

# Document Type Profiles in *Nature*, *Science*, and *PNAS*: Journal and Country Level

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## Abstract

**Purpose:** In this contribution, we want to detect the document type profiles of the three prestigious journals *Nature*, *Science*, and *Proceedings of the National Academy of Sciences of the United States (PNAS)* with regard to two levels: journal and country.

**Design/methodology/approach:** Using relative values based on fractional counting, we investigate the distribution of publications across document types at both the journal and country level, and we use (cosine) document type profile similarity values to compare pairs of publication years within countries.

**Findings:** *Nature* and *Science* mainly publish *Editorial Material*, *Article*, *News Item* and *Letter*, whereas the publications of *PNAS* are heavily concentrated on *Article*. The shares of *Article* for *Nature* and *Science* are decreasing slightly from 1999 to 2014, while the corresponding shares of *Editorial Material* are increasing. Most studied countries focus on *Article* and *Letter* in *Nature*, but on *Letter* in *Science* and *PNAS*. The document type profiles of some of the studied countries change to a relatively large extent over publication years.

**Research limitations:** The main limitation of this research concerns the Web of Science classification of publications into document types. Since the analysis of the paper is based on document types of Web of Science, the classification in question is not free from errors, and the accuracy of the analysis might be affected.

**Practical implications:** Results show that *Nature* and *Science* are quite diversified with regard to document types. In bibliometric assessments, where publications in *Nature* and *Science* play a role, other document types than *Article* and *Review* might therefore be taken into account.

**Originality/value:** Results highlight the importance of other document types than *Article* and *Review* in *Nature* and *Science*. Large differences are also found when comparing the country document type profiles of the three journals with the corresponding profiles in all Web of Science journals.



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**Keywords** Country; Document type profile; *Nature*; *Science*; *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*

## 1 Introduction

In bibliometric assessments, *Article* and *Review* are document types of scientific communication that are usually taken into account, while other types, like *Editorial Material*, are often excluded. Earlier studies have dealt with the issue of which document types should be included in the assessments. Some of these studies treat a certain document type and argue that the type should be included in the assessments, e.g. *Book Review* (Zuccala & van Leeuwen, 2011), *Editorial Material* (van Leeuwen et al., 2013), and *Proceedings Paper* (Michels & Fu, 2014). Research that concerns document type classification problems in Web of Science (WoS) has been done, where the corresponding studies treat document types such as *Research Letter* (van Leeuwen et al., 2007) and *Proceedings Paper* (Michels & Fu, 2014), and the validity of the used classification (Harzing, 2010; 2013; van Leeuwen et al., 2007). Lewison (2009) investigated the usage of document type as an indicator in research output assessment, whereas Zhang, Rousseau, & Glänzel (2011) studied country profiles in relation to document types. Citation impact of document types has been studied (Braun, Glänzel, & Schubert, 1989b; Campanario et al., 2011; Frandsen, 2008; Garfield, 1987; van Leeuwen et al., 1999; Rousseau, 2009; Sigogneau, 2000), as well as document types used in social media (Haustein, Costas, & Larivière, 2015).

Research on document types has mainly focused on all journals covered by WoS. In this study, we restrict our attention to the three journals *Nature*, *Science*, and *Proceedings of the National Academy of Sciences of the United States (PNAS)*. In view of the prestige these three journals have within the scientific community, and the important role they play in various research assessments, we believe it is of importance to study them separately. Earlier research on *Nature*, *Science*, and *PNAS* has compared their internationality (e.g. Kaneiwa et al., 1988), their publication patterns and citation impact (e.g. Braun, Glänzel, & Schubert, 1989a; Wang et al., 2008), and their dynamic usage history (e.g. Wang et al., 2014). However, in this study, we examine the document types of the three journals using two levels of analysis: journal and country.

## 2 Data and Methods

A total of 35,816 publications, appearing in the three journals, were retrieved from WoS on November 15, 2015. *News Item* is one of the main document types of *Nature* and *Science*, but it was not formally indexed in WoS until 1996. In view of this, we do not use publications published before 1996 in order to avoid comparisons, between years, which might be affected by the absence/presence of



*News Item* publications in the journals. We use a 5-year time gap, year 1999 as the start year and year 2014 as the end year.

The number of publications of each journal for the four years is shown in Table 1. At the journal level of the study, we used all publications appearing in the three journals. There exist, however, publications without addresses in our dataset. Therefore, at the country level of the study, we only used all publications with addresses appearing in the three journals. At this level, we made use of address fractionalization. Clearly, due to co-authorship, a publication might involve more than one country among its addresses. If, for instance, a publication has two USA addresses and one France address, USA contributes 2/3 and France 1/3 to the publication.

Table 1. Number of publications of the journals.

Journal \ Year	1999		2004		2009		2014	
	All	With add.	All	With add.	All	With add.	All	With add.
<i>Nature</i>	3,000	2,014	2,603	1,766	2,544	1,666	2,561	1,708
<i>Science</i>	2,726	1,729	2,682	1,711	2,516	1,724	2,602	1,631
<i>PNAS</i>	2,827	2,759	3,336	3,208	4,220	4,078	4,199	3,998

Table 2 reports the 10 most productive countries, regarding fractional publication output, in the three journals in the publication year 2014. The countries are ordered descending according to the total number of publication fractions in the three journals. In addition to the top 10 countries, we included the other (relative to People's Republic of China) four BRICS countries as cases for comparison, i.e. Brazil, Russia, India, and South Africa.

Table 2. Number of publication fractions of the 10 most productive countries and four BRICS countries in year 2014.

Countries	Number of publication fractions			Rank		
	<i>Nature</i>	<i>Science</i>	<i>PNAS</i>	<i>Nature</i>	<i>Science</i>	<i>PNAS</i>
USA	807.4	872.1	2,261.8	1	1	1
UK	208.8	159.8	259.1	2	2	2
Germany	93.2	87.2	195.5	3	3	3
P. R. China	61.1	46.9	169.9	6	6	4
France	65.5	49.8	129.3	5	4	6
Canada	49.7	48.3	116.7	7	5	7
Japan	31.4	42.6	139.4	10	7	5
Australia	68.8	41.0	73.8	4	8	8
Switzerland	48.6	38.3	64.2	8	9	10
Netherlands	34.7	36.1	69.9	9	10	9
Brazil	8.8	9.4	13.1	19	18	24
India	6.0	6.3	12.2	25	21	25
Russia	7.3	3.4	7.2	21	28	30
South Africa	4.3	5.5	5.2	30	23	32



## Research Paper

In the bibliographic records of WoS, the document type of each publication is recorded. Based on this information, we calculated, for a given journal, a given document type and a given year the number of publications for the combination. In order to map the document type profile for each of the three journals across time, the raw numbers were used to obtain the relative contribution of publications to each document type, and for each considered year, with respect to all publications published in the journal.

For journal  $i$ , document type  $j$ , and publication year  $y$ , we define  $P_{ijy}$  as the number of publications of journal  $i$  of document type  $j$  in year  $y$ , and  $R_{ijy}$  as the percentage of publications of document type  $j$  of journal  $i$  in year  $y$  relative to the total number of publications of journal  $i$  in year  $y$ . Formally:

$$R_{ijy} = P_{ijy}/P_{iy} \times 100, \quad (1)$$

where  $P_{iy}$  is the total number of publications of journal  $i$  in year  $y$ .

Then, for journal  $i$  in year  $y$ , the (relative) document type distribution is represented by the vector  $D_{iy}$ , defined as in Equation (2):

$$D_{iy} = (R_{i1y}, R_{i2y}, \dots, R_{iny}), \quad (2)$$

where  $n$  is the number of document types of journal  $i$  in year  $y$ .

For a country  $c$ , we define  $P_{ijyc}$  as the number of  $c$  publication fractions in journal  $i$  of document type  $j$  in year  $y$ , and  $R_{ijyc}$  as the percentage of  $c$  publication fractions in journal  $i$  of document type  $j$  in year  $y$  relative to  $P'_{ijy}$ , the number of publications, with at least one address, in journal  $i$  of document type  $j$  in year  $y$ . Formally:

$$R_{ijyc} = P_{ijyc}/P'_{ijy} \times 100. \quad (3)$$

Since fractionalization is used, the sum of the percentages across all countries in journal  $i$ , with regard to document type  $j$  and in year  $y$ , is equal to 100. For country  $c$  in journal  $i$  in year  $y$ , the (relative) document type distribution is represented by the vector  $D_{iyc}$ , defined as Equation (4):

$$D_{iyc} = (R_{i1yc}, R_{i2yc}, \dots, R_{inyc}), \quad (4)$$

where  $n$  is the number of document types of journal  $i$  in year  $y$ .

By application of the cosine measure, we obtained similarities, for each journal, for pairs of years within a country. The similarity between years  $y$  and  $y+5$  for country  $c$  in journal  $i$  is defined as Equation (5):

$$S_{iy(y+5)c} = \frac{\sum_{j=1}^n R_{ijyc} \times R_{ij(y+5)c}}{\sqrt{\sum_{j=1}^n (R_{ijyc})^2} \times \sqrt{\sum_{j=1}^n (R_{ij(y+5)c})^2}}. \quad (5)$$



### 3 Results

#### 3.1 Document Type Profiles at the Journal Level

Figures 1–3 show the document type profiles of *Nature*, *Science*, and *PNAS*, respectively, for the years 1999, 2004, 2009, and 2014 (the percentages in boxes apply to year 2014; the underlying data is shown in Tables A1, A2, and A3 in Appendix). Notice that the bars across the document types, for a given journal and a given year, correspond to a vector of the type defined in Equation (2). From Figures 1 and 2, it is clear that *Nature* and *Science* have quite diversified document type profiles, where the types are foremost *Article*, *Editorial Material*, *News Item*, and *Letter*. For *PNAS*, however, its publications are heavily concentrated on the type *Article*, regardless of year. This outcome reflects the difference in aims and scope of *Nature*, *Science*, and *PNAS*. *Nature* and *Science* are not only research journals but also scientific news magazines, whereas *PNAS* is strongly oriented towards research.

Comparing the changes in percentages for the two types *Article* and *Editorial Material* across different years in *Nature* and *Science*, we find that the percentages of *Article* are decreasing slightly from 1999 to 2014, while the percentages for *Editorial Material* are increasing (Figures 1 and 2, respectively). Such material represents scientific news or opinions of experts on scientific news. This outcome

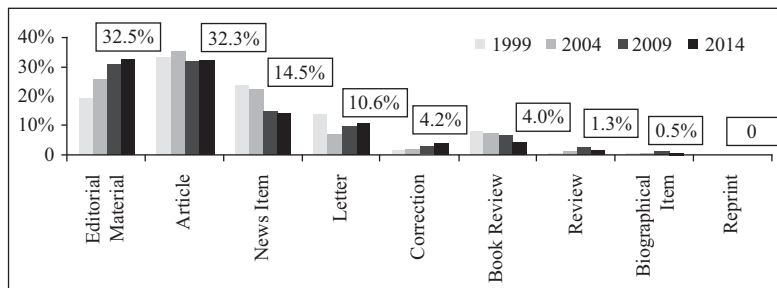


Figure 1. Document type profiles in *Nature* in years 1999, 2004, 2009, and 2014.

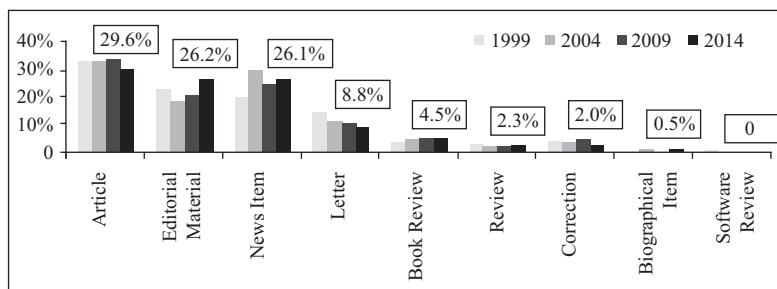


Figure 2. Document type profiles in *Science* in years 1999, 2004, 2009, and 2014.



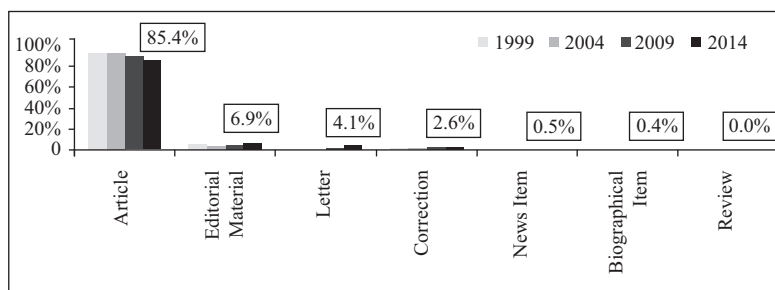


Figure 3. Document type profiles in *PNAS* in years 1999, 2004, 2009, and 2014. Note that 0.0% is the result rounded to the nearest tenth.

indicates that reporting news or expert opinions on important research tends to be increasingly important. Notice that for *Nature*, the absolute numbers of publications decrease from 1999 to 2009 (Table 1). Thus, the increasing percentages for *Editorial Material* are consistent with the assumption that the absolute numbers of *Editorial Material* are constant. However, the latter is not the case: these absolute numbers strictly increase across the four considered years (Table A1).

### 3.2 Document Type Profiles at the Country Level

The publication volumes of the document types *Review*, *Biographical Item*, and *Reprint* in *Nature* in year 2014 are small (Tables A1, A2, and A3 in the Appendix). Therefore, these three document types are not taken into account at the country level. Moreover, the types *Correction* and *News Item* were also excluded, since publications of these types often lack addresses in our *Nature* data. Also for *Science* and *PNAS*, and for similar reasons as in the *Nature* case, some document types were excluded. For all three journals, and with respect to comparison between countries, we restrict the result presentation to the latest publication year in the study, 2014.

Figures 4–6 visualize for the three journals, in the form of radar plots, the 2014 document type profiles of the countries. Notice that a radar plot corresponds to a vector of the type defined in Equation (4). Sample observations:

- *Nature*

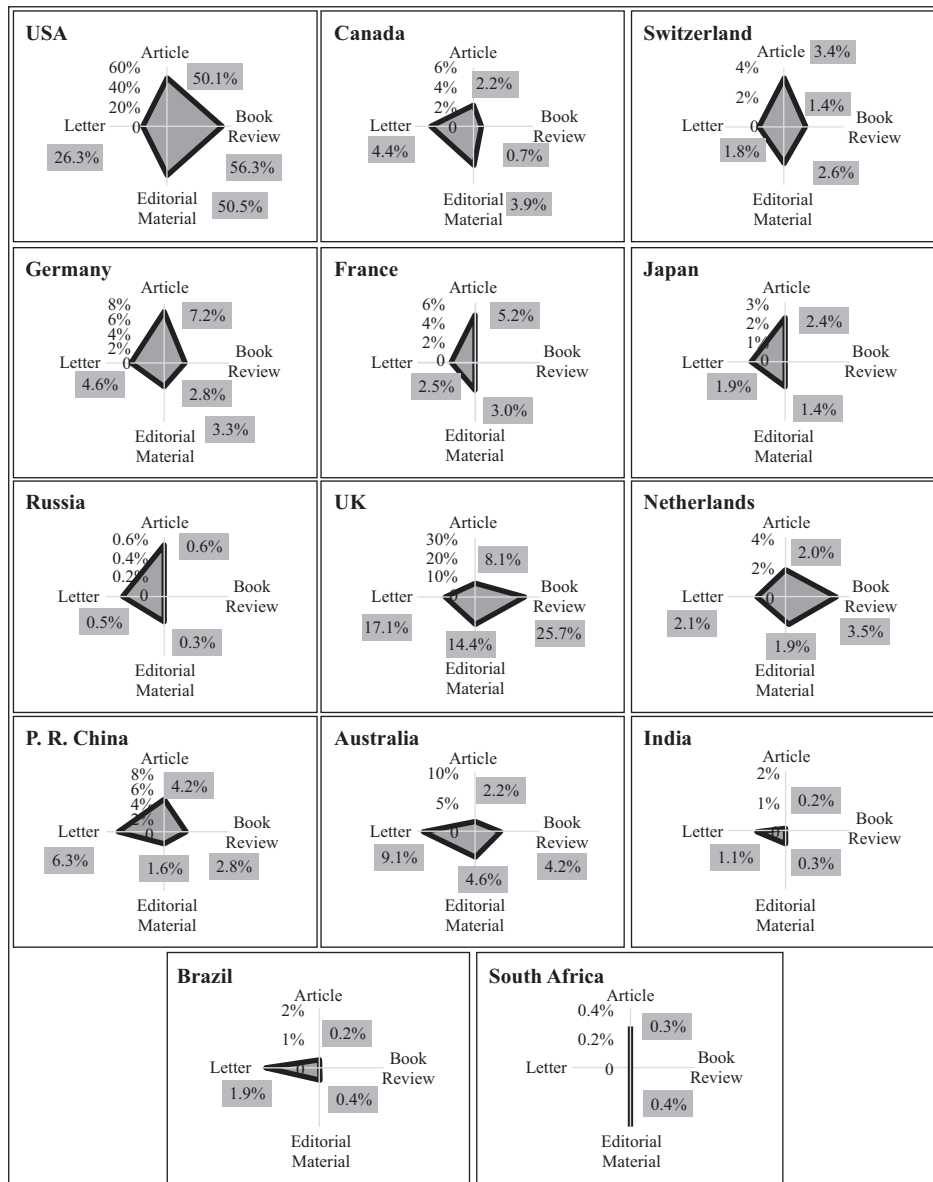
- USA exhibits a relative balanced profile in *Nature*, with similar emphasis on *Article*, *Book Review*, and *Editorial Material* (50%–56% of the total publication fraction output across the countries for these types) and with less emphasis on *Letter*.
- Several countries focus strongly on *Article*. The outcomes for Switzerland and Germany suggest a rhombus document type profile with great emphasis on *Article*. France, Japan, and Russia show a triangle document type profile with more emphasis on *Article* and less emphasis on *Letter* and *Editorial Material*.



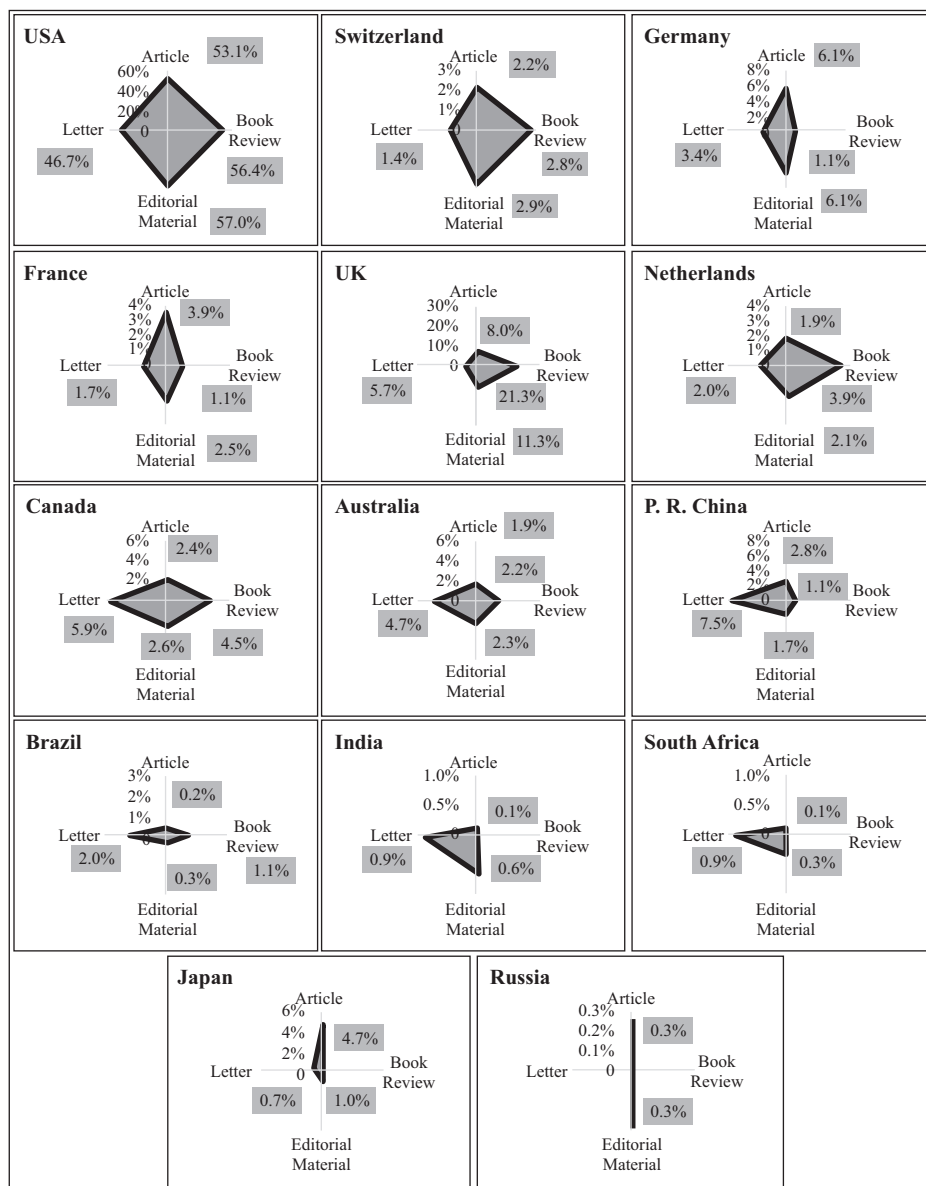
- Several countries focus on *Letter* rather than other document types. The outcomes for People's Republic of China and Australia suggest a rhombus document type profile with great emphasis on *Letter*. India and Brazil have a triangle document type profile with more emphasis on *Letter* than *Article* and *Editorial Material*.
- *Science*
  - As in the *Nature* case, USA has a fairly even profile, and stands for the largest percentages (47%–57% of the total publication fraction output across the countries for all four included types). Switzerland has a relatively balanced profile with similar emphasis on *Article*, *Editorial Material*, and *Book Review*.
  - Most studied countries focus strongly on the type *Letter*. Canada, Australia, People's Republic of China, and Brazil have a rhombus document type profile with strong emphasis on *Letter*. India and South Africa have a triangle document type profile with the strongest emphasis on *Letter*.
- *PNAS*
  - Germany and UK have an “equilateral triangle” profile, which suggests a balanced structure, with similar emphasis on *Article*, *Editorial Material*, and *Letter*.
  - USA and Canada have an “isosceles triangle” structure with most emphasis on *Editorial Material*, and similar emphasis on *Article* and *Letter*. Notice that USA accounts for about 70% of the total publication fraction output across the countries for the type *Editorial Material*.
  - Most studied countries focus strongly on *Letter*, like France, People's Republic of China, Australia, and the Netherlands.

Table 3 (4, 5) gives the cosine similarity values for pairs of years within the 14 countries in *Nature* (*Science*, *PNAS*). In all three figures, values below 0.8 are marked in grey. For *Nature* and *Science*, the document type profiles of most countries change only slightly between different years. With regard to *PNAS*, for a majority of the countries, the similarity values for the document type profiles for the years 2004 and 2009 are generally much lower compared to the other year pairs. The profiles of some BRICS countries change to a relatively large extent. For instance, the profiles of India and South Africa (2004 vs. 2009; 2009 vs. 2014) regarding *PNAS* (Table 5). The radar plots of Figure 7 visualize the 2004, 2009 and 2014 document type profiles of these two countries in *PNAS*. Clearly, the profile structures are quite different across the three years for both India and South Africa, which is reflected by the corresponding low cosine values.



Figure 4. Radar plots representing the country document type profiles in *Nature* in year 2014.



Figure 5. Radar plots representing country document type profiles in *Science* in year 2014.

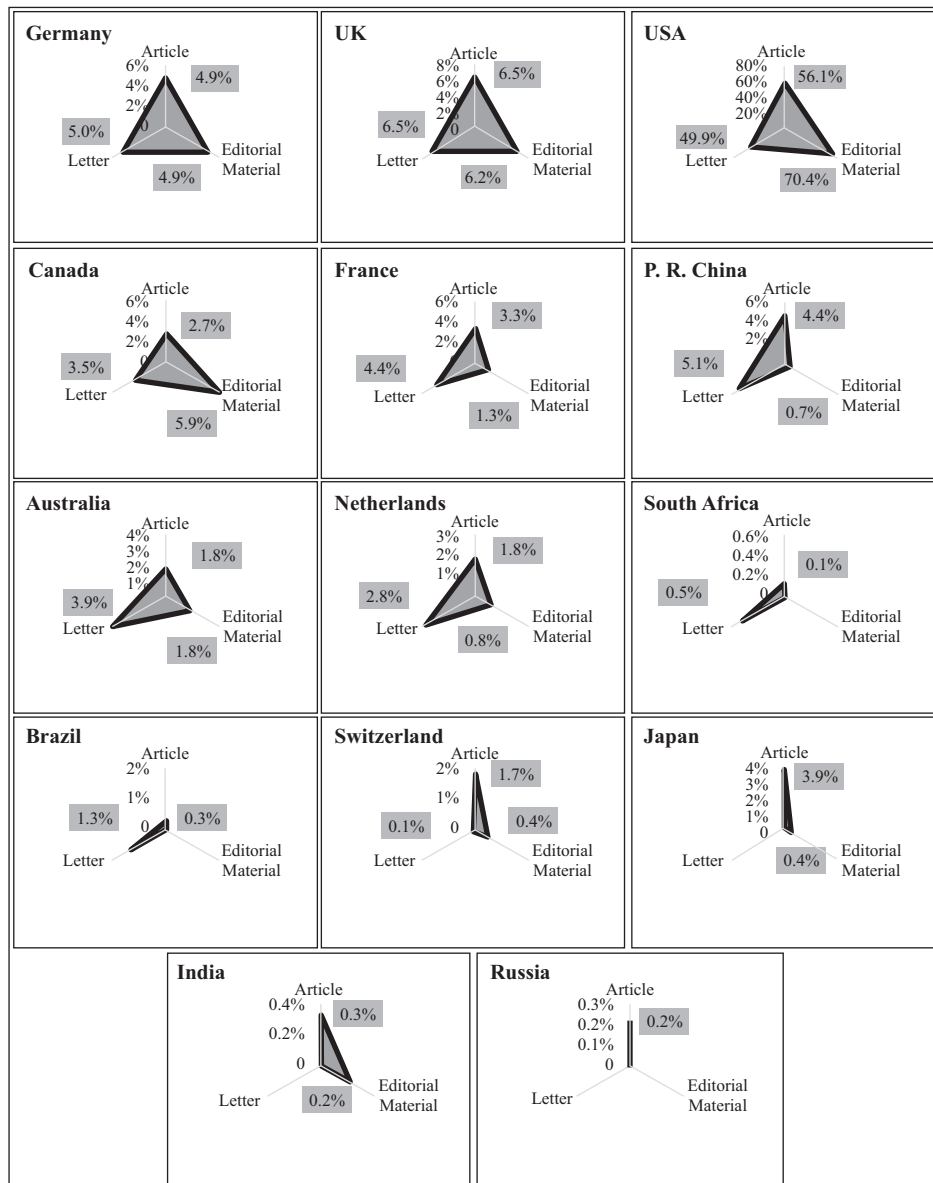
Figure 6. Radar plots representing country document type profiles in *PNAS* in year 2014.

Table 3. *Nature*: Similarity values for country document type profiles for pairs of years.

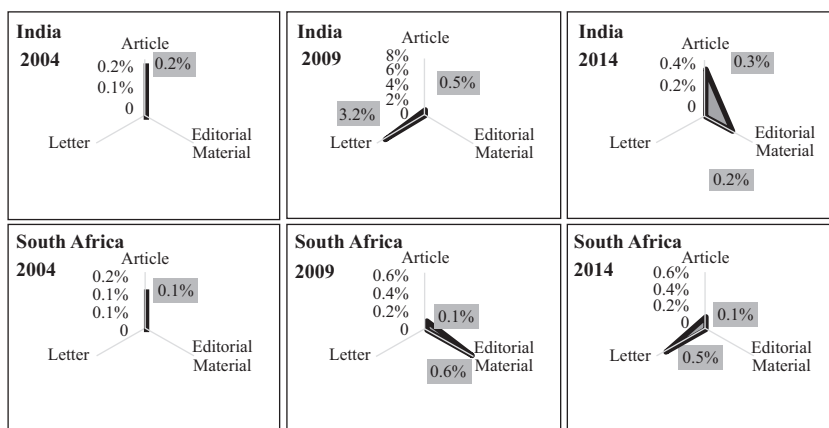
Countries	1999 vs. 2004	2004 vs. 2009	2009 vs. 2014	Countries	1999 vs. 2004	2004 vs. 2009	2009 vs. 2014
Australia	0.695	0.689	0.973	Netherlands	0.991	0.739	0.980
Brazil	0.944	0.989	0.996	P. R. China	0.667	0.508	0.887
Canada	0.920	0.950	0.919	Russia	0.741	0.943	0.844
France	0.987	0.946	0.912	South Africa	0.233	0.998	0.463
Germany	0.968	0.965	0.986	Switzerland	0.976	0.926	0.897
India	0.624	0.984	0.957	UK	0.992	0.995	0.989
Japan	0.936	0.989	0.844	USA	1.000	0.999	0.979

Table 4. *Science*: Similarity values for country document type profiles for pairs of years.

Countries	1999 vs. 2004	2004 vs. 2009	2009 vs. 2014	Countries	1999 vs. 2004	2004 vs. 2009	2009 vs. 2014
Australia	0.647	0.961	0.983	Netherlands	0.897	0.888	0.953
Brazil	0.964	0.950	0.815	P. R. China	0.923	0.933	0.810
Canada	0.821	0.939	0.903	Russia	0.496	0.945	0.603
France	0.937	0.970	0.961	South Africa	0.952	0.955	0.989
Germany	0.926	0.970	0.991	Switzerland	0.911	0.950	0.906
India	0.642	0.545	0.957	UK	0.985	0.992	0.975
Japan	0.994	0.907	0.911	USA	0.995	0.998	0.995

Table 5. *PNAS*: Similarity values for country document type profiles for pairs of years.

Countries	1999 vs. 2004	2004 vs. 2009	2009 vs. 2014	Countries	1999 vs. 2004	2004 vs. 2009	2009 vs. 2014
Australia	0.601	0.711	0.973	Netherlands	0.773	0.371	0.968
Brazil	1.000	0.941	0.540	P. R. China	0.133	0.993	0.660
Canada	0.993	0.739	0.969	Russia	1.000	1.000	1.000
France	0.968	0.639	0.996	South Africa	1.000	0.169	0.042
Germany	0.992	0.660	0.979	Switzerland	0.998	0.736	0.721
India	1.000	0.138	0.114	UK	0.948	0.730	0.988
Japan	0.987	0.896	0.915	USA	1.000	0.879	1.000

Figure 7. Radar plots representing document type profiles of India and South Africa in *PNAS* in years 2004, 2009, and 2014.

## 4 Discussion and Conclusion

In this study, we have treated the document type profiles in the three journals *Nature*, *Science* and *PNAS*. We analyzed the profiles at two levels, journal and country. The results for the journal level show that *Nature* and *Science* mainly publish *Editorial Material*, *Article*, *News Item* and *Letter*. The publications of *PNAS*, though, are heavily concentrated on the type *Article*, regardless of year. This outcome mirrors the difference in aims and scope of the journals. *Nature* and *Science* aim at publishing remarkable scientific research and important scientific news related to such research. *PNAS* is a very academic journal, which almost exclusively publishes high-level frontier research. Interestingly, the percentages for the type *Article* for *Nature* and *Science* are decreasing slightly from 1999 to 2014, while the corresponding percentages for *Editorial Material* are increasing. Van Leeuwen (2013) explored the possibilities to include editorial materials in research assessment procedures. With regard to citation impact, the difference between articles and editorial materials turned out to be relatively small. Partly based on this outcome, the authors concluded that some editorial materials can be included in research assessment procedures.

At the country level, the results show, with regard to year 2014, that most studied countries focus on *Article* and *Letter* in *Nature*, but on *Letter* in *Science* and *PNAS*. The BRICS countries, except People's Republic of China, have rather unbalanced document type profiles, and this is the case also for Japan. The publication output of Brazil, Russia, India, and South Africa in the three journals is small, a fact that might explain the unbalanced profiles of these countries. For the comparison of profiles between different years, there are BRICS countries for which the profiles change to a quite large extent.

Large differences are found when comparing the country document type profiles of the three journals with the corresponding profiles in all WoS journals (Zhang, Rousseau, & Glänzel, 2011). For example, with respect to all WoS journals, it was shown that People's Republic of China published almost exclusively documents of the type *Article*, whereas the publishing emphasis of China in *Nature*, *Science*, and *PNAS* is on *Letter*. A similar pattern can be observed for several other countries of this study. This suggests that the country document type profiles of *Nature*, *Science*, and *PNAS* are different from the corresponding profiles of other WoS journals.

For future research, we would like to compare the citation impact of different document types in *Nature*, *Science*, and *PNAS* with their impact across all WoS journals.



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## Author Contributions

J.L. Ding (dingjielan@mail.las.ac.cn) performed the research, designed the research framework, collected and analyzed the data, wrote the first draft and revised the paper. P. Ahlgren (perahl@kth.se) designed the research framework, collected and analyzed the data, wrote and revised the manuscript. L.Y. Yang (yangly@mail.las.ac.cn, corresponding author) put forward the research idea, planned and designed the outline and contributed to the writing of the paper. T. Yue (yuet@mail.las.ac.cn) joined discussion of the findings and contributed to the writing of the paper.

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## Appendix A

Table A1. *Nature*. Numbers of publications by document type.

Document type \ Year	Number of publications				Percentage			
	1999	2004	2009	2014	1999	2004	2009	2014
Editorial Material	574	660	780	833	19.1%	25.4%	30.7%	32.5%
Article	998	916	800	828	33.3%	35.2%	31.4%	32.3%
News Item	709	584	381	371	23.6%	22.4%	15.0%	14.5%
Letter	404	183	250	272	13.5%	7.0%	9.8%	10.6%
Correction	41	45	78	108	1.4%	1.7%	3.1%	4.2%
Book Review	232	180	169	102	7.7%	6.9%	6.6%	4.0%
Review	18	21	66	34	0.6%	0.8%	2.6%	1.3%
Biographical Item	21	14	19	13	0.7%	0.5%	0.7%	0.5%
Reprint	3	0	1	0	0.1%	0	0.0%	0
Total	3,000	2,603	2,544	2,561	100.0%	100.0%	100.0%	100.0%

Note. 0.0% is the result rounded to the nearest tenth.

Table A2. *Science*. Numbers of publications by document type.

Document type \ Year	Number of publications				Percentage			
	1999	2004	2009	2014	1999	2004	2009	2014
Article	893	873	843	769	32.8%	32.6%	33.5%	29.6%
Editorial Material	609	490	520	683	22.3%	18.3%	20.7%	26.2%
News Item	534	787	611	679	19.6%	29.3%	24.3%	26.1%
Letter	388	281	257	230	14.2%	10.5%	10.2%	8.8%
Book Review	93	102	117	117	3.4%	3.8%	4.7%	4.5%
Review	78	51	54	59	2.9%	1.9%	2.1%	2.3%
Correction	100	85	106	52	3.7%	3.2%	4.2%	2.0%
Biographical Item	7	12	8	13	0.3%	0.4%	0.3%	0.5%
Software Review	24	1	0	0	0.9%	0.0%	0	0
Total	2,726	2,682	2,516	2,602	100.0%	100.0%	100.0%	100.0%

Note. 0.0% is the result rounded to the nearest tenth.

Table A3. *PNAS*. Numbers of publications by document type.

Document type \ Year	Number of publications				Percentage			
	1999	2004	2009	2014	1999	2004	2009	2014
Article	2,603	3,077	3,759	3,586	92.1%	92.2%	89.1%	85.4%
Editorial Material	151	129	181	290	5.3%	3.9%	4.3%	6.9%
Letter	0	0	122	174	0	0	2.9%	4.1%
Correction	66	88	142	111	2.3%	2.6%	3.4%	2.6%
News Item	0	0	0	21	0	0	0	0.5%
Biographical Item	1	35	10	15	0.0%	1.0%	0.2%	0.4%
Review	6	7	6	2	0.2%	0.2%	0.1%	0.0%
Total	2,827	3,336	4,220	4,199	100.0%	100.0%	100.0%	100.0%

Note. 0.0% is the result rounded to the nearest tenth.

