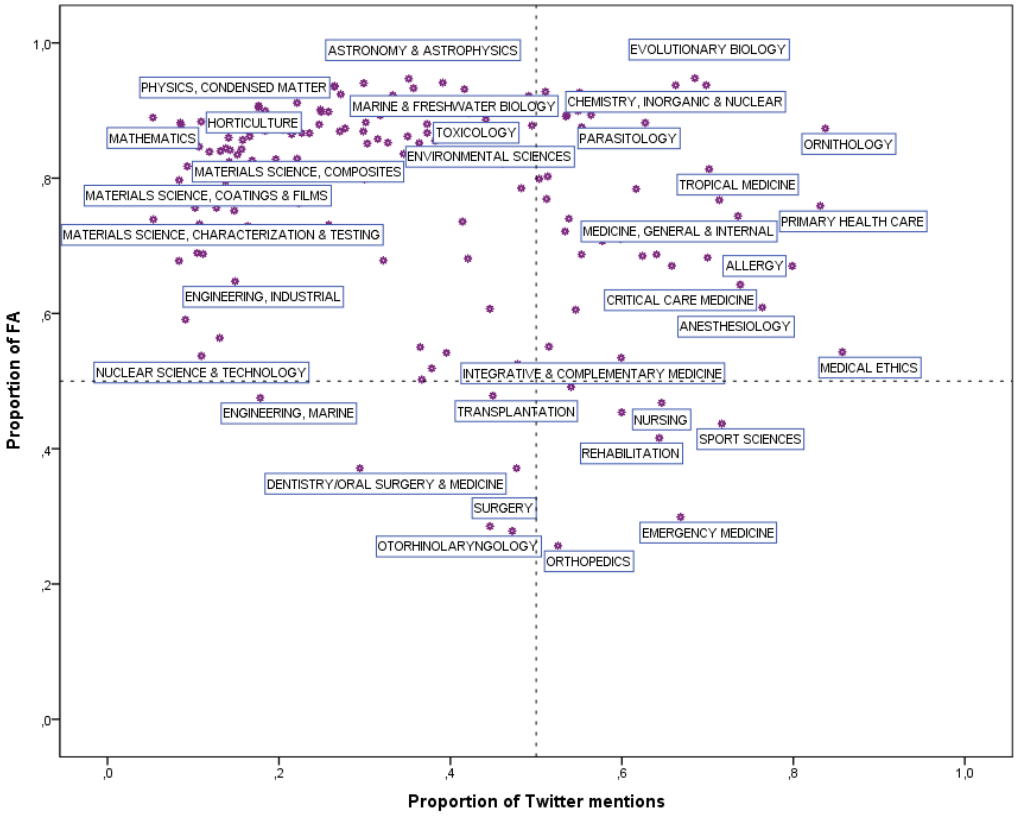
Table 3. List of the 25 subject categories with higher proportion of Twitter mentions*

	WORLD		BRAZIL		SOUTH AFRICA		SPAIN	
		%Tw		%Tw		%Tw		%Tw
1	Ornithology	81.43	**Ornithology**	81.01	Allergy	95.35	Medical ethics	85.71
2	Allergy	75.39	Allergy	79.43	**Cell & tissue engineering**	84.62	Ornithology	83.73
3	Anesthesiology	74.63	Primary health care	73.91	Anesthesiology	83.02	Primary health care	83.13
4	Primary health care	70.50	Critical care medicine	69.77	Sport sciences	80.60	Allergy	79.88
5	Health care sciences & services	67.50	Anesthesiology	68.23	Medical informatics	74.47	Anesthesiology	76.38
6	Psychiatry	67.06	Sport sciences	63.47	Health care sciences & services	72.73	Critical care medicine	73.81
7	Medical ethics	66.96	Substance abuse	61.21	Medical ethics	71.58	Medicine, general & internal	73.54
8	Critical care medicine	66.12	Health care sciences & services	60.39	**Multidisciplinary sciences**	71.26	Sport sciences	71.67
9	**Evolutionary biology**	65.78	Clinical neurology	57.41	**Evolutionary biology**	70.56	Psychiatry	71.36
10	Sport sciences	62.37	Neuroimaging	57.26	Parasitology	70.46	Tropical medicine	70.18
11	Substance abuse	61.48	Psychiatry	57.09	Ornithology	70.31	Health care sciences & services	69.99
12	**Multidisciplinary sciences**	60.18	Multidisciplinary sciences	55.52	Tropical medicine	69.71	**Multidisciplinary sciences**	69.83
13	Neuroimaging	59.84	Respiratory system	54.39	**Biology**	67.61	Neuroimaging	68.99
14	Parasitology	59.56	Infectious diseases	54.39	Substance abuse	66.67	**Evolutionary biology**	68.52
15	Tropical medicine	58.40	Virology	52.91	Infectious diseases	64.96	Emergency medicine	66.85
16	Behavioral sciences	58.34	Medical informatics	52.73	**Biodiversity conservation**	64.83	Chemistry, inorganic & nuclear	66.27
17	Geriatrics & gerontology	57.17	Rehabilitation	52.59	Public, environm. & occupant. health	64.82	Clinical neurology	65.82
18	Infectious diseases	57.15	Microbiology	50.45	**Ecology**	64.15	Respiratory system	65.77
19	Medical informatics	56.66	Medical ethics	50.00	Immunology	63.99	Nursing	64.64
20	Public, environm. & occupant. health	55.79	**Evolutionary biology**	49.46	Primary health care	63.33	Rehabilitation	64.36
21	Nutrition & dietetics	55.31	Emergency medicine	48.86	Geriatrics & gerontology	63.16	Rheumatology	64.04
22	Clinical neurology	54.97	Geriatrics & gerontology	48.68	Neuroimaging	62.79	Parasitology	62.73
23	Rehabilitation	54.76	Immunology	48.46	Clinical neurology	61.85	**Genetics & heredity**	62.43
24	Nursing	54.73	Mathematical & comput. biology	48.00	Genetics & heredity	60.86	Geriatrics & gerontology	62.40
25	Pediatrics	54.69	Parasitology	47.12	Behavioral sciences	60.85	Substance abuse	61.97

*Subject categories highlighted in bold are those that are also among the 25 disciplines with higher proportions of FAs (table 2)

Spain shows similar patterns to the world average in terms of FAs and Twitter mentions. The disciplines with higher funding rates are also those related to *Physics*, *Biology* and *Chemistry*, as well as other subject categories such as *Mathematics* and *Materials science* (Figure 2). As for the whole world, most of the subject categories are in the upper left part of the plot, so there is a majority of disciplines with high proportions of FAs but with lower proportions of Twitter mentions. In contrast to the world general pattern, Spanish papers from some biomedical and clinical medicine disciplines attracted more attention on Twitter but received less external financial support. See for example, *Medical ethics*, *Sport sciences*, *Emergency medicine* or *Nursing* (Figure 2).

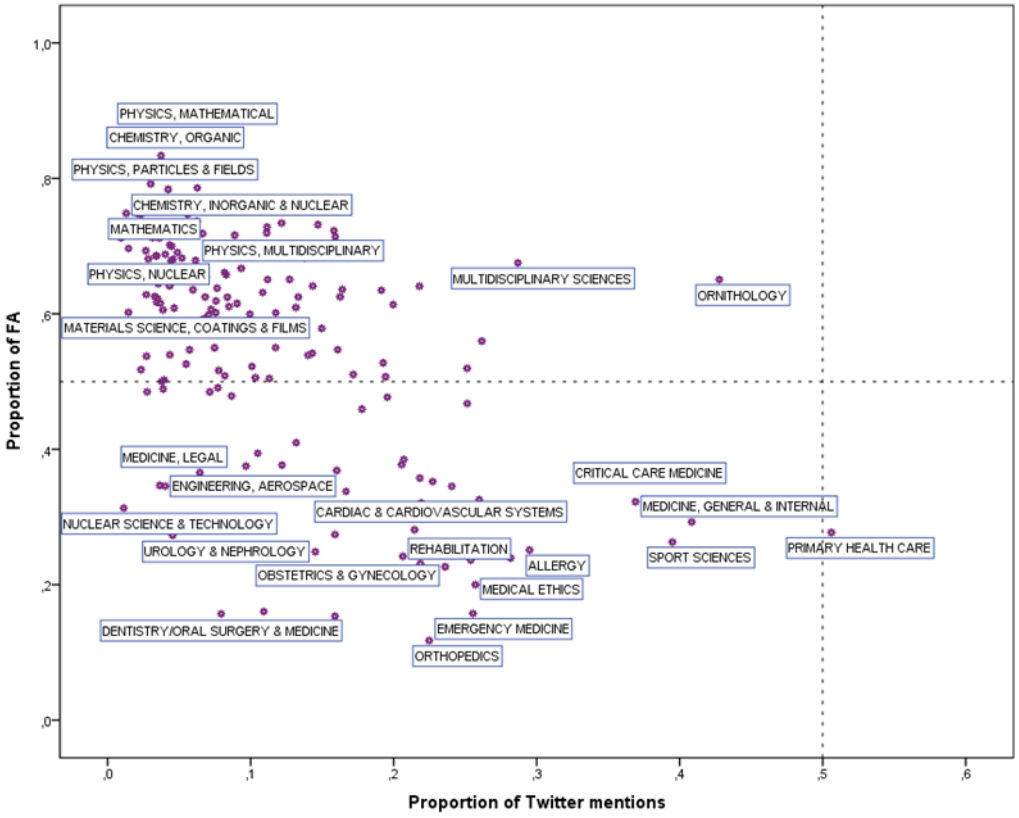
Figure 2. Proportion of Spanish papers with FA and Twitter mentions by subject category



But, which subject categories acknowledged more external financial support from Spanish agencies? And, what topics are of most interest for Spanish Twitter users? Figure 3 shows the proportion of Spanish papers with funding acknowledgment to Spanish agencies and Twitter mentions from Spanish users. As stated above, the proportion of national FA and Twitter mentions were calculated considering the total scientific production of each country.

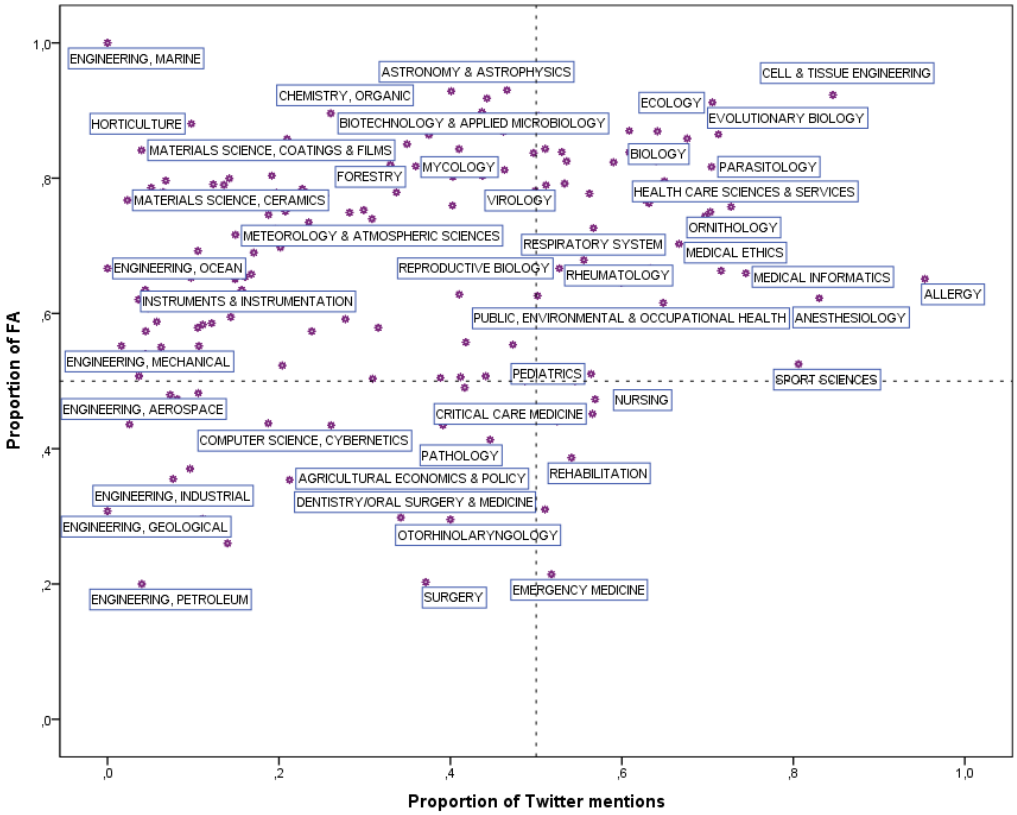
Regarding the proportion of FA, the subject categories acknowledging more financial support from Spain, were *Organic chemistry* and *Mathematical physics*, together with other disciplines related to those same fields (*Physics* and *Chemistry*). On the other hand, as previously stated (Table 1), only the 10.9% of Spanish papers were mentioned on Twitter by Spanish users and only one discipline —*Primary health care*— reached a proportion of publications with Twitter mentions from Spain above 50%. *Primary health care* and *Ornithology*, together with other related to medicine, such as *General and internal medicine* and *Sport sciences*, are the disciplines of greater interest for Spanish Twitter users.

Figure 3. Proportion of Spanish papers acknowledging national funding vs. proportion of publications receiving Twitter mentions from Spain, by subject category



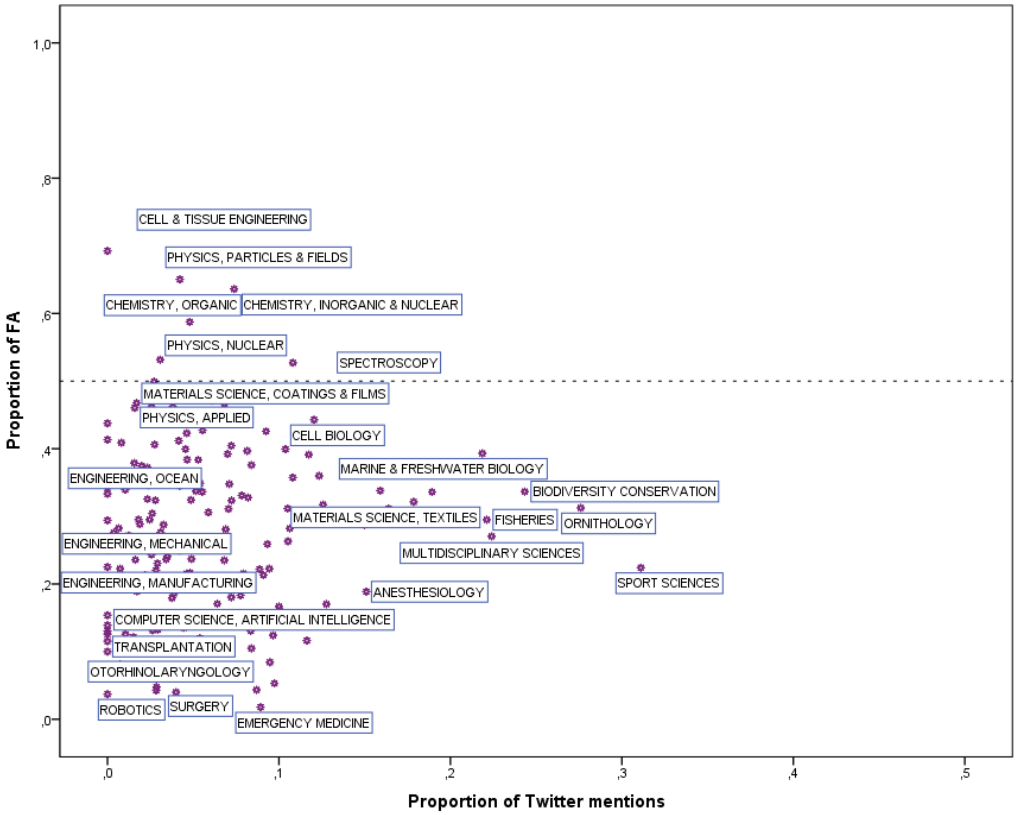
Concerning South African scientific production (Figure 4), there are more disciplines in the bottom left side of the plot, since less than 50% of the papers in a larger number of subject categories included FAs and were mentioned on Twitter. Among those with less than a half of papers with FAs and Twitter mentions, there are some disciplines related to Engineering fields, such as *Petroleum engineering*, *Geological engineering*, *Industrial engineering* and *Computer science*; and to medicine, like *Surgery*, *Pathology* and *Dentistry*. Other medical and biomedical disciplines reached higher proportions of Twitter mentions, such as *Allergy* or *Cell & tissue engineering*. Moreover, in contrast with Spain and the world production, *Ornithology* papers from South Africa attracted less attention on Twitter, although the proportion of mentions is still high (around 70%).

Figure 4. Proportion of South African papers with FA and Twitter mentions by subject category



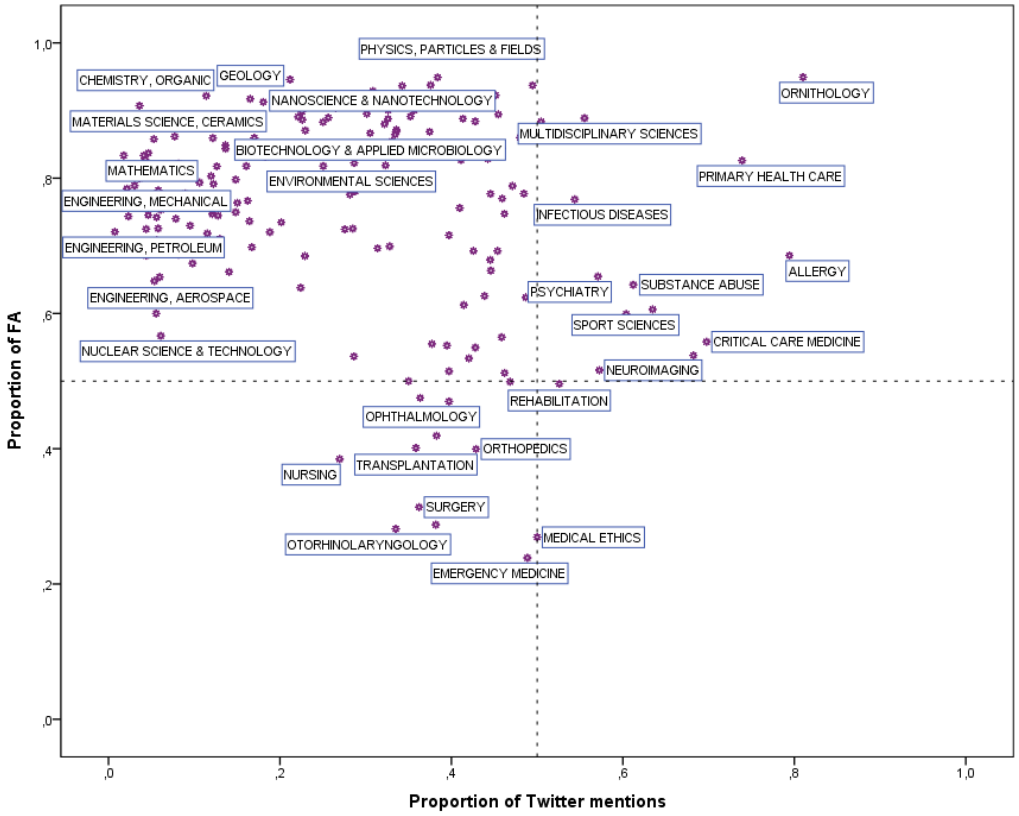
In South Africa, only a few subject categories present more than 50% of papers acknowledging funding from national institutions (Figure 5). The disciplines with higher proportions of FA from South Africa are *Cell & tissue engineering* and some *Physics* and *Chemistry* disciplines. Regarding Twitter mentions, South African users mentioned less than 35% of the papers in all subject categories, being *Sport sciences* (31%) and *Ornithology* (27%) the disciplines attracting more interest. Moreover, most of the disciplines reached proportions of Twitter mentions from South African accounts below 10%.

Figure 5. Proportion of South African papers acknowledging national funding vs. proportion of publications receiving Twitter mentions from South Africa, by subject category



Finally, in the case of Brazilian publications, in most subject categories more than half of the papers included FAs. In fact, only 13 subject categories reached proportions of FAs below 50%, and all of them are related to medical fields. However, it should be noted that there are few disciplines with more than 50% of the papers mentioned on Twitter, and that almost all of them are within medical or biomedical fields. *Allergy*, *Critical care medicine* or *Sport sciences* are among these highly mentioned disciplines. Noteworthy is the case of *Ornithology*, which is the discipline with the highest funding rate as well as the one with the highest proportion of Twitter mentions.

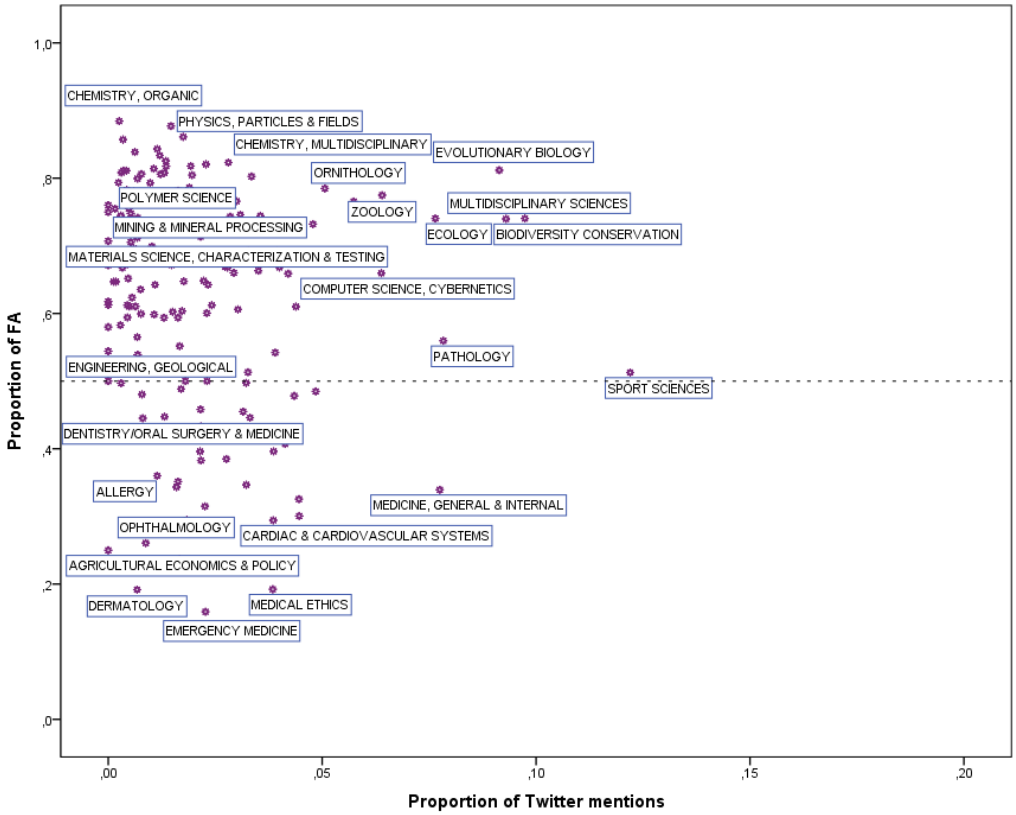
Figure 6. Proportion of Brazilian papers with FA and Twitter mentions by subject category



Taking into account only financial support and Twitter mentions from Brazilian agencies and users, results show that, comparing with South Africa and Spain, papers acknowledged most frequently funding from national funders (Figure 7), since in most subject categories more than 50% of articles included a Brazilian agency in the funding acknowledgments section. Once again, disciplines within *Physics* and *Chemistry* fields have the highest proportions of papers acknowledging sponsorship from national funding bodies.

On the other hand, Brazilian scientific production has a very small proportion of Twitter mentions from Brazilian users, since as stated in table 1, only 2.4% of papers were mentioned by Brazilian users. In fact, *Sport sciences* with a 12% of papers mentioned on Twitter by Brazilian users, is the discipline which attracted more local attention in this platform.

Figure 7. Proportion of Brazilian papers acknowledging national funding vs. proportion of publications receiving Twitter mentions from Brazil, by subject category



Discussion

This study provides an overview about which fields receive more frequently financial support and those that are more attractive for Twitter users. This type of analysis, exploratory in nature, can be seen as a potential tool for science policy makers, research managers and research funders in order to explore the relationship between funding schemes and the attention that their outputs are receiving on social media. This opens the possibility to identify research areas with a strong social media attention but a relatively lower level of funding (e.g. *Emergency medicine*), as well as research areas with strong levels of funding but whose outcomes have a lower reception on social media (e.g. *Nanoscience & Nanotechnology*), thus allowing for the possible development of strategies to increase the awareness of the funding, research and outcomes in these less visible areas.

Our results show that disciplines with higher proportions of papers acknowledging external financial support are those related to *Chemistry*, *Physics* and *Biological Sciences*. Disciplines attracting more attention on Twitter are related to medicine (e.g. *Allergy*, *Primary health care* and *Sport sciences*), and to biological fields, being *Evolutionary biology* and especially *Ornithology* as a discipline with the most tweets. On the contrary, those with lower proportions of Twitter mentions are within *Engineering*, *Mathematics*, *Chemistry* and *Physics*. These findings are in line with previous studies that found that general medicine fields have a stronger presence in Twitter (Costas, Zahedi & Wouters, 2015) and lower shares of FA (Costas & van Leeuwen, 2012; Paul-Hus, Desrochers & Costas, 2016). As stated in previous studies, the use of Twitter in the field of *Ornithology* has grown exponentially in recent years, partly due to the promotion of the use of social media by some ornithological organizations (Dudley & Smart, 2016) and to the presence of the most relevant Ornithology journals on Twitter (Finch, O'Hanlon & Dudley, 2017). Moreover, *Ornithology* comprises a

wide community including, in addition to scientists, birdwatchers or amateurs and other interested people in the field who can be engaged in research projects through citizen science techninques (Bonney et al., 2009). Involving the public in this type of projects can result in a greater number of people sharing and consuming scientific literature on Twitter.

Differences between countries also exist, especially regarding national FAs and Twitter mentions from the same country. While in total funding rates there were not big differences, proportions of national FAs were much lower in South Africa. The growth of international collaboration in South Africa in the last decades, promoted by research organizations and universities (Sooryamoorthy, 2010) might explain the lower rates of national funders. This suggests that South African scientific production profits more from international funding, in part, due to cooperation with foreign partners.

As it has been previously stated, research collaboration and, specifically, international collaboration is beneficial to gain access to financial resources (Wang & Shapira, 2015), since some funding agencies promote cooperation between foreign partners by setting as a condition for applicants the inclusion of researchers from different countries in the project proposals. Moreover, as pointed out by Sooryamoorthy & Shrum (2007), international collaboration is of special importance in developing countries due to their difficulties in accessing resources.

In addition, the lower proportion of mentions from national Twitter accounts, suggests that scientific outputs, especially from South Africa and Brazil, but also from Spain, attract more attention from foreign users. Similar results were previously found by Zahedi & Costas (2017). More research is needed in order to investigate the possible influence of the presence of international collaboration in the geographical origin of Twitter mentions, as well as other factors such as the technological development of the countries or their cultural, linguistic and political features.

The approach presented in this study has certain limitations that should be taken into account. First of all, the sample only includes articles and reviews covered by WoS and published in English so there is a bias regarding language of publications. That can affect primarily the Brazilian scientific publication output, since Brazilian researchers prefer publishing in national journals and tend to publish more in their own language (Glanzel, Leta & Thijs, 2006). Secondly, the use of the DOI as a linkage between sources in WoS and Altmetric.com is another limitation as it is not available for all documents (Gorraiz, Melero-Fuentes, Gumpenberger & Valderrama-Zurián, 2016). Finally, regarding FA data, only the most frequently acknowledged agencies and funders could be identified. Nevertheless, given the exploratory nature of this research, we believe these limitations do not invalidate the results that have been obtained and this preliminary analysis can be considered as a first step toward the incorporation of social media metrics for the analysis of the interest of broader audiences in scientific topics and how they are related to funding strategies. The type of analysis presented here could be extended by considering other social media platforms or metrics, such as mentions on news, blogs, or Facebook.

References

Abad-García, M. F., González-Teruel, A., & Sánchez, G. S. (2017, June). Spanish funded paediatric research: Contribution of Anales de Pediatría to its dissemination. *Anales de Pediatría* (Vol. 86, No. 6, pp. 306-313. https://doi.org/10.1016/j.anpedi.2016.04.006

Álvarez-Bornstein, B., Morillo, F., & Bordons, M. (2017). Funding acknowledgments in the Web of Science: completeness and accuracy of collected data. *Scientometrics*, 112(3), 1793-1812. https://doi.org/10.1007/s11192-017-2453-4

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: a developing tool for expanding science knowledge and scientific literacy. *BioScience*, *59*(11), 977-984. https://doi.org/10.1525/bio.2009.59.11.9

Costas, R., & Leeuwen, T. N. (2012). Approaching the "reward triangle": General analysis of the presence of funding acknowledgments and "peer interactive communication" in scientific publications. *Journal of the Association for Information Science and Technology*, 63(8), 1647-1661. https://doi.org/10.1002/asi.22692

Costas, R., Zahedi, Z.Wouters, P. (2015) "The thematic orientation of publicationsmentioned on social media: Large-scale disciplinary comparison of social media metrics with citations", *Aslib Journal of Information Management*, Vol. 67 Issue: 3, pp.260-288, https://doi.org/10.1108/AJIM-12-2014-0173

Dinsmore, A., Allen, L., & Dolby, K. (2014). Alternative perspectives on impact: The potential of ALMs and altmetrics to inform funders about research impact. *PLoS biology*, 12(11). https://doi.org/10.1371/journal.pbio.1002003

Dudley, S., & Smart, J. (2016). How social are ornithologists?. *Ibis*, 158(4), 894-898. https://doi.org/10.1111/ibi.12403

Finch, T., O'Hanlon, N., & Dudley, S. P. (2017). Tweeting birds: online mentions predict future citations in ornithology. *Royal Society open science*, 4(11), 171371. http://dx.doi.org/10.1098/rsos.171371

Glänzel, W., Leta, J., & Thijs, B. (2006). Science in Brazil. Part 1: A macro-level comparative study. *Scientometrics*, 67(1), 67-86. https://doi.org/10.1007/s11192-006-0055-7

Gök, A., Rigby, J., & Shapira, P. (2016). The impact of research funding on scientific outputs: Evidence from six smaller European countries. *Journal of the Association for Information Science and Technology*, 67(3), 715-730. https://doi.org/10.1002/asi.23406

Gorraiz, J., Melero-Fuentes, D., Gumpenberger, C., & Valderrama-Zurián, J. C. (2016). Availability of digital object identifiers (DOIs) in Web of Science and Scopus. *Journal of Informetrics*, 10(1), 98-109. https://doi.org/10.1016/j.joi.2015.11.008

Haustein, S. (2018). Scholarly Twitter metrics. In: Glaenzel W, et al. (eds) *Handbook of Quantitative Science and Technology Research*. Berlin: Springer. arXiv:1806.02201

Haustein, S. & Costas, R. (2015). Determining Twitter Audiences: Geolocation and Number of Followers. In The 2015 Altmetrics Workshop Amsterdam, 9 October 2015. Retreived from: http://altmetrics.org/altmetrics15/haustein/.

Helene, A. F., & Ribeiro, P. L. (2011). Brazilian scientific production, financial support, established investigators and doctoral graduates. *Scientometrics*, 89(2), 677. https://doi.org/10.1007/s11192-011-0470-2

Herranz, N., & Ruiz-Castillo, J. (2012). Sub-field normalization in the multiplicative case: High-and low-impact citation indicators. Research Evaluation, 21(2), 113-125. https://doi.org/10.1093/reseval/rvs006

Paul-Hus, A., Desrochers, N., & Costas, R. (2016). Characterization, description, and considerations for the use of funding acknowledgement data in Web of Science. *Scientometrics*, 108(1), 167-182. https://doi.org/10.1007/s11192-016-1953-y

Sooryamoorthy, R. (2010). Science and scientific collaboration in South Africa: Apartheid and after. *Scientometrics*, 84(2), 373-390. https://doi.org/10.1007/s11192-009-0106-y

Sooryamoorthy, R., Shrum, W. (2007). Does the internet promote collaboration and productivity? Evidence from the scientific community in South Africa. *Journal of Computer-Mediated Communication*, 12(2), 733-751. https://doi.org/10.1111/j.1083-6101.2007.00347.x

Thelwall, M., Kousha, K., Dinsmore, A., & Dolby, K. (2016). Alternative metric indicators for funding scheme evaluations. *Aslib Journal of Information Management*, 68(1), 2-18. https://doi.org/10.1108/AJIM-09-2015-0146

Ubfal, D., & Maffioli, A. (2011). The impact of funding on research collaboration: Evidence from a developing country. *Research Policy*, 40(9), 1269-1279. https://doi.org/10.1016/j.respol.2011.05.023

Wang J, Shapira P (2015) Is There a Relationship between Research Sponsorship and Publication Impact? An Analysis of Funding Acknowledgments in Nanotechnology Papers. *PLoS ONE* 10(2): e0117727. https://doi.org/10.1371/journal.pone.0117727

Wang, J., & Shapira, P. (2011). Funding acknowledgement analysis: an enhanced tool to investigate research sponsorship impacts: the case of nanotechnology. *Scientometric*s, 87(3), 563-586. https://doi.org/10.1007/s11192-011-0362-5

Zahedi, Z.; Costas, R. (2017). How visible are the research of different countries on WoS and Twitter? An analysis of global vs. local reach of WoS publications on Twitter. Figshare. Paper https://doi.org/10.6084/m9.figshare.5481283.v1