Research Evaluation, 28(2), 2019, 169–181
doi: 10.1093/reseval/rvy043
Advance Access Publication Date: 30 January 2019
Article

OXFORD

Field patterns of scientometric indicators use for presenting research portfolio for assessment

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Abstract

This study investigates what names of metrics or databases researchers use to present their research portfolio and how their use is influenced by the field. I have analysed the data comprising 3,695 self-presentation documents (82,710 pages) from various academic promotion procedures in Poland. My study aims to determine the differences in the use of scientometrics indicators across all fields of science. I have used 21 codes (metrics and databases' names) for coding all documents, analysed the patterns of scientometric indicators use, and found out that there is a significant relation between publication patterns and patterns of scientometric indicators use. My analyses reveal that researchers in 'Hard Sciences' (except for mathematics) very often use metrics to describe their output, researchers in 'Soft Sciences' (except for economics) only occasionally use metrics, and scholars from 'Arts' hardly ever use metrics. My most noteworthy finding highlights that patterns of scientometric indicators use are related to the publication patterns in the given field. I conclude with several recommendations for various research policies and show what metrics could be used and expected in promotion procedures in various fields.

Key words: scientometric indicator; academic promotion; self-presentation; research portfolio; Poland.

1. Introduction

Bibliometrics has been implemented in various contexts of research evaluation and the debate on using the author-level metrics has continued for quite a while (de Rijcke et al. 2016; Wildgaard 2016). Researchers are familiar with citation indexes, because they play a crucial role in their decisions about tenure, promotion, and other academic moments of evaluation. It reflects the increasing importance of metrics in academia. Nonetheless, researchers have sometimes somewhat ambivalent attitudes about metrics and citation indicators (Hargens and Schuman 1990). They criticize citations and other metrics as an inadequate proxy of the research quality and, at the same time, perceive such indicators as an instrument that could provide more advanced forms of information about various researcher's publications (Aksnes and Rip 2009).

However, the bibliometric knowledge of those who are evaluated is greatly differentiated in several ways. On the one hand, researchers trained in scientometrics or science and technology studies are familiar with bibliometrics, while at the same time they are the object of bibliometric evaluation which can create various tensions (Fochler and De Rijcke 2017). On the other hand, researchers from other fields, for example, sociology or biology, are familiar with metrics to certain degree but their knowledge is mostly partial and not properly contextualized because they need it mostly to understand their own field.

To describe the bibliometric knowledge and the use of bibliometric indicators, Rousseau and Rousseau (2015) coined the term 'metric-wiseness' that is defined as a 'researcher's capacity to use the characteristics and formats of scientometric indicators to present one's true research value' (Rousseau and Rousseau 2015: 2389). Metrics are used by researchers (e.g. for presenting the value of their research) and evaluators (e.g. for assessing the quality of research). Being metric-wise is knowing the bibliometric indicators and their formulas. Moreover, a metric-wise researcher knows how to properly use metrics. Thus, metric-wiseness is a technical ability to present the value of researcher by the bibliometric indicators. Being a metric-wise researcher does not depend on the quality of researcher in question (Rousseau and Rousseau 2017).

Researchers present their researcher portfolios to provide the experts with necessary basic information about their output in various evaluation procedures. In this way, researchers construct their 'academic self' by a process of summation and by selecting materials to present to others. Studies on disseminating web CVs of researchers via the Internet (Más-Bleda and Aguillo 2013; Kousha and Thelwall 2014) show that there are differences between the fields of sciences in the use of this type of reporting research portfolio. Li et al. (2017b) proposed the idea of 'citation personal display' which is defined as mentioning by researchers their citation counts or citation-based indices on the personal websites. Hyland (2011) shows by analysing the academic web homepages that differences in such self-presentation practices are influenced by seniority, gender, and discipline. In lines with Goffman's (1956) dramaturgical approach, researchers self-consciously construct 'artifacts' by which they manage the impression they give of themselves: researchers make their choice as to what information should be displayed and, thus, they present an idealized version of themselves. The range of the information reported depends not only on various individual-specific patterns but is also guided by the norms and goals of specific settings (Hogan 2010). One can conclude that self-presentation practices are shaped or determined by the understanding that is common in the discipline as to what should and what should not to be presented in the portfolio. Thus, researchers select what (e.g. which publications, which metrics' values) should be assessed by others. Moore (2017) shows that in the neoliberal workplace workers are asked to measure their own productivity. When we look at the researchers' practices, this kind of self-measurement can be understood as a search for metrics which could explain and report our productivity.

Nonetheless, the use of metrics in self-presentation practices in all fields of science is only scarcely analysed in empirical research. This gap may result from the lack of documents that could be analysed in terms of self-presentation practices and bibliometric knowledge of those who present and construct their 'academic self' by such documents. Similar challenges related to the lack of documents, which could be investigated, are observed in the analysis of the peer reviews in funding agencies (Gillespie et al. 1985; Gallo et al. 2016).

The aim of the present article is to determine how researchers from different fields use metrics and databases' names to report and promote their research portfolio. In this study, I analyse 3,695 self-presentation documents from the habilitation procedures in Poland. A self-presentation document is an obligatory attachment to the application with which the candidate for the habilitation degree has to demonstrate the value of their research and scientific output.

Researchers from different fields work in various epistemic cultures (Cetina 1999). These different epistemic approaches shape and determine different publication, citation, and evaluation cultures (de Solla Price 1970; Cole and Zuckerman 1984; Wouters 1999; Lamont 2009). For instance, in the so-called 'hard sciences' (e.g. life sciences and medicine) an article is a main type of publication, whereas in the so-called 'soft sciences' (e.g. in the humanities and law) a monograph plays a key role. These patterns are influenced by numerous factors, for instance, internal to science like the growing importance of interdisciplinarity and cooperation (Levitt and Thelwall 2016) or external to science like the science policy and research evaluation systems (Schneider et al. 2014).

Publication patterns vary across fields (Engels et al. 2012). In general, one can say that 'soft sciences' can be characterized as 'book sciences', whereas 'hard sciences' as 'article sciences'. However, as Kulczycki et al. (2018) show these patterns are related not only to the disciplines but also to each country's cultural and historic heritage. Thus, publication patterns differ both between the fields (e.g. patterns in mathematics differ from those in economics in the same way in Finland and Poland) and within the fields (e.g. patterns in economics in Finland differ from patterns in economics in Poland). For instance, articles constitute 44.8% of the total volume of publications in the social sciences and humanities in Poland in 2014, whereas this share in Flanders (Belgium) is 74.8%. Also, patterns across countries can be significantly different. In Norway, articles in economics constituted 72.8% of the total volume in the 2011–4 period whereas in Finland this share was 46.4%. Moreover, the share of articles is growing in the social sciences and humanities in all analysed countries (Kulczycki et al. 2018). Therefore, the terms 'article sciences' and 'book sciences' are not always coherent with soft and hard sciences.

Investigating how publication patterns relate to using scientometric indicators is challenging but can reveal in which fields of science indicators are perceived as an important source of information on the specific evaluation contexts. Hammarfelt and Haddow (2018) use the term 'metric culture' to take into account how researchers themselves use metrics when presenting themselves, among others, in CVs. The authors' findings show that personal publication strategies can be based on indicators or journal rankings. Hammarfelt and Haddow observe that it would be surprising if metrics did not have any influence on research practices and publication strategies. This means that using metrics influences publication patterns. However, it might also be interesting to examine whether publication patterns are related to the metric culture and whether, for instance, the dominant or most important type of publications (book or article) in a given field is related to the intensity of metric use. Such relations and field patterns can be examined in self-presentation documents in which researchers present their research portfolios.

In Poland, the assessment criteria of candidates for the habilitation (explicitly formulated) are the same for all fields. Despite these uniform criteria, it is reasonable to assume that candidates present their research outputs in different ways. As Lamont (2009) shows in her analysis of academic judgement, hiring and promotion decisions are made within disciplinary cultures and the assessment criteria often resonate with the definition of excellence from their specific disciplines. Lamont (2009) argues that the rule of cognitive textualization plays an important role in the evaluation because experts use these criteria that are the most appropriate for the given field. Candidates for the habilitation, as established researchers, sometimes become evaluators (e.g. in funding agencies) and, then, they also work in their discipline-specific evaluation cultures. Therefore, different patterns of scientometric indicators use might occur in their self-presentation documents although the habilitation procedure in Poland is standardized. Researchers adjust their self-presentation practices to the evaluation culture of their field because they know that constructing their 'academic self' is strictly related to how they will be evaluated (Bornmann 2008).

This study aims to contribute to the debate on the self-presentation practices and use of metrics in all fields of science. When analysing self-presentations documents, I tested the assumption that patterns of scientometric indicators use are related to the publication patterns in the given field. Moreover, the article also addresses several important and related issues that arise when one examines what metrics should be applied to which field of science. The study is, thus, driven by two main research questions:

- What metrics and databases are used in the self-presentation documents in the habilitation procedure in Poland?
- What are the field patterns of using the metrics and databases in the self-presentation documents?

The article is structured as follows. In Section 2, a description of the habilitation procedure in Poland in presented. In Section 3, the materials and methods are discussed. The next section presents the results with the special focus on the metrics and the patterns of scientometric indicator use that are used most often in relation to the publication patterns. In the final section, the main findings are analysed, upon which the conclusions are given.

2. Context: habilitation in Poland

The promotion procedures for research staff vary across countries. In some European academic systems, there are qualification procedures that are similar to the Polish solution. In Germany, for example, habilitation is a type of the second PhD and may be presented in the form of a thesis or a series of publication (Enders 2001). In France, habilitation is one of the ways to become a full professor (Musselin 2014). In Italy, the Italian National Scientific Qualification (ASN) is a prerequisite for applying for tenure or full professor positions (Marzolla 2016).

In Poland, the degrees (PhD and habilitation) are awarded in every discipline of science or art (a list of disciplines is given in the Appendix). The habilitation gives researchers the right to be a supervisor of PhD students. Candidates for habilitation are usually established researchers: the mean age of the candidates in 2016 is 44.9 (Najwyższa Izba Kontroli 2017).

In September 2011, various deep structural reforms were implemented in the area of academic promotions in Poland. The Ministry of Science and Higher Education made the habilitation procedures more transparent and codified. The three most significant changes in the procedure are: (1) the public availability of the documents, (2) the criteria of assessment, and (3) the form of the main achievement. The Polish government decided to publish online the candidates' applications, the reviews, and the final decisions which have been perceived by the scientific community as a real revolution. The detailed assessment criteria have been explicitly stated and officially codified for the very first time.

The candidate has to submit an application in which the main achievement as well as the other achievements are presented. The main achievement should be published as a whole or in its essential part(s). It can be a 'monograph', a 'series of publications', or some other form (e.g. an original project, technological or artistic achievement, etc.).

Each procedure is conducted by the given faculty or research institute, upon which it is verified by the Degrees and Titles Committee, that is, the national institution responsible for maintaining the quality of academic promotions in Poland. When a candidate submits their application, the committee establishes a habilitation commission (chair, secretary, three reviewers, two members) which issues the recommendation (positive or negative) on the basis of the reviews. The final decision is made by the scientific council of the faculty of research institute.

2.1 Documents in the habilitation procedure

The candidate for habilitation has to submit an obligatory set of five documents. As Table 1 shows two of these documents are available for the general public. The remaining three documents are not published and they are available only for the members of the habilitation commission in the given procedure. Moreover, in every completed procedure, the Degrees and Titles Committee, publishes five more documents. Eventually, however, seven documents in each procedure are publicly available on the website of the agency: http://www.ck.gov.pl/promotion.html

In the habilitation procedure, there are two crucial documents for candidates in the context of the self-presentation practices. The first one is 'self-presentation' (the original term being 'autoreferat') in Polish which is publicly available for the general public. The other document is a 'List of all publications & research achievements' which is not publicly available. The structure of this document results directly from the official assessment criteria. Thus, in this document the candidate is obliged to show, among others, the value of the bibliometric indicators indicated in the official assessment criteria (see Section 2.2). The obligation to prepare this document is similar to the ASN procedure in Italy in which the applicant has to present, among others, a list of publications and the values of (non)-bibliometric indicators (Marzolla 2016).

The self-presentation in Polish is the only document that is both public available for the general public and written by the candidate themselves. This means that the candidate uses this document to demonstrate the value of their research and has full control of the form and the tone of the presentation. The Degrees and Titles Committee has published[1] a suggested structure of the self-presentation documents in Polish which should consist of five parts: (1) Name and Surname; (2) List of diplomas; (3) History of employment; (4) Presentation of the main achievement (title, authors, the aims, and results]; and (4) Presentation of the remaining research achievements. One can assume that two documents, that is 'Self-presentation in Polish' and 'List of all publications & research achievements', should not be identical in content because they constitute one set of documents in a single procedure. However, in light of the division of the documents into the publicly available and non-available ones, it is justified to assume that candidates will use the

Table 1. List of documents in a single habilitation procedure

Documents submitted by the candidate		Publicly available documents published by the Degree and Titles Committee
Publicly available	Available only for the habilitation commission	
1. Application 2. Self-presentation in Polish	1. PhD certificate 2. Self-presentation in English 3. List of all publications and research achievements	1. Information of the Habilitation commission 2. Review 3. Review 4. Review 5. Decision

same information in both documents to show their full output and to demonstrate its research value by various indicators.

Candidates for habilitation perceived their self-presentations as documents that mainly appeal to the habilitation commission although they are publicly available since the very beginning of the procedure. In contrast to regular academic CVs, researchers do not disseminate self-presentation (or any other habilitation documents) either on their academic websites or in any other ways. Thus, the main goal of the self-presentation is to convince the commission members that the given candidate meets all the necessary criteria and to warrant a positive assessment.

2.2 Assessment criteria for habilitation candidates

The habilitation procedure can be initiated by a candidate who holds PhD and who—in the period that follows their obtaining the PhD—has scientific achievements that constitute a significant contribution to the advancement of a given scientific discipline. Moreover, the candidate has to show that their scientific activity is substantial. The criteria of assessment which should be followed by the three reviewers have been published in the ministerial regulation[2] and divided into three categories.

In the first category, there are criteria that depend on the areas of knowledge (see the list of areas in the Appendix). Candidates from the Humanities and the Arts (not the art sciences but performative arts) have to list their publications which are indexed in the Web of Science (WoS) or the European Reference Index for the Humanities (ERIH). Candidates from the Social Studies have to list their publications from the Journal Citation Reports (JCR) or the ERIH. Candidates from other areas can list only publications from the JCR. Moreover, the candidate can list their patents, consumer or industrial patterns, and—in the area of the Arts—list of artworks.

In the second category, there are the same criteria for all areas of knowledge by which the reviewers assess the scientific activity of the candidate. The candidate has to list: other publications which do not meet the criteria of the first category, expertise, project, grants, invited talks, rewards, and the values of three bibliometric indicators (i.e. citations, h-index, and Total Impact Factor) according to the WoS. The first two indicators are common and well known in the scientific community. However, the obligation to present the values of these indicators for candidates from the Humanities and from the Arts is questionable because of the coverage degree of publications in the Humanities in the WoS (Sivertsen and Larsen 2012). Moreover, candidates from the Arts communicate mostly by their artworks, not by publications. Thus, using the citations and h-index to assess their output is even more problematic. The third indicator, that is Total Impact Factor, is not properly explained in the regulations nor is there any official formula or interpretation how to calculate its value. However, the common practice has been to use the 2-year Impact Factor from the publications so that the indicator resembles ‘total impact’ (Beck and Gáspár 1991) or ‘author impact factor’ (Pan and Fortunato 2014). From other European countries, it is only in Italy that the promotion procedures are based explicitly on bibliometric indicators. Nonetheless, the Polish approach to the bibliometric indicators is different from the Italian one in which the ‘bibliometric indicators’ are applied to the hard sciences (biology and medicine), whereas ‘non-bibliometric indicators’ (e.g. normalized number of authored books) to the social sciences and humanities (Marzolla 2016).

In the last category, there are the same criteria for all areas of knowledge by which reviewers assess the candidate’s teaching activity, international cooperation, and popularization of science. The candidate has to list: presentations given at national and international conferences, rewards, memberships of societies and editorial boards, participations in research consortia and networks, internships, supervision of students, and doctoral candidates.

All information necessary to assess the candidate in these three categories of criteria has to be presented in the ‘List of all publications & achievements’. This means that this information is not publicly available and the candidate can use the same information in their self-presentation to demonstrate the research value of their output.

3. Materials and methods

3.1 Data

This study is based on an analysis of the self-presentation documents from the completed habilitation procedures of 3,695 senior scientists who in the overwhelming majority are affiliated with Polish higher education institutions. All sets of documents, which were publicly available (N = 5,721), were collected from the official website of the Degrees and Titles Committee on 2 May 2016. Subsequently, the sets were divided into three categories depending on whether: (1) the set has been completed, that is all seven documents have been published (N = 3,695), (2) it is ongoing, that is only the application and self-presentation in Polish have been published (N = 1,533), or (3) is incomplete, that is one or more document is missing (N = 493). In the present study, only self-presentation documents from the completed procedures (from the 2011 to May 2016 period) are analysed. The success rate, that is, the positive decision that results in the candidate’s receiving habilitation, for the analysed data set is 92.1%.

The final set of the selected self-presentation documents consists of 82,710 pages which in the majority are scanned copies of original documents with candidates’ signatures in blue. Prior to the analysis, the text in all documents have been recognized (Optical Character Recognition) by the Poznań Supercomputing and Networking Center. The mean length of the document is 22.38 pages.

Subsequently, all self-presentation documents were manually classified into the following categories: gender, type of achievement (monograph, series of publication, other), and (in accord with the official Polish classification) area, field, discipline of science (this classification is given in the Appendix). Then, all self-presentation documents were imported to the *MaxQDA 12* software and coded.

3.2 Coding and code scheme

Having compiled, the final set of the selected self-presentation documents, I sought to create a categorization scheme for the names of the metrics and databases. I started with analysing the assessment criteria for the habilitation procedure and the existing literature on bibliometric indicators, upon which I formulated my research questions. In this study, the coding segment is defined as an occurrence of a name (or acronym) of the metric (e.g. Impact Factor) or a name of the database (e.g. JCR). The coding procedure consisted of two phases.

In the first phase, I conducted a frequency analysis of initially selected codes on the basis of all self-presentation documents. This allowed me to gain the first insight into how the names of metrics and databases are used in the self-presentations. In this process, I used the flectional words from the lemmata list included in the *MaxQDA* software for Polish and the numerous variations of each metric and database name (e.g. Impact Factor, Impakt Factor, Impakt Faktor, etc.), the latter resulting from various spelling-mistakes made by the candidates and/or from the poor quality of the recognized text. Then, I checked all results of the frequency analysis and re-coded the results if they had been mistakenly coded (e.g. a given metric name was used not for presenting the candidate's research output but as a subject of the study). Ultimately, my analysis yielded 32,709 coded segments.

In the second phase, I prepared another version of the scheme which included the new codes built on the basis of reading of the results of the frequency analysis. This version served as the ground for coding segments when I read all documents. Having read and coded, I prepared the final version of the codes scheme and determined whether the given code (or more precisely: the metric's or database's name) is included in the assessment criteria for habilitation candidates. Different codes linked to different names were merged if they were related to the same object. For instance, in Poland, many scientists use the term 'Lista Filadelfijska' (eng. Philadelphian List) or 'Lista A' (Part A of the Polish Journal Ranking that is used in the Polish research evaluation system and that has been created on the basis of the JCR) with reference to the JCR. Thus, in the final code scheme, all such uses were merged into single codes. Finally, I coded 48,616 segments using 21 codes which are summarized in Table 2. In the final scheme, only codes with at least 30 coded segments were included: other codes, for instance, 'Eigen Factor' or 'Arts & Humanities Citation Index', were merged into the *Other metrics* or *Other databases*, respectively.

In the *Metrics* category, apart from such well-known metrics as 'Citations' or 'Impact Factor', there are also two other metrics specific to the Polish context: 'Points' and 'Total Impact Factor'. 'Points' refers to a bibliometric indicator used in the Polish performance-based research funding system for assessing publications (Kulczycki et al. 2017). Although this metric is not officially mentioned in the regulations of habilitation procedure, some universities and reviewers use it as a proxy for assessing the quality of publications and researchers (Kulczycki 2017). 'Total Impact Factor' is explicitly included in the regulation of habilitation procedure.

In the *Databases* category, there are also two databases specific to the Polish context. The first one, that is 'Index Copernicus International', is a Polish online database in which various journals are indexed. In the previous years, the Degrees and Titles Committee published an obligatory questionnaire for the habilitation candidates in the medical, health, and sport sciences. Candidates had to provide values of various bibliometric indicators, among others, the Index Copernicus Value calculated on the basis of 'Index Copernicus International'. It is noteworthy that this questionnaire was officially abandoned in 2011. In practice, in the analysed set of documents, the candidates provided only information whether the given journal is indexed in the Index Copernicus International or not. Thus, this code is in the *Databases* category. The other database is the 'Polish Journal Ranking', which is a key element in the Polish performance-based research funding system as it is employed for assessing journal articles in the evaluation of higher education institutions (Kulczycki and Rozkosz 2017). The *metric* 'Points' refers to the *database* 'Polish Journal Ranking'. Nonetheless, the points are assigned also to monographs and chapters which are not included in the rankings in question.

When preparing the first version of code scheme, I initially assumed that there would be also the third category of codes, that is, *Identifiers* (e.g. ORCID, Scopus Author ID). In the end, however, only 57 segments were coded. Twenty-three of them were the URL addresses to the Google Scholar Citations' profiles. Thus, this category is not included in the final scheme and results. Furthermore, I have identified three other codes that are neither the *Metrics* nor the *Databases* but that allow me to provide more in-depth interpretation of how scholars understand bibliometric indicators and how they present the value of their research through bibliometric indicators. Those three other codes are: *Printscreens*, *Hand-made bibliometrics*, and *Justification for not being listed in any Database*.

Table 2. The codes scheme with two main code categories: *Metrics* and *Databases*

Metrics	*Databases*
1. Citations*	1. European Reference Index for the Humanities [ERIH]*
2. h-index*	2. Google Scholar
3. Impact factor	3. *Index Copernicus International* [ICI]
4. *Points*	4. Thomson Reuters
5. Self-citations	5. Journal Citation Reports [JCR]*
6. *Total Impact Factor**	6. Master Journal List
7. Other metrics	7. MedLine
	8. *Polish Journal Ranking* [PJR]
	9. Publish or Perish
	10. PubMed
	11. Science Citation Index [SCI]
	12. Scopus
	13. Web of Science (Web of Knowledge) [WoS]*
	14. Other databases

Note: Asterisk (*) marks codes which are explicitly included in the assessment criteria for habilitation candidates. Italicized codes are specific to the Polish context.

4. Results

In this section, I discuss the differences between various fields concerning the use of the *Metrics* and *Databases*, upon which I present the results of contingency table analysis (with Chi-squared test) so as to determine whether there is a significant relation between the form of the main achievement and the use of the *Metrics* or *Databases*. Then, I characterize the field patterns of scientometric indicators use. Finally, I move beyond the names of metrics and databases and present three other codes which were used by the candidates to present the value of their outputs.

4.1 Using the names of the *Metrics* and *Databases*

Generally, candidates for the habilitation degree use the names of the *Metrics* or *Databases* to provide some additional information about the value of their publications. Thus, when they describe some of their publications, they use various metrics at the same time (e.g. the value of Impact Factor, the number of citations) and indicate in which database(s) the journal—in which they have published—is indexed in. Moreover, when candidates describe their profile in terms of bibliometric indicators, they provide information from different databases. For instance, the value of the h-index is very often provided not only on the basis of the WoS but sometimes also on the basis of Scopus, Google Scholar, and Publish or Perish and sometimes even instead of it. In various fields, the candidates provide a list of the most important publications (even though the list has to be provided as a separate document) and describe them by using various metrics.

Table 3 shows the ranking of the most often used codes in the self-presentation documents. In the *Metrics*, 'Impact Factor' and 'Points' are the two most frequently used codes although they are not explicitly included in the assessment criteria. In the *Databases*, the most often used code is 'Journal Citation Reports' (explicitly included) and 'Polish Journal Ranking' (not included in the assessment criteria).

Table 4 illustrates how many self-presentations from the given field have at least one coded segment from the *Metrics* or the *Databases* categories. In the 'Pharmaceutical science', in each of the 69 self-presentations there was used at least one code from the *Metrics* category and in 56 of these there was used a code from the *Database*. In the 'Film studies' and the 'Drama and theatre studies' none of the 21 codes was used in any self-presentation.

Table 5 shows how many different codes and coded segments were used in the self-presentations from the given field. In all documents, the mean number of the codes used is 3.41 and the mean number of the coded segments is 13.16.

Table 3. The number of the coded segments in the *Metrics* and the *Databases* code categories

Code (*Metric*)	Coded segments	Code (*Database*)	Coded segments
Impact Factor	15,949	Journal Citation Reports [JCR]*	3,862
Points	9,691	*Polish Journal Ranking* [PJR]	1,653
Citations*	7,627	Web of Science (Web of Knowledge) [WoS]*	1,352
*Total Impact Factor**	2,777	Scopus	939
h-index*	1,767	Google Scholar	509
Self-citations	1,032	*Index Copernicus International* [ICI]	398
Other metrics	37	Thomson Reuters	289
		European Reference Index for the Humanities [ERIH]*	205
		Publish or Perish	186
		Other databases	140
		PubMed	95
		MedLine	41
		Science Citation Index [SCI]	37
		Master Journal List	30

Note: Asterisk (*) marks codes which are explicitly included in the assessment criteria for habilitation candidates. The italicized codes are specific to the Polish context.

Table 4. Self-presentation documents with the *Metrics* and the *Databases* codes per field

Field	N	Number of self-presentations with code(s)					
		Metrics or *Databases* (N)	*Metrics* or *Databases* (%)	*Metrics* (N)	*Metrics* (%)	*Databases* (N)	*Databases* (%)
Pharmaceutical science	69	69	100.00	69	100.00	56	81.20
Sport science	42	41	97.60	41	97.60	38	90.50
Veterinary science	40	39	97.50	39	97.50	32	80.00
Medical science	427	402	94.10	402	94.10	341	79.90
Chemical sciences	229	210	91.70	209	91.30	161	70.30
Agricultural sciences	186	165	88.70	161	86.60	143	76.90
Biological sciences	298	264	88.60	261	87.60	216	72.50
Health science	46	40	87.00	40	87.00	34	73.90
Earth Sciences	92	75	81.50	60	65.20	65	70.70
Technology	549	441	80.30	397	72.30	406	74.00
Physical sciences	185	144	77.80	136	73.50	123	66.50
Forestry science	23	17	73.90	17	73.90	15	65.20
Economics	187	127	67.90	111	59.40	114	61.00
Social studies	189	69	36.50	53	28.00	55	29.10
Mathematics	86	26	30.20	24	27.90	20	23.30
Law	159	47	29.60	34	21.40	30	18.90
Humanities	593	130	21.90	87	14.70	95	16.00
Theology	43	4	9.30	3	7.00	3	7.00
Visual arts	70	2	2.90	0	0.00	2	2.90
Music studies	169	2	1.20	2	1.20	0	0.00
Film studies	2	0	0.00	0	0.00	0	0.00
Drama and theatre studies	11	0	0.00	0	0.00	0	0.00

Note: The fields are sorted by the percentage of the documents in the field with at least one code from the *Metrics* or *Databases*.

Table 5. The number of the codes and coded segments per field

Field	Number of codes			Number of coded segments		
	Mean	Median	Max.	Mean	Median	Max.
Sport science	7.17	7.5	11	23.36	18	97
Pharmaceutical science	6.04	6	10	32.87	29	139
Health science	6.00	7	13	26.52	17	220
Veterinary science	5.95	7	11	30.98	21	142
Medical science	5.83	6	12	20.30	17	215
Agricultural sciences	5.75	7	12	18.09	17	107
Biological sciences	5.13	6	11	24.00	20	165
Chemical sciences	4.88	6	11	31.80	24	301
Technology	4.76	6	13	17.41	11	305
Forestry science	4.57	6	9	10.48	9	53
Physical sciences	3.98	4	10	13.14	8	163
Earth sciences	3.42	3	10	8.82	5	76
Economics	3.40	2	11	8.64	4	106
Mathematics	1.21	0	8	3.10	0	34
Social studies	1.11	0	9	3.18	0	49
Law	0.82	0	10	1.26	0	15
Humanities	0.50	0	10	1.18	0	40
Theology	0.19	0	4	0.30	0	7
Visual arts	0.03	0	1	0.03	0	1
Music studies	0.01	0	1	0.01	0	1
Film studies	0.00	0	0	0.00	0	0
Drama and theatre studies	0.00	0	0	0.00	0	0

Note: The fields are sorted by the mean number of the codes in the field.

4.2 Field patterns of scientometric indicators use

I have analysed all procedures from all fields (N = 3,456) except for procedures with the 'other form' as the main achievement. Pearson's χ^2 test indicates that there is a significant association between the type of main achievement and whether or not the candidates use the *Metrics* or the *Databases* names (at least one segment was coded), $\chi^2 = 554.91$, $P < 0.001$, phi = 0.4, and df = 1. In these habilitation procedures in which a monograph was indicated as the main achievement (N = 1,255), the *Metrics* or the *Databases* are used in 42.5% self-presentation documents. While in these procedures in which a series of publications was indicated as the main achievement (N = 1,761), the percentage of the self-presentation documents with the *Metrics* or the *Databases* is 81.5%.

In Poland, there are seven areas of science and one area of arts which are divided into 22 fields (see the Appendix). Candidates from all these fields are evaluated according to the same regulations with some slight exceptions regarding the databases from which candidates can present their publications according to the first category of criteria (see the detailed description in Section 2.2). Nonetheless, communicating research results in different types of publications in a given field is reflected in the type of the main achievement indicated by the candidates.

Table 6 shows the field patterns of the use of the names of the *Metrics* or the *Databases*. The results from 22 fields are sorted according to the percentage of procedures with a series of publications as the main achievement. All 21 codes are divided into two categories. In the first category, there are codes related to metrics or databases that have been explicitly included in the assessment criteria for habilitation candidates. The other category contains criteria that have not been included in the assessment criteria. In the table, the two dashed lines are added to further categorize all fields into three categories (i.e. 'Hard sciences', 'Soft sciences', and 'Arts'), even though such classification is not a part of the Polish field classification. It is noteworthy that there are significant differences between these three categories in terms of the percentage of the main achievement as a series of publications.

The codes included in the assessment criteria are very often used in the self-presentation documents from all fields of 'Hard Sciences'. These codes are rarely used in 'Soft sciences'. In 'Arts', the codes are hardly used. The codes not included in the assessment criteria (such as 'Impact Factor', 'Points', 'Self-Citations', 'Scopus', 'Polish Journal Ranking') are very often used in 'Hard sciences'. In 'Soft sciences' and 'Arts', the situation is similar to the use of the codes included in the assessment criteria.

The use of the metrics and databases' names for presenting the research portfolio reflects the classification of knowledge into 'Arts', on the one hand, and two major categories of science (i.e. 'Hard sciences' and 'Soft sciences'), on the other. In these fields in which the series of publications is perceived as the main type of achievement, researchers often describe the value of their research by showing the bibliometric indicators and informing the reviewers (as well as the audience) about the databases in which the journals with their papers are indexed in.

Two main outliers can be identified among all fields. The first outlier is Mathematics in 'Hard Sciences'. Only 30.2% of self-presentations have at least one coded segment, whereas for 'Hard sciences' (except Mathematics) the share of self-presentations is 87.2%. The mean number of the codes used in Mathematics is 1.21 and the mean number of the coded segments is 3.10 whereas for 'Hard Sciences' (except Mathematics) is 5.13 and 20.69, respectively. The codes used most often in 'Hard sciences' are substantially less frequently used in Mathematics. For instance, 'Total Impact Factor' is used in 14.0% of self-presentations in Mathematics whereas in 64.6% of self-presentations in 'Hard Sciences'. There are

Table 6. The percentage of the habilitation procedures in which the codes are used at least once in a single self-presentation

Science /Art	Field	Number of documents	Percentage of self-presentations with a series of publications as the main achievement	Codes included in the assessment criteria						Codes not included in the assessment criteria														
				Total Impact Factor	Citations	h-index	JCR	Web of Science	ERIH	Impact Factor	Points	Self-citations	Scopus	PJR	Thomson Reuters	Google Scholar	ICI	SCI	Publish or Perish	PubMed	Master Journal List	Medline	Other databases	Other metrics
Hard sciences	Chemical sciences	229	98.70%																					
	Pharmaceutical science	69	98.60%																					
	Mathematics	86	96.50%																					
	Veterinary science	40	92.50%																					
	Biological sciences	298	91.30%																					
	Medical science	427	88.80%																					
	Physical sciences	185	85.90%																					
	Agricultural sciences	186	79.00%																					
	Health science	46	78.30%																					
	Sport science	42	76.20%																					
	Earth Sciences	92	71.70%																					
	Technology	549	64.70%																					
	Forestry science	23	56.50%																					
Soft sciences	Social studies	189	29.10%																					
	Humanities	593	26.80%																					
	Economics	187	23.50%																					
	Theology	43	16.30%																					
	Law	159	11.90%																					
Arts	Music studies	169	2.40%																					
	Film studies	2	0.00%																					
	Visual arts	70	0.00%																					
	Drama and theatre studies	11	0.00%																					

0% 50% 100%

Note: Fields are sorted according to a percentage of procedures with a series of publications as the main achievement.

similar results for 'Points' (24.4% and 49.1, respectively) and 'Impact Factor' (14.0% and 72.4%, respectively).

The other outlier is Economics in 'Soft Sciences'. Economics constitutes a notably different pattern in which more self-presentations used obligatory codes. The mean number of the codes used in Economics is 3.40 and the mean number of the coded segments is 8.64, whereas for 'Soft Sciences' (except Economics) it is 0.66 and 1.54, respectively. In 'Soft sciences', the codes are substantially less often used than in Economics. For instance, 'Total Impact Factor' is used in 17.6% of self-presentations in Economics (more than in Mathematics), whereas in 3.9% of self-presentations in 'Soft Sciences' (except Economics). There are similar results for, among others, 'Points' (17.6% and 3.9, respectively) and 'Citations' (51.9% and 14.2%, respectively). Nonetheless, 'ERIH' is substantially less frequently used in Economics (4.3%) than in other 'Soft Sciences' (10.1%).

4.3 Beyond typical bibliometric characteristics

In addition to 21 codes related to the use of the *Metrics* or the *Databases*' names for reporting the value of the research results, there can be observed three other ways to present and contextualize the candidates' output, that is, *Printscreens*, *Hand-made bibliometrics*, and *Justification for not being listed in any Database*.

The first way can be observed both in 'Hard sciences' and 'Soft sciences'. In 62 self-presentation documents, I have identified 87 printscreens from different databases, among others, from the WoS (N = 62), Google Scholars Citations (N = 16), and Scopus (N = 4). In all these cases, the printscreens present the name of the candidate and the figures with the number of citations or h-index.

The second way appears in 18 self-presentation documents from various fields (nine of which are from the 'Technology' field). In these cases, the candidates reported the number of citations which did not occur in the WoS, Scopus, or Google Scholar. These presentations were based on the candidates' own calculations and accompanied by lists of sources in which those citations could be found (e.g. master or doctoral theses published only in paper version). In 11 self-presentation documents, the results of this hand-made bibliometrics were presented in various charts, figures, and tables.

The third way can be observed most clearly in self-presentations from the 'Law' category. In 16 of 159 documents from this field, I have identified a paragraph (expressed in almost exactly the same way) in which the candidates justified why their publications were indexed in neither the JCR nor the ERIH. The candidates wrote that their research interests were connected with the continental legal system and in this field monographs and chapters are the main types of publications. Thus, the argument was that the candidates' most important papers were indexed neither in the JCR (since journals devoted to the continental legal system are not indexed in the JCR) nor in the ERIH (since journals from the 'Law' category are not indexed in this reference list). This type of justification has been identified only in one case from other fields. A candidate from the 'Technology' field wrote that their main interest was 'Weaponry', which is why their results could not be published because they were classified.

5. Discussion and conclusion

My most noteworthy finding highlights that patterns of scientometric indicators use are related to the publication patterns and play a central role in the self-presentation practices. In this article, I have provided an analysis of how often researchers use metrics and databases' names to present the value of their research. It has been shown that there are substantial differences in the use of metrics among different fields of science.

Overall, the present findings reveal that researchers in 'Hard sciences' very often use metrics to describe their research output, researchers in 'Soft sciences' only sometimes use metrics, and scholars from 'Arts' hardly ever use metrics to present their portfolio. Thus, the present results confirm the established findings regarding the differences among fields. However, two anomalies can be observed. The first one concerns researchers from the Mathematics field who do not use metrics as often as do scholars from other 'Hard sciences'. This could be explained by different publication habits in the field (Korevaar and Moed 1996). Moreover, Li et al. (2017a) have observed that the citation personal display is significantly lower for researchers from the Mathematics field than for researcher from chemistry and physics.

The other anomaly concerns researchers from 'Economics' who use metrics more often than researchers from other 'Soft sciences'. An explanation for this could be provided by the fact that within 'Economics' itself there is an ongoing debate as to whether this field is to be characterized as a 'hard' or a 'soft' science (Hudson 2017; Mayer 1980). According to Lamont (2009), this oscillating between 'hard' and 'soft' sciences is related to the increasing formalization of this field and—what is more important—is reflected in an evaluation culture of 'Economics'. Moreover, Kulczycki et al. (2018) show that publication patterns in Economics in six European countries (among other in Poland) are substantially different from all other disciplines in 'Soft Sciences'. For instance, in Economics, articles constitute a higher share of the total volume of publications than in Law or Philosophy and Theology. Moreover, publications in English in Economics constitute a higher share of the total volume than in all other disciplines in 'Soft Sciences'.

In light of the present analysis, one can observe that a growing share of articles in 'Soft sciences' (reported by Kulczycki et al. 2018) does not change the key role played by monographs in these fields. In the overwhelming majority, researchers in 'Soft Sciences' indicate monographs as their main achievements. Even in Economics almost twice as many researchers indicate monographs than in Forestry Science, that is, a field from 'Hard sciences' with the smallest share of indicated monographs. The decision of Economics researchers to indicate a monograph as the main achievement may be influenced by the evaluation context. For many years, researchers in the social sciences and humanities in Poland took for granted that the habilitation thesis had to be presented as a monograph. This was not an official regulation but a very common practice and general habit before 2011. Thus, when interpreting the results, it is justified to assume that some candidates for habilitation in Economics believed that their reviewers still shared this common practice and regarded it as the best form of habilitation thesis. Although Economics looks like a 'Soft Science' in terms of the publication patterns, its patterns of scientometrics indicators use are similar to fields in which articles play a more important role. This context of evaluation and the audience to which self-presentation documents are addressed may also influence the results in Mathematics. Researchers may consciously choose to not use metrics for this particular audience, that is the habilitation commission, even though they can do so for certain specific evaluation purposes other than the habilitation procedure.

Two limitations of the present analysis need to be pointed out. The first one concerns the data source. As mentioned in the Materials and Methods section, only documents specific to the Polish context have been analysed. As Li et al. (2017b) show certain national differences between countries can be observed in relation to the degree of attention paid to different metrics. Hammarfelt and Haddow (2018) show that 62% of Australian scholars from the humanities used metrics (e.g. for presenting their research portfolio) in comparison to only 14% of Swedish humanists. Thus, if we assume that scholars in various countries work in various epistemic, metric, and evaluation cultures, then we may say that the results of the present analysis might be biased because of the regulations of the academic promotions procedures in Poland: the requirement to show the values of metrics from the WoS can influence the results. It should be noted, however, that in the present study documents from all fields have been analysed. Although generalization is limited, it is justified to talk about field patterns of scientometric indicators use. The other potential limitation of the present study results from the fact that I analysed only the use of scientometric indicators and did not investigate how scholars understand and perceive them. The character of the data does not allow us to draw conclusions about the technical knowledge, intrinsic motivation, or external pressure that could shape the way in which metrics are used. However, in the set of documents analysed above, I have clearly identified 11 wrong uses of metrics which can be interpreted as resulting from lack of technical knowledge (e.g. one candidate from 'Social studies' wrote that their h-index is 4.25). Intrinsic motivations (e.g. 'how to present my research portfolio in the best possible way') and external pressures (e.g. 'I should present some/many metrics because experts pay particular attention to them') could be investigated directly here. To do this, the present analysis would have to be accompanied by, for instance, in-depth qualitative studies. On the other hand, one can say that the candidates' intrinsic motivation is (to some extent) expressed by their use of various metrics even if there is no obligation to use any in the self-presentation documents. Similarly, certain external pressure can be traced to the research policy (the assessment criteria), which has significantly determined the use of various indicators specific to the Polish context.

In my analysis, I have focused on the frequency with which researchers use metrics in their self-presentation documents. Nonetheless, the data and the findings presented here can be seen as a contribution to the discussion concerning the use of metrics in the academic promotion procedures and research evaluation in general. For instance, the results presented in Table 6 clearly show what metrics and databases are valued differently in the three areas of knowledge (i.e. 'Hard sciences', 'Soft sciences', and 'Arts'). The research policy in Poland can be taken as evidence for which metrics are actually used and which can be employed in the promotion procedures in various fields. For instance, it is clear that WoS, h-index, and Total Impact Factor are not perceived by researchers from 'Soft sciences' as indicators that provide important information about their research in this particular evaluation context. It is possible that researchers consider some indicators to be not that relevant for the habilitation commission, but crucial for a more specific context (e.g. a letter of recommendation). Thus, candidates for habilitation adjust the form and content of their self-presentation to the actual audience. In this way, researchers can control the impression they give off themselves by using specific indicators. That is why researchers from 'Soft sciences' used Google Scholar more often to present the number of citations than WoS.

Evaluation of the social sciences and humanities should rely on different sources and criteria of research quality (Giménez-Toledo et al. 2017; Ochsner et al. 2016). At the same time, one might consider the possibility of changing the set of obligatory databases given in the first category of the assessment criteria. As the present findings illustrate researchers from various fields use not only WoS but also Scopus and Google Scholar. Moreover, the findings unambiguously show that using any metrics or databases for assessing scholars from 'Arts' is not justified because these scholars do not consider this to be relevant information for the habilitation commission in this evaluation context.

Finally, it can be concluded that different metric-wiseness patterns reflect different views on the evaluation cultures in given fields. The present findings show that for many researchers the scientometric indicators play an important role in constructing their idealized version of themselves are prepared for both the evaluators and for the general audience. They use metrics even if it is not obligatory. Therefore, the next step of research into the use of scientometric indicators could be an in-depth investigation of researchers' intrinsic motivations and external pressures to which they are subject. It could provide us with a deeper understanding of the consequences of using metrics in research practices and research evaluation.

Notes

1. http://www.ck.gov.pl/articles/id/47.html, Online access: 10 November 2017.
2. Regulation of the Minister of Science and Higher Education of 1 September 2011 regarding the criteria for assessing the accomplishments of a person aspiring for the degree of habilitated doctor (Journal of Laws of 2011, No. 196, item 1165).

Acknowledgements

An earlier version of this text was presented at the 22 Nordic Workshop on Bibliometrics and Research Policy in November 2017. I would like to thank the audience for their support. I also would like to extend my thanks and appreciation to Mikolaj Domaradzki and Ewa A. Rozkosz for their useful suggestions and helpful remarks. Moreover, I would like to thank the Poznan Supercomputing and Networking Center for the help with converting the scanned paper documents into searchable files.

Funding

This work was supported by the National Programme for the Development of Humanities in Poland [grant number 0057/NPHR3/H11/82/2014].

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Appendix. Classification of areas of knowledge, fields of sciences/art, and disciplines

This classification follows the official translation of the *Rozporządzenie Ministra Nauki i Szkolnictwa Wyższego z dnia 8 sierpnia 2011 r. w sprawie obszarów wiedzy, dziedzin nauki i sztuki oraz dyscyplin naukowych i artystycznych* (Dz.U. 2011 nr 179 poz. 1065) [ang. The regulation of the Minister of Science and Higher Education of 8 August 2011 on the areas of knowledge, fields of science and art, and scientific and artistic disciplines].

Area	Field	Discipline
Humanities	Humanities	Archaeology
		Library and information science
		Ethnology
		Philosophy
		History
		History of Art
		Linguistics
		Cultural studies
		Literary studies
		Family sciences
		Arts
		Management
		Religious studies
	Theology	
Social studies	Social studies	Safety
		Defence studies
		Media studies
		Political science
		Public policy
		Cognitive studies and social communication
		Education
		Psychology
		Sociology
	Economics	Economics
		Finance
		Management
		Commodity studies
	Law	Public administration
		Law
		Canon law
Physical sciences	Mathematics	Mathematics
		Information science
	Physical sciences	Astronomy
		Biophysics
		Physics
		Geophysics
	Chemical sciences	Biochemistry
		Biotechnology
		Chemistry
		Environmental protection
		Chemical engineering
Biological sciences	Biological sciences	Biochemistry
		Biophysics
		Biology
		Biotechnology
		Ecology
		Microbiology
		Environmental protection
	Earth sciences	Geophysics
		Geography
		Geology
		Oceanography

(continued)

Appendix. Continued

Area	Field	Discipline
Technological sciences	Technology	Architecture and urban planning
		Automation and robotics
		Biocybernetics and biomedical engineering
		Biotechnology
		Mechanical engineering
		Construction
		Electronics
		Electronic engineering
		Energetics
		Geodesy and cartography
		Mining and engineering geology
		Information science
		Chemical engineering
		Material sciences and engineering
		Industrial engineering
		Environmental engineering
		Mechanics
		Metallurgy
		Chemical technology
		Telecommunications
		Transportation
		Textile engineering
Agricultural, forestry and veterinary sciences	Agricultural sciences	Agronomy
		Biotechnology
		Agricultural engineering
		Environmental sciences
		Horticulture
		Aquaculture
		Food science
		Animal husbandry
	Forestry science	Wood technology
		Forestry
	Veterinary science	
Medical, health and sport sciences	Medical science	Medical biology
		Medicine
		Dentistry
	Pharmaceutical science	
	Health science	
	Sport science	
The arts	Film studies	
	Music studies	Conducting
		Musical instruments
		Composition and musical theory
		Sound design
		Rhythm and dance
		Voice studies
	Visual arts	Fine arts
		Art and design
		Conservation and restoration
	Drama and theatre studies	