The visibility of philosophy of science in the sciences, 1980-2018

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Abstract

In this paper, we provide a macro level analysis of the visibility of philosophy of science in the sciences over the last four decades. Our quantitative analysis of publications and citations of philosophy of science papers, published in 17 main journals representing the discipline, contributes to the longstanding debate on the influence of philosophy of science on the sciences. It reveals the global structure of relationships that philosophy of science maintains with science, technology, engineering and mathematics (STEM) and social sciences and humanities (SSH) fields. Explored at the level of disciplines, journals and authors, this analysis of the relations between philosophy of science and a large and diversified array of disciplines allows us to answer several questions: what is the degree of openness of various disciplines to the specialized knowledge produced in philosophy of science? Which STEM and SSH fields and journals have privileged ties with philosophy of science? What are the characteristics, in terms of citation and publication patterns, of authors who get their philosophy of science papers cited outside their field? Complementing existing qualitative inquiries on the influence of specific authors, concepts or topics of philosophy of science, the bibliometric approach proposed in this paper offers a comprehensive portrait of the multiple relationships that links philosophy of science to the sciences.

Keywords: philosophy of science, visibility, sciences, bibliometrics, citation analysis.

Introduction

Philosophers, and other scholars of the social sciences and humanities, have only recently started to use quantitative methods to analyze the structure of the field of philosophy and its different subfields. For instance, using bibliographic coupling, Noichl (2019) found that the disciplinary structure of philosophy was quite cohesive, and that the

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usual division between analytic and continental philosophy was in fact overstated. Some authors have applied text mining and computational topic-modeling algorithms to identify the historical evolution of key research topics in major philosophy of science journals (Malaterre et. al. 2019; Malaterre et. al. 2020). Others have used co-citation analysis to identify the set of central journals defining the field of philosophy of science (Wray 2010), the publications and authors that have had the most influence in the fields of philosophy of science (Wray and Bornmann 2015) and analytical philosophy (Petrovich and Buonomo 2018), as well as the representative topics of the discipline of philosophy (Healy 2013). Finally, other authors have applied bibliometric methods to study the relationship between philosophy of science and other fields or disciplines. Weingart (2014) used co-citation networks and bibliographic coupling to analyze the relationship between philosophy of science and history of science. Kreutzman (2001) used author co-citation analysis to study the relationship between philosophy of science and epistomology, while McLevey et. al. (2018) developed exponential random graph models to assess the effect that publishing in science journals has on the accumulation of symbolic capital inside the field of philosophy of science. Building on these studies, our paper aims, using citation analysis and citation networks, at assessing the changing visibility of philosophy of science in other fields of the natural sciences, engineering and mathematics (STEM) and the social sciences and humanities (SSH) over the last four decades.

Whether philosophy of science is, should be, or could be, useful to science and/or influences, should influence, or could influence science is a longstanding debate that has been recently reignited by philosophers of science as well as scientists (e.g. Pernu 2008; Pigliucci 2008; Rovelli 2018; Laplane et. al. 2019; De Haro 2020; Boniolo and Campaner 2020). Advocates of a wider diffusion of ideas and tools developped in philosophy of science, and of a tighter relationship between philosophy of science and the sciences, have mainly relied on individual examples of philosophers of science who have made significant philosophical contributions to understanding and resolving scientific problems, clarifying scientific concepts or critiquing scientific assumptions (Laplane et al. 2019). However, up to now, there are few empirical analyses that have assessed, on a larger scale, the extent to which the knowledge produced inside the field of philosophy of science has been actually used, or at least referred to, in science (Pradeu et al., submitted). This paper sheds light on

this issue from a broader and more quantitative perspective, by measuring the visibility of philosophy of science papers in the sciences, through citations made to philosophy of science journals by STEM as well SSH disciplines. Explored at the three levels of disciplines, journals and authors, this quantitative analysis allows us to unveil several features of the relationship and interface between philosophy of science and a large and diversified array of disciplines.

In this paper, visibility is defined through the citations that the field of philosophy of science, its journals and its authors, has received from other sciences over the last four decades. We use the term "visibility" of philosophy of science in the sciences, rather than "influence" or "impact", because "visibility" describes in a more neutral and accurate way the very fact of being cited. Indeed, a philosopher doesn't need to be formally cited by authors from other sciences to influence them. For instance, although Einstein acknowledged the influence that David Hume and Ernst Mach's philosophy had on his theory of special relativity (Norton 2010), this influence did not translate into formal citations from his physics papers to Hume's and Mach's philosophical works. Another form of implicit scientific acknowledgement was underscored by sociologist Robert K. Merton, who identified the phenomenon of "obliteration by incorporation", according to which classic sources, although considered foundational, stop being cited (e.g., Galileo, Newton, Einstein) as they become taken for granted in a given scientific field (Merton 1988).

While influence doesn't necessarily translate into visibility, on the opposite, visibility does not necessarily mean influence. Indeed, as noted by MacRoberts and MacRoberts (1986, p. 167), "the mere presence of a reference is not a marker of influence, nor is the absence of a reference evidence that it is uninfluential". In that respect, Moravscik and Murugesan (1975) opposed "organic" and "perfunctory" citations, to establish the difference between citations that are "truly needed for the understanding of the referring paper" and express a genuine influence, and citations that are "mainly an acknowledgment that some other work in the same general area has been performed" (Moravscik and Murugesan 1975, p. 8). Since it is not the purpose of this paper to qualitatively evaluate the nature of citations made to philosophy of science by other disciplines, we refer to

citations made to philosophy of science articles, journals and authors outside the field of philosophy of science as the visibility of philosophy of science in other sciences. We are here interested in the visibility of philosophy of science works in science at a global level, and propose a macroscopic analysis of the links between the discipline of philosophy of science and other scientific disciplines like biology, physics, mathematics, etc. Despite the existence of perfunctory citations, it remains that the act of citing a paper provides a reliable proxy for evaluating the degree of symbolic recognition that disciplines, journals and authors receive in the reward system of science (Merton 1973), as has been already documented in many sociology of science and bibliometric studies (Cole and Cole 1967; Garfield 1972; Price 1976; Merton 1988, Gingras 2016).

Analyzing citation flows between disciplines and citation networks contribute to our understanding of the structure of relationships, at a macro level, that philosophy of science maintains with other disciplines. Using quantitative bibliometric methods helps answer questions such as: what is the degree of openness of various disciplines to the specialized knowledge produced in philosophy of science? Which STEM and SSH fields and journals have privileged ties with philosophy of science? What are the characteristics, in terms of citation and publication patterns, of philosophy of science authors who get their philosophy of science papers cited outside their field? All these questions could, of course, be explored through qualitative inquiries and interviews on the influence of specific authors, topics or subfields of philosophy of science on other disciplines, but these inquiries could only offer a very limited portrait of the global structure of the multiple relationships that links philosophy of science to STEM and SSH disciplines. The global structure of those links can only be made visible by using tools developed in bibliometrics over the last forty years (Price 1963). In this paper, we have deliberately stuck to a descriptive stance, as our aim is first to replace hypothetical or fantasized views – that either exaggerate or downplay the visibility of philosophy of science in the sciences – with empirically validated data of the kind of relations they really entertain. In a complementary paper (Pradeu et al. submitted), we will try to characterize the precise philosophical content of the papers that happen to be much cited by scientists.

Bibliometric definition of the field of "philosophy of science"

In order to obtain a representative landscape of the field of philosophy of science, we have selected 17 major philosophy of science journals included in the Clarivate Analytics Web of Science (WoS) database, one of the most commonly used in bibliometric studies, which also contains data on thousands of journals in all STEM and SSH disciplines. That same database also gives us all the citations to the papers published in the selected philosophy of science journals coming from journals in the STEM and SSH disciplines between 1980 and 2018. The WoS includes the Science Citations Index Expanded, the Social Sciences Citation Index, and the Arts and Humanities Citation Index. The disciplinary classification of journals used in this paper is that of the U.S. National Science Foundation[5]. This classification has the advantage of categorizing each journal into one single discipline, which avoids double counting and attributing citations made by a given journal to several disciplines. While philosophy of science is not formally defined in this classification as a single field or specialty of philosophy, we consider our list of 17 major philosophy of science journals as representative of the field, because they obviously include all the journals that most philosophers of science recognize as central in that domain. These journals are: *Philosophy of Science*, *The British Journal for the Philosophy of Science*, *Synthese*, *Studies in History and Philosophy of Science* (and its offsprings Part A, B, and C from 1998 onward), *Erkenntnis*, *European Journal for the Philosophy of Science*, *International Studies in the Philosophy of Science*, *Journal for General Philosophy of Science*, *Foundations of Science*, *Hyle*, *History and Philosophy of the Life Sciences*, *Biology & Philosophy*, *Theoretical Medicine and Bioethics*, *Journal of Medicine and Philosophy*, *Medicine Health Care and Philosophy*. In addition to including the most central journals in philosophy of science (Wray 2010), this list of 17 journals covers large areas of philosophy of science, where researchers are the more active, such as philosophy of biology, philosophy of physics, and philosophy of medicine which is well represented with three journals.

[5] https://www.nsf.gov/statistics/nsf13327/pdf/tabb1.pdf

Of course, philosophy of science articles are sometimes also published in more generalist philosophy journals, such as *The Journal of Philosophy* or *Nous*, and most importantly in philosophy of science books and edited volumes. In this study, citations made to philosophy of science books and book chapters are not included in our sampling, since this would have required to identify beforehand and manually all philosophy of science books that have been published in the last several decades – an obviously impossible task. However, given that our aim is not to construct a list of "most cited" people but to analyze the global links between disciplines, our selected list of 17 central philosophy of science journals allows us to define a representative community of authors in that field. Although citations made to philosophy of science books and book chapters are not counted, the several thousand articles contained in our list of 17 central philosophy of science journals, which are cited over a period of 40 years, provide us with a very strong statistical sample to determine the general structure of citation flows from STEM and SSH disciplines to philosophy of science as a discipline. Given that books are still important in philosophy, one could also argue that we should take into account citations coming *from* books and not only from journal articles. However, we have shown elsewhere that such an inquiry does not change substantially the general pattern observed through the lens of academic journals (Gingras and Khelfaoui 2019). The basic reason is that it would be very unlikely that a prominent or visible philosopher of science who would be cited for influential monographs or for papers he or she has published in general philosophy journals would not also have published papers in philosophy of science journals, and thus be cited for these papers. For all these reasons, we are confident that our list of 17 major philosophy of science journals provides a very representative, though not exhaustive, sample of the academic production in that field.

We assess the visibility of philosophy of science, that is of all authors who did publish in the selected journals regardless of their backgrounds and affiliations, in the other scientific fields at three levels: disciplines, journals and authors. At the discipline level, we analyze citation flows from STEM and SSH disciplines to the field of philosophy of science, as defined by our list of 17 journals. More precisely, we count the references made, between 1980 and 2018, by all disciplines to each of the 17 philosophy of science journals. The results obtained in this part of the paper allow us to determine which STEM and SSH

disciplines are the most likely to cite philosophy of science, since we don't expect the external visibility of philosophy of science to be evenly distributed amongst all disciplines. In addition to establishing the degree of openess of STEM and SSH disciplines to philosophy of science, the results also allow us to define its level of insularity, that is, the degree to which a field is self-referencing. Total citations to philosophy of science from other disciplines are then calculated for each decade of the 1980-2018 period, in order to observe possible variations over time. Finally, in order to establish if the levels of insularity and visibility observed for philosophy of science are low, normal or high, we compare the results with those obtained for the the remaining field of general philosophy, as well as those obtained for the field of science studies, which shares a similar interest in science as philosophy of science, but from sociological and historical perspectives.

From the discipline macro level, we move a step further to analyze the visibility of philosophy of science in other sciences at the journal level. We do this by ranking the top-10 journals of each the STEM and SSH disciplines that cite the most philosophy of science journals and the top-5 philosophy of science journals cited by these disciplines. We thus focus on the journals that cite philosophy of science the most, though these journals are not necessairly the ones that are themselves the most cited in their own scientific discipline (as a way of illustration, in biology, these ten journals are, in the recent period: *Acta Biotheoretica, Journal of Theoretical Biology, Evolutionary Biology, Theory in Biosciences, Cladistics, Evolution, Biosystems, Journal of Experimental Zoology Part B, Biology Direct,* and the *Journal of Evolutionary Biology*). While citation flows at the discipline level help us identify the STEM and SSH disciplines that cite the most philosophy of science, citation analysis at the journal level provides us with a more precise idea of the subfields of these discipline that have a particular affinity with philosophy of science. For instance, in biology, we expect, for obvious reasons, that journals in the subfield of evolutionary biology are more likely to cite philosophy of biology articles than journals in the subfield of biochemistry or oceanography. Similarly, in physics, we expect theoretical physics journals to be more likely to cite philosophy of modern physics articles than applied physics or optics journals. The list of top-10 citing and top-5 cited journals is also established for each decade of the 1980-2018 period, in order to observe possible variations over time. Similarly, a time analysis of the top-5 cited philosophy of science

journals in each citing discipline makes it possible to observe variations over time in the philosophy of science journals that are of interest to other disciplines. For instance, if biology consistently cites philosophy of science journals, we expect that *Biology & Philosophy*, as well as *Studies in History and Philosophy of Biological and Biomedical Sciences* will appear amongst the most visible philosophy of science journals in these disciplines. We also expect that, with the rise of ethical issues in the contemporary practice of medicine and biology, medicine and biomedical sciences will show over time a more pronounced interest for medical ethics and bioethics journals, such as *Theoretical Medicine and Bioethics*.

Journal rankings only provide a limited description of citation flows from STEM and SSH journals to philosophy of science journals, since they only give, for each citing discipline, information on the top-10 citing and top-5 cited journals. In complement to these rankings, we generated citation networks, using the open-source visualization software Gephi (Cherven 2013), to provide a more comprehensive picture of the citation relationship between philosophy of science journals and *all* other STEM and SSH journals. Citation networks are represented by nodes connected by edges. Each node represents either a citing journal or a philosophy of science cited journal. Nodes representing philosophy of science journals are colored in red, in order to distinguish them from other citing journals. Edges represent citations from STEM or SSH journals to philosophy of science journals. The more a STEM or SSH journal cites a given philosophy of science journal, the thicker will be the edge that connects them. The more a philosophy of science journal receives citations from different STEM or SSH journals, the more central its position will be in the network, and the larger the size of its node will be. We show three different networks that represent citation flows from STEM journals, social science journals, and humanities journals to our 17 philosophy of science journals. In order to facilitate the visibility of the main nodes of the network, we only show links between journals with at least 15 citations between 1980 and 2018. One of the main features of the Gephi software is its use of the Louvain community detection algorithm to identify coherent clusters (identified by nodes of the same color) within a larger network (Blondel et al. 2008). In our case, these clusters represent different communities of journals that share the particularity of citing the same philosophy of science journals. In this regard, citation networks do not only provide a more

comprehensive picture of the journals who cite philosophy of science, but also allow to define sub-communities of citing journals, which might be composed of different STEM, social science or humanities disciplines.

From the journal level, we then move to the author level. We define a list of authors who have contributed as first authors at least one article in one of the 17 philosophy of science journals and have received for their articles at least 20 citations from STEM journals or 20 citations from philosophy of science journals, between 1980 and 2018 (we apply the 20 citations threshold over the period to keep the number of authors in the network manageable). While the choice of counting citations to first co-authors is dictated by technical constraints, it remains that 86% of the articles published in our sample of 17 philosophy of science journals are single authored. Moreover, it is very unlikely that any important philosophy of science author would be cited solely for articles where he or she appears as second or third co-author. Thus, we are confident that by counting citations only to first co-authors, and by using a low citation threshold of 20 citations over a 30 years period, we adequatley capture the global visibility of philosophers of science. Through this method, we can define three different communities of authors: 1) authors of philosophy of science articles who remain mostly cited, and therefore visible, in the field of philosophy of science; 2) authors who get cited in both philosophy of science and STEM disciplines; and 3) authors who get mostly cited, and are thus mainly visible, in STEM disciplines. We then use the citation and publication patterns of these authors to identify the characteristics that seem to allow their philosophy of science articles to transcend the boundaries of their field and gain visibility in science disciplines.

Which scientific disciplines cite philosophy of science journals?

We start by assessing the visibility of philosophy of science in other sciences at the discipline level. In **Figure 1**, an alluvial chart provides the distribution of citations from different STEM and SSH disciplines to philosophy of science, between 1980 and 2018. It shows that 30.2% of all citations to philosophy of science come from that field, and that 19.7% come from the rest of philosophy. Overall, 49.9% of the citations made to philosophy of science journals come from philosophy, broadly defined (i.e., including philosophy of science). Our results confirm McLevey's et. al. finding that "roughly half

of the citations to articles in (philosophy of science) journals come from journals in different disciplines" (McLevey et. al., 2018). With 28.8% of citations, SSH is the second grand disciplinary field citing philosophy of science. Psychology, health and science studies are the three SSH discplines that cite the most philosophy of science journals. With 21.3% of citations, STEM is the third grand disciplinary field citing philosophy of science. As in SSH disciplines, citations to philosophy of science are not evenly distributed among STEM disciplines. Indeed, clinical medicine, biology and physics are the three disciplines where philosophy of science is the most visible, while it is almost invisible in a field such as chemistry, or earth and atmospheric sciences. These differences might be explained by the fact that those disciplines tend to be more applied and less fundamental. The fact that some sub-specialties of philosophy of science, like philosophy of chemistry or enginering, developed only recently may also contribute to explain that low level of visibility.

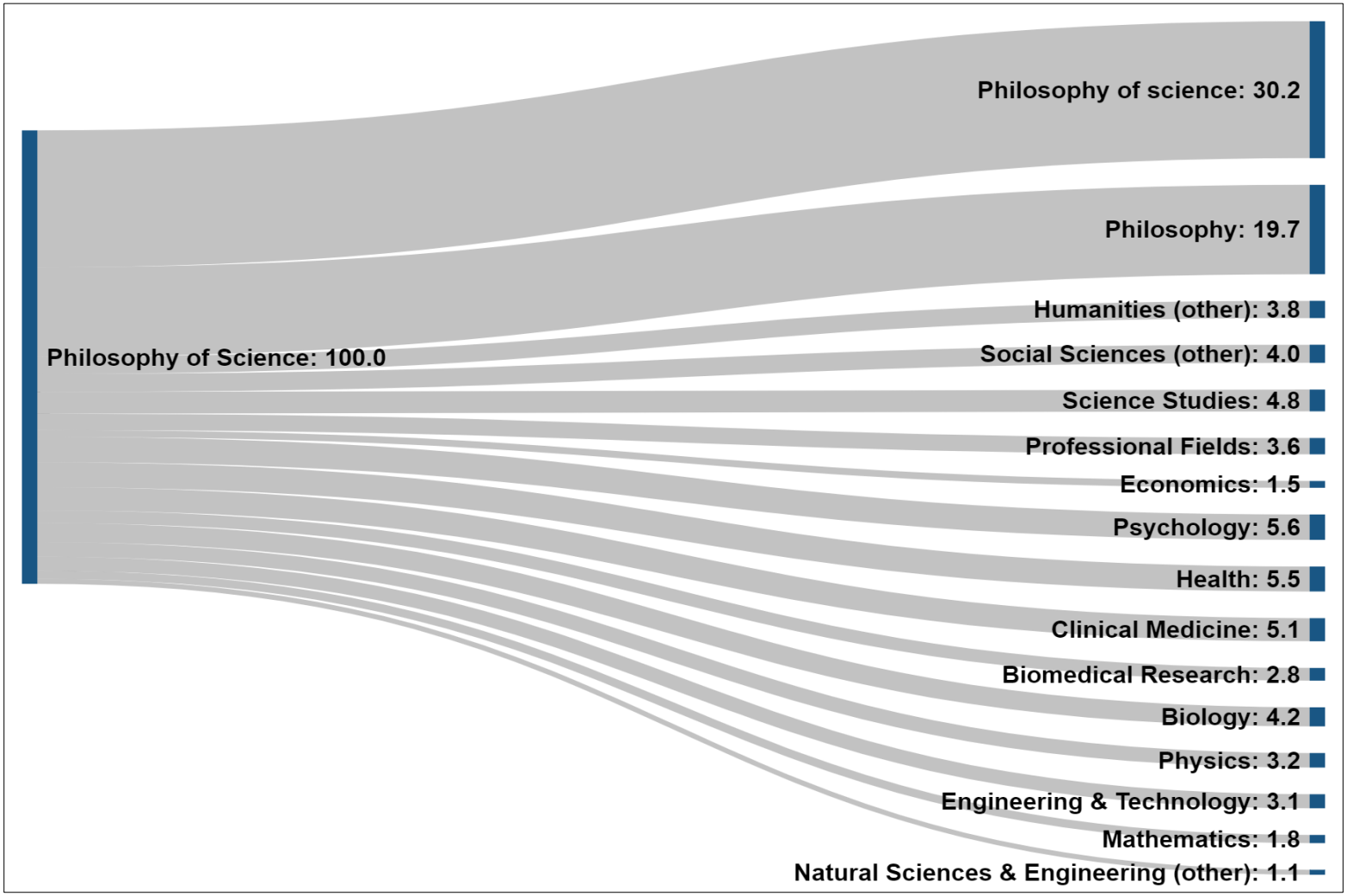
Another part of the explanation for the tendency of some scientists to cite philosophy of science could come from some recent evolutions in the field of philosophy of science. These evolutions might include:

i) an increasing focus on philosophy of special sciences (philosophy of biology, physics, and so on) rather than general philosophy of science (Mizrahi 2020);

ii) the emergence of "philosophy of science in practice", an approach "dedicated to fostering the pursuit of a philosophy of science that considers theory, practice and the world simultaneously, and never in isolation from each other" (Ankeny et al. 2011);

iii) an emphasis, by an increasing number of philosophers of science, on advancing science rather than simply discussing science. We have proposed an in-depth analysis of this latest aspect in another paper (Pradeu et al. submitted). We called it "philosophy *in* science", and defined it by the use of philosophy as a toolbox to help solve scientific problems. "Philosophy in science" is particularly prone to have a higher visibility in science, because it tends to raise the exact same questions that scientists themselves are trying to solve in their daily practice.

Figure 1 - Distribution of citations to philosophy of science journals coming from other disciplines between 1980 and 2018 (%)



As shown in **Table 1**, when compared to philosophy of science, the rest of the field of philosophy is significantly more self-referencing, since 57.1% of citations to philosophy are internal to this field (excluding philosophy of science), while 9.4% of citations to philosophy are from philosophy of science journals. This difference between philosophy and philosophy of science is mainly attributable to an effect of field size. Indeed, since the field of philosophy includes significantly more journals and researchers than the subfield of philosophy of science, it is not surprising that many more citations are generated within the field of philosophy, since the potential number of citing items is larger. While its share of citations from SSH disciplines is equivalent to that of philosophy of science (27.5%), the rest of the field of philosophy receives, as could be expected, much less citations from STEM disciplines, with only 5.9%, comparatively to 21.3% for philosophy of science. When compared to the field of science studies, which also has an interest in science but from a more sociological and historical perspective, philosophy of science has a similar visibility in STEM disciplines (21.3% for philosophy of science vs 18.5% for science studies). Both fields also have a similar level of insularity or percentage of self references (30.2% philosophy of science vs 29.2% for science studies).

Table 1 – Distribution of citations made to philosophy, philosophy of science and science studies journals from other disciplines

Research fields	Philosophy of science	Philosophy	Other Social sciences and humanities	Natural Sciences and Engineering
Philosophy of science	30.2	19.7	28.8	21.3
Philosophy	9.4	57.1	27.5	5.9
Science studies	2.7	1.4	77.4 (29.2 in science studies)	18.5

Table 2 provides the distribution of citations to philosophy of science made by other disciplines, for each decade of the 1980-2018 period. The breakdown by decade makes visible the variations through time in the share of citations made by each major discipline to philosophy of science. The level of self-referencing of philosophy of science has increased from 26.9% to 31.8% between 1980 and 2018, while the share of citations received from philosophy has decreased from 25.9 to 19.9% during the same period. This

result suggests that the specialty of philosophy of science has grown in size, including more journals and more researchers, and become more autonomous from the rest of philosophy. The disciplines of health and clinical medicine are those where philosophy of science has increased its visibility the most as compared to other STEM and SSH fields (from 1.7 to 6.1% in health, and from 2.8 to 5.2% in medicine). This can be explained by the rise of ethics-related issues in these two fields, reflections that generate more citations to publications on medical ethics in the field of philosophy of science. Other disciplines where the visibility of philosophy of science has not changed significantly over time are biology, physics, mathematics, engineering, professional fields and science studies. It is also interesting to observe that the visibility of philosophy of science has experienced an important decline in psychology (from 8.1 to 4.8%), economics (from 2.8 to 1.2%), and language and linguistics (from 2.5 to 1.1%). However, this decline might only be apparent and biased by the fact that three interdisciplinary journals with a huge philosophical focus, *Philosophy and Psychology*, *Economics and Philosophy*, *Linguistics and Philosophy* are classified in the WoS database as being part of these three disciplines and not as philosophy journals. When citations to these three journals are considered as citations to philosophy of science journals, the visibility of philosophy of science in psychology declines from 8.1 to 5.7%, in economics from 2.9% to 1.7%, and in language and linguistics from 5.0% to 4.6%. Thus, while the decline of the philosophy of science in psychology and economic is confirmed, the inclusion of *Linguistics and Philosophy* in the list of philosophy of science journals shows that the visibility of philosophy of science has remained stable over time in the discipline of language of linguistics.

Table 2 - Distribution of citations to philosophy of science journals made by STEM and SSH disciplines, percentage by decade

Discipline	1980-1989	1990-1999	2000-2009	2010-2018
Philosophy of Science	26.9	27.9	29.2	31.8
Philosophy	25.9	19.7	17.2	19.9
Biology	4.2	4.6	5.5	3.4
Physics	2.3	2.9	3.4	3.3
Engineering & Technology	2.0	4.1	3.7	2.8
Mathematics	1.5	1.2	1.5	2.0
Biomedical Research	1.2	1.7	2.6	3.3

Medicine	2.8	4.6	6.3	5.2
Psychology	8.1	7.6	5.6	4.8
Health	1.7	4.5	6.7	6.1
Professional Fields	3.7	4.5	3.3	3.4
Science Studies	4.3	3.6	4.4	4.6
Economics	2.8	2.2	1.5	1.2
Language & Linguistics	2.5	1.7	1.5	1.1
Other STEM or SSH disciplines	11.1	9.2	7.6	7.1
Total	100.0	100.0	100.0	100.0

Which scientific journals cite philosophy of science journals?

It is well known that the distribution of citations within a set of journals is not homogeneous and rather follows in general a power law such that a minority of journals account for the large majority of the citations received. It is thus useful to observe the level of concentration of citations among the top-ten citing journals for each citing discipline. This measure gives an indication of the degree of dispersion of citations made to philosophy of science among the many journals of each citing discipline. The more citations are concentrated in the top-10 citing journals, the more the interest of that discipline in philosophy of science is restricted to a limited number of journals, which may indicate that there exists a sub-community of that discipline with a special interest for those philosophical questions about their science. As shown in **Table 3**, a first general observation is that, between 1980 and 2018, the concentration of citations to philosophy of science has declined in all other disciplines' top-10 citing journals, except for mathematics which, after a significant decline in concentration (from 68.2 to 50.5% between 1980 and 2009), has increased to its initial level, due to an important surge in citations to philosophy of science journals in the *Review of Symbolic Logic*. Overall, philosophy of science has enjoyed a larger spread and visibility among science journals of disciplines other than mathematics over the last four decades. Disciplines where citations to philosophy of science journals have dispersed in a larger number of journals are science studies, physics, engineering and technology, health, medicine, and economics. Disciplines where concentration of citations has not changed substantially are psychology, language and linguistics, and biology.

Table 3 – Proportion of citations to philosophy of science coming from top-10 citing journals, by discipline

Discipline	1980-1989	1990-1999	2000-2009	2010-2018
Philosophy	43.1	46.8	40.8	31.3
Biology	40.3	35.9	39.9	30.6
Physics	79.4	77.6	55.0	56.6
Engineering & Technology	64.7	57.9	59.5	47.0
Mathematics	68.2	54.5	50.5	69.3
Clinical Medicine	38.4	20.6	14.9	20.6
Health	63.3	55.8	52.6	44.1
Psychology	52.5	47.4	48.5	48.6
Science Studies	88.2	85.2	70.9	60.5
Economics	71.7	61.7	62.0	53.7
Language & Linguistics	73.1	81.1	80.1	68.6

In Appendix A, the visibility of philosophy of science is further analyzed by looking, for each discipline and decade, at the top-10 journals citing philosophy of science, as well as the top-5 cited philosophy of science journals. In some STEM disciplines, the top-10 journals citing philosophy of science share the particularity of focusing on the theoretical foundations and principles of their discipline and of hosting scientific papers of a conceptual and philosophical nature. This is, for instance, the case of biology which counts amongst its top-10 citing journals *Acta Biotheoretica*, the *Journal of Theoretical Biology*, and *Theory in Biosciences*. Journals focusing on the topics of evolution (*Evolution*, *Evolutionary Biology*), biological systematics (*Systematics Biology*, *Systematics Zoology*, *Systematics Botany*), and cladistics (*Cladistics*) are also amongst the top biology journals citing consistently philosophy of science across the whole studied period. Unsurprisingly, the most popular philosophy of science journal cited by the discipline of biology is *Biology & Philosophy*; it is followed by *Philosophy of Science*, *The British Journal for the Philosophy of Science*, *Studies in History and Philosophy of Science* (before 2000), and *Studies in History and Philosophy of Science – Part C* (which has an obvious focus on biology), also remain consistently in the top-5 cited philosophy of science journals over the whole analyzed period.

In the case of physics, the top-10 journals citing philosophy of science are also interested in the theoretical and conceptual foundations of the discipline. Over the four decades, *Foundations of Physics* remains the top journal citing philosophy of science,

followed by *International Journal of Theoretical Physics*. *American Journal of Physics* also consistently cites philosophy of science, which is not surprising, since this journal has a strong focus on methods and pedagogical issues in the teaching of physics, which can benefit from philosophical insights for the transmission of knowledge in this discipline. Some specialties of physics seem also more likely to cite philosophy of science journals than others. It is the case of particle physics, atomic and molecular physics (*Physical Review D*, *Physical Review A*), which might cite philosophy of quantum physics articles, gravitation (*Classical and Quantum Gravity*), and mathematical physics (*Philosophical Transactions of the Royal Society – Part A*, *Journal of Mathematical Physics*, *Physics Journal A*). Between 1980 and 1999, *Philosophy of Science* is the most cited philosophy of science journal by physics journals, but it is replaced in the 2000-2018 period by *Studies in History and Philosophy of Science - Part B,* which has an exclusive focus on the history and philosophy of modern physics.

Citations to philosophy of science journals from the discipline of mathematics come from three main specialties: probability and statistics, logics, and applied mathematics. Between 1980 and 1999, mathematics journals citing philosophy of science are mainly focused on issues of statistical inference and probabilistic causality on the one hand (*Annals of Statistics*, *American Journal of Statistical Inference*), and logic on the other hand (*Journal of Symbolic Logic*, *Annals of Pure and Applied Logic*). While philosophy of science articles remain visible in logic journals between 2000 and 2018, mathematics applied to computer science and artificial intelligence (*Fundamenta Informaticae*, *Annals of Mathematica and Artificial Intelligence*) become much more open to philosophy of science during the same period. By contrast, between 2000 and 2018, statistics journals almost disappeared from the top-10 mathematics journals citing philosophy of science. In engineering and technology journals, citations to philosophy of science journals are mainly concentrated in the subfield of computer science, more particularly around the topics of fuzzy sets, artificial intelligence and cybernetics (*Fuzzy Sets and Systems*, *Artificial Intelligence*, *Minds and Machines*, *Kybernetes*). *Synthese*, followed by *Philosophy of Science*, is the most cited philosophy of science journals by both disciplines of mathematics and engineering and technology. This is not surprising since some subfields of these two disciplines share a similar interest in philosophy of science.

Medicine and health share a common interest in ethical and bioethical issues raised by philosophy of science. The top-10 medicine journals citing philosophy of science journals cover a wide spectrum of medical specialties, ranging from biomedicine, internal medicine, epidemiology, pediatrics, geriatrics, critical care, psychiatry, to brain research. This disciplinary diversity confirms a result obtained in Table 3 that showed that, over the four analyzed decades, medicine has the lowest concentration of philosophy of science citations in its top-10 citing journals. In other words, as compared to other STEM and SSH disciplines, interest for philosophy of science in medicine is more widely spread across its different specialties. In the social sciences of health, citations to philosophy of science journals come mainly from medical ethics and nursing ethics journals (*Medical Ethics*, *Bioethics*, *Nursing Ethics*). The journal *Social Science & Medicine* also cites highly philosophy of science journals, mainly for articles related to medical and social ethics. Unsurprisingly, three philosophy of science journals, with a large focus on ethics and bioethics, are the most cited by both medicine and health disciplines: *Journal of Medicine and Philosophy*, *Medicine, Heath Care and Philosophy*, and *Theoretical Medicine and Bioethics*.

In the field of psychology, the top-10 journals citing philosophy of science are mainly concentrated in the two subfields of behavioral science (*Behavioral and Brain Sciences*, *Journal of Brain Behavior*) and cognitive science (*Cognition*, *Cognitive Science*). Theoretical psychology journals, such as *Theory in Psychology* and *New Ideas in Psychology*, as well as interdisciplinary journals such as *Frontiers in Psychology* and *Psychology and Philosophy* (which is devoted to studying the links between psychology and philosophy) are also amongst these top-10 citing journals over the four decades analyzed here. The most cited philosophy of science journals in psychology are also the most central in the field of philosophy of science (Wray 2010): *Philosophy of Science*, *The British Journal for the Philosophy of Science*, and *Synthese*. Finally, in the field of science studies, philosophy of science articles are mainly cited by sociology of science and technology journals (*Social Studies of Science*, *Science, Technology and Human Values*), history of science (*Isis*, *History of Science)*, and history of biology journals (*Journal of the History of Biology*, *British Journal for the History of Science*). The most cited philosophy of science journals in science studies is *Studies in History and Philosophy of Science – Part*

A, which is not surprising since philosophy of science is closely linked with the field of science studies (including history of science), through the intermediate field of history and philosophy of science (HPS) (see Figure 1 in Weingart 2015, p. 208).

Network of relations between journals

The relationship between citing STEM and SSH journals and cited philosophy of science journals can be further explored through journal citation networks presented in figures 2, 3, and 4. **Figure 2** shows the network of STEM citing journals and philosophy of science cited journals. The network displays four distinct citing communities which are colored in blue, green, red and purple. At the right of the network, the blue community represents STEM journals that cite philosophy of medicine journals, with *Journal of Medicine and Philosophy* being, by far, the most cited in this community. Unsurprisingly, STEM journals in the blue community belong exclusively to the discipline of medicine. The green community at the center of the network is mostly composed of biology journals (with a few other biomedical science journals) citing *Biology & Philosophy*, then, to a lesser extent, *Studies in History and Philosophy of Biological and Biomedical Sciences*, and, marginally, *History and Philosophy of the Life Sciences*. The orange community at the left of the network is composed of physics journals that cite mainly *Studies in History and Philosophy of Modern Physics*, and to a lesser extent *Studies in History and Philosophy of Science – Part A.* The purple community at the top of the network is composed of mathematics and computer science journals first citing *Synthese*, and then *Erkenntnis*. Two philosophy of science journals stand at intermediate positions between different communities. The main one, *Philosophy of Science*, is cited by journals from the four communities and stands at the heart of the network, which reflects the variety of topics tackled by its articles and the centrality of this journal, not only in the field of philosophy of science, but also as seen from STEM journals citing philosophy of science. Slightly off-centered at the right of the network, *The British Journal for the Philosophy of Science* is cited by all communities except medicine. Finally, it is interesting to notice the intermediate position of two science journals in the network, *PLoS One* and *Science*. Their particular position reflects the fact that these journals, known for covering all scientific disciplines, but focusing on bioscience and medicine (Milojevic, 2020), cite philosophy of

science journals with a particular inclination for philosophy of biology and philosophy of medicine.

Figure 3 shows the network of citation between social science journals citing philosophy of science journals. The network is structured by three communities in blue, green and orange. The blue community at the right of the network is composed of social sciences of health journals citing philosophy of medicine journals. The green community, at the bottom left of the network, is composed of science studies journals. The top part of this community is structured around sociology and history of science journals mainly citing *Studies in History and Philosophy of Science – Part A*, while the bottom part, where history of medicine journals are more present, is structured around *Studies in History and Philosophy of Biological and Biomedical Sciences*, as well as *History and Philosophy of the Life Sciences*. It is interesting to notice the intermediate position held by *Social History of Medicine,* which cites both philosophy of life science journals (in the green community) and philosophy of medicine journals (in the blue community). *Biology & Philosophy* and *British Journal for Philosophy of Science* are situated at the border of the science studies journals community, and the community in orange. The latter is populated by journals from various disciplines (economics, professional fields, sociology), but largely dominated by psychology journals, especially those specialized in behavior and cognition. This orange community is divided in two sub-communities, one structured around *Synthese* and the other around *Philosophy of Science*. As was the case in the previous network of STEM journals citing philosophy of science journals, *Philosophy of Science* also occupies a central position in the whole network of social sciences journals, being cited by journals from the three communities.

Figure 4 shows the network of relationships between humanities journals, featuring disciplines such as philosophy, history, and language and linguistics, citing philosophy of science journals. Four communities, in blue, green, orange and purple are visible. The most important community, in purple at the top left of the network, includes a majority of philosophy journals and is centered around *Synthese*, which is also the most cited journal in the whole network. Philosophy journals in the purple community also tend to cite *British Journal for Philosophy of Science*, *Philosophy of Science* and *Erkenntnis*. Another smaller community, in orange at the bottom left, is also composed of philosophy journals but is

centered around Philosophy of Science, while also citing to a lesser extent philosophy of science journals that structure the purple community. The green community at the bottom of the network features mainly history of philosophy and history of ideas journals, centered around *Studies in History and Philosophy of Science - Part A*. Finally, the small blue community at the right of the network represents humanities journals, especially in religious studies and ethics, citing philosophy of medicine journals.

Figure 2 - Network of STEM journals citing philosophy of science journals (1980-2018)

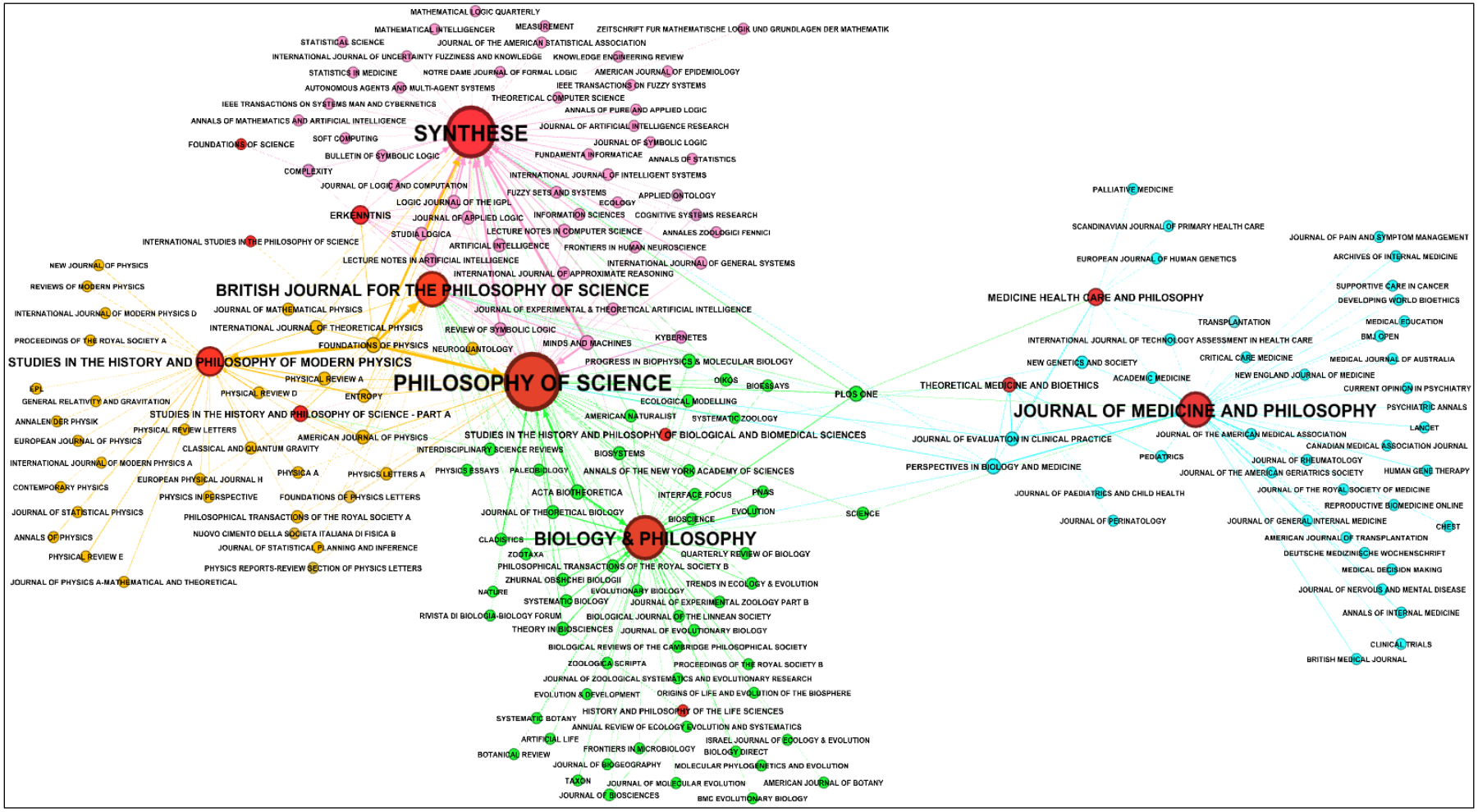


Figure 3 - Network of Social Sciences journals citing philosophy of science journals (1980-2018)

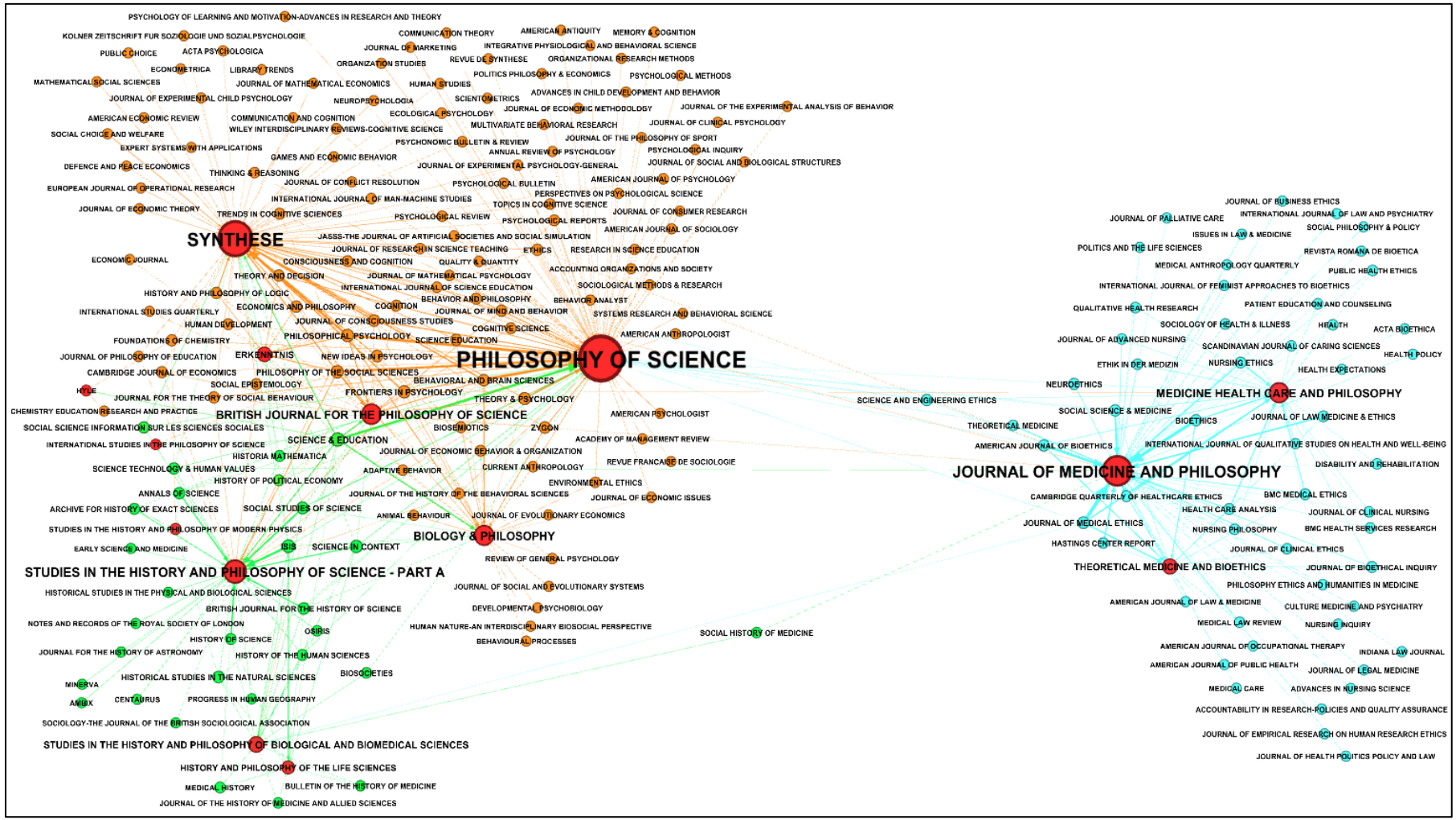
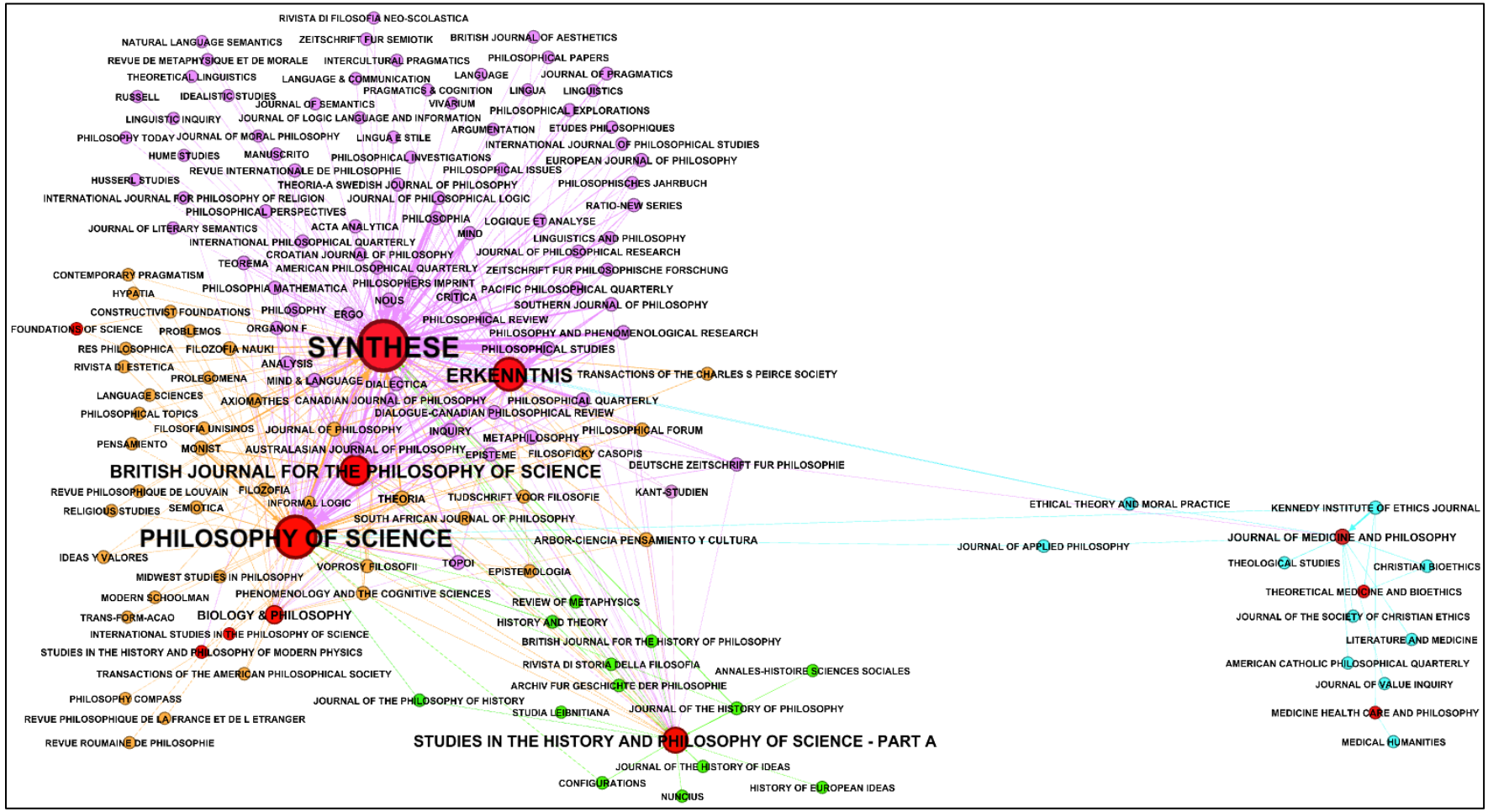


Figure 4 - Network of Humanities journals citing philosophy of science journals (1980-2018)



The visibility of philosophers of science in other sciences

Though disciplines have particular structural characteristics, they are of course composed of researchers with their own social characteristics and intellectual contributions to the field. We will now look at the last level of analysis, that of authors of the articles published in the 17 journals that for us are representative of the field of philosophy of science. Being interested in the links of that discipline to other scientific disciplines, and not in the internal dynamic of philosophy of science itself, we limit our focus on citations coming from STEM fields to authors who published in our set of philosophy of science journals. For this purpose, we construct a network that connects scientific disciplines to philosophers of science.

Figure 5 shows citations from STEM and philosophy of science fields (each represented by a single node) to authors who have published at least one paper as a first author in one of the 17 philosophy of science journals before 2018. To make the network legible, we show only links for authors having at least 20 citations from the STEM field or from philosophy of science in the 1980-2018 period. The more citations an author receives from the fields of STEM or philosophy of science, the thicker is the edge that connects that author's node to the discipline citing him or her. As shown in Figure 5, the network is strikingly structured by three distinct communities of authors. The community at the right of the network is composed of 297 authors who are mostly cited by philosophy of science journals, meaning that their articles do not transcend the boundary of their field. Authors featured in this community are in large majority philosophers of science, or philosophers who publish at least part of their works in philosophy of science journals. The two other communities are the most interesting to analyze, since they are composed of authors who get some of their philosophy of science articles cited not only in philosophy of science but also in STEM disciplines. Their work thus appears more visible to scientists than those of the first group.

The community at the left of the network represents authors of philosophy of science articles who are mainly cited by journals of STEM disciplines. A detailed analysis of the 169 author names composing this community shows that it mainly includes scientists who have published one or several articles in philosophy of science journals. These articles have mainly attracted the attention of other scientists, since they are largely cited by STEM

journals. This is for example the case of computer scientists Joseph Goguen and Lotfi Zadeh, who have been abundantly cited by mathematicians and engineers for two paper on fuzzy logic they published in *Synthese* (Goguen 1969; Zadeh 1975). These citations to Zadeh and Goguen partly explain why *Synthese* is the most cited philosophy of science journal in the disciplines of mathematics and engineering and technology. Famous physicists Albert Einstein, Niels Bohr and Edwin Schrödinger, whose philosophy of science papers have been published in the 1930s and 1950s are still cited nowadays by physics journals. But most physicists that are cited in STEM journals for articles they published in philosophy of science journals are still active, including Mario Castagnino, Stephen Adler, Charles H. Bennett, Michele Campisi, and Diederick Aerts. Some prominent biologists have also published philosophy of science papers that are highly cited in STEM journals, such as Theodosius Dobzhansky, John Maynard Smith, Daniel Simberloff, Brian K. Hall, Richard Michod, and others. Scientists from different STEM disciplines are also present in this community, which is actually mainly populated by scientists, not professional philosophers of science. As shown in **Table 4**, 24.7% of these authors are mainly active in the field of biology, followed by medicine, physics, mathematics and engineering. This result suggests that scientists from these STEM disciplines might also be the most likely to publish articles in philosophy of science journals. Bioethicists, mostly in medical ethics, form 12.9% of the community, while social scientists, mostly from the fields of psychology and science studies, only form 5.7% of the community. Interestingly, the community also includes 9.4% of philosophers mainly active in subfields of philosophy other than philosophy of science, and 7.1% of philosophers of science whose papers are mainly cited in STEM fields.

Table 4 – Distribution, by discipline, of authors whose philosophy of science articles are mostly cited in STEM fields

Discipline	Number of authors	% of authors
Biology	42	24.7
Medicine	25	14.7
Physics	18	10.6
Mathematics	13	7.6
Engineering	9	5.3
Other STEM disciplines	3	1.8
Bioethics	22	12.9
Philosophy of science	12	7.1
Philosophy	16	9.4
Social sciences	10	5.7

The community at the center of the network is composed of 200 authors whose philosophy of science articles receive citations from both philosophy of science and STEM fields. Of these 200 authors, 79.5% are philosophers of science, 5% are philosophers mainly active in subfields other than philosophy of science, 15% are scientists, and 0.5% are social scientists. We categorized authors as philosophers of science, philosophers mainly active in subfields other than philosophy of science, or scientists based on the subfields and journals where they published the most frequently, the disciplines in which they received their PhD, and their departmental affiliations. What make philosophers of science of this central community visible in both philosophy of science and STEM disciplines? An analysis of the publication and citation patterns of this limited group of 159 authors provides some answers, as shown in **Table 5**:

- 55 out of 159 philosophers of science from this community (34.6%) also figure amongst the top-100 most cited authors in philosophy of science journals between 1980 and 2018.
- 48 philosophers of science (30.1%) have published at least 5 peer-reviewed articles in STEM journals.
- 14 philosophers of science (8.8%) belong to both previous categories (they are amongst the top-100 cited philosophers of science and have also published more than 5 STEM peer-reviewed articles).
- 27 philosophers of science (13.5%) belong to none of these categories.

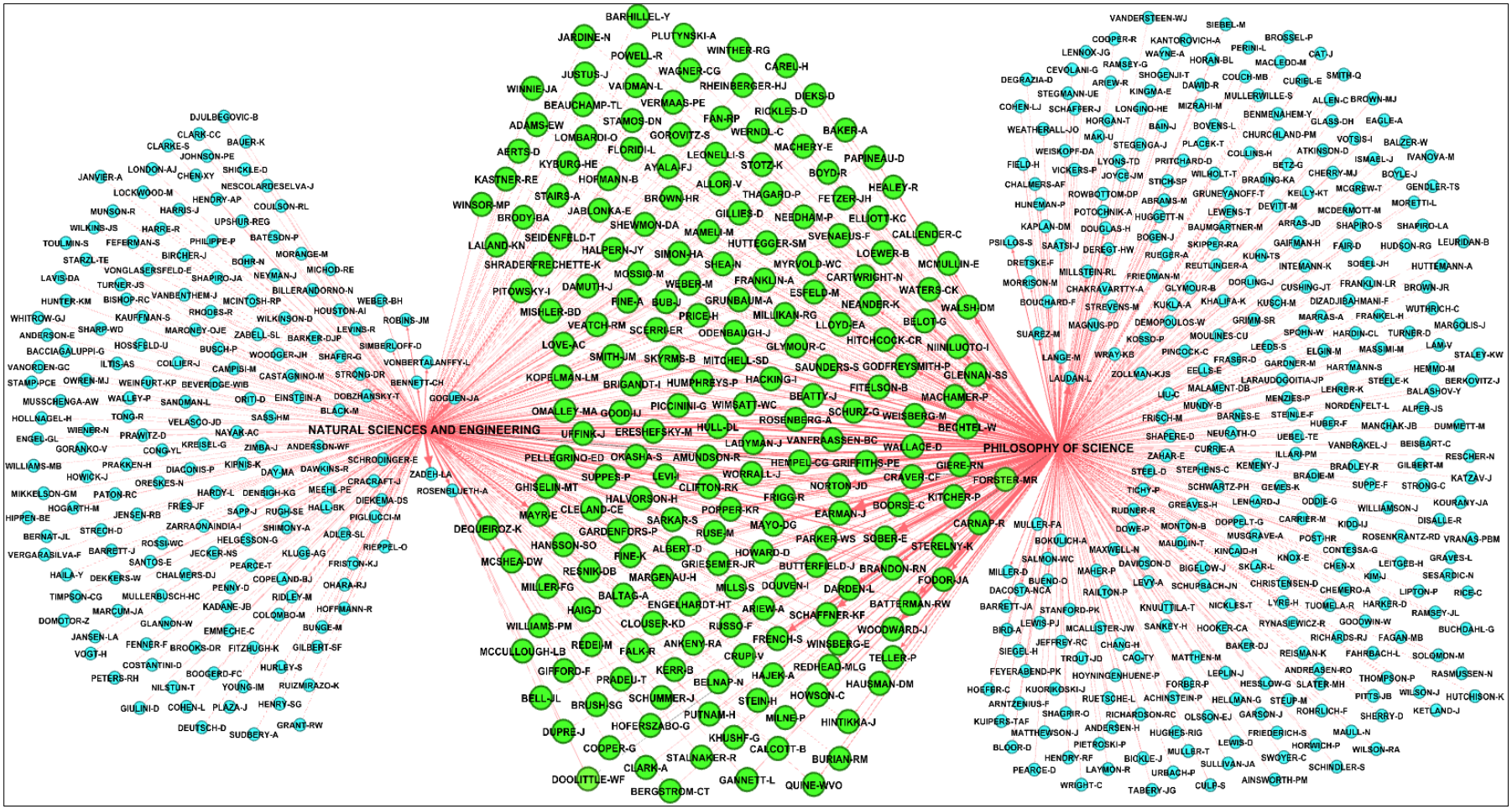
- 15 philosophers of science (7.5%) are active in the subfield of bioethics, especially medical ethics.

Overall, 79% of philosophers of science who get cited in both fields of philosophy of science and STEM are either highly cited authors in the field of philosophy of science or intervene frequently in science, through the frequent publication of peer-reviewed articles in journals of STEM disciplines. In other words, two main categories of philosophers of science are more likely to be cited by both scientists and philosophers of science: those who achieve high visibility in their own field (philosophy of science) may be able to extend this visibility to STEM fields, while those who publish frequently in STEM disciplines may also get their philosophy of science articles visible in STEM. The remaining of the central community is composed of philosophers and scientists: 10 philosophers who specialize in subfields other than philosophy of science compose 5% of the community, and 30 scientists, half of them biologists, compose 15% of the community. Finally, only one social scientist, Herbert A. Simon, is present in this community.

Table 5 – Distribution of philosophy of science authors who are cited by both philosophy of science and STEM disciplines

Author category	Number of authors	% of authors
Top-100 cited philosophers of science	55	27.5
Philosophers of science with at least 5 papers in STEM	48	24.0
Philosopher of science belonging to both above categories	14	7.0
Other philosophers of science	27	13.5
Philosophers (other than philosophers of science)	10	5.0
Bioethicists	15	7.5
Scientists	30	15.0
Social scientists	1	0.5
Total	200	100.0

Figure 5 – Network of authors of philosophy of science articles cited at least 20 times in STEM or philosophy of science, 1980-2018



Conclusion

In this paper, we assessed the visibility of philosophy of science in the sciences at the level of disciplines, journals and authors. Analyzing all citations received by 17 major philosophy of science journals between 1980 and 2018, we first confirmed McLevey's et. al. finding (2018) that about half of citations received by the field of philosophy of science come from outside the field of philosophy. This share of external citations was found particularly important when compared to that of the rest of the field of philosophy. For the last four decades, philosophy of science has increased its visibility in a large number of STEM and SSH disciplines and, more importantly, spread its visibility among more journals and subfields, as demonstrated by the decreasing concentration of citations made by top-10 citing STEM and SSH journals to philosophy of science journals. These citations, however, are not evenly distributed among disciplines and journals, some having developed more affinities with philosophy of science than others. Even inside each discipline, citations made to philosophy of science are not evenly distributed. Obviously, the affinity between STEM and SSH citing journals and cited philosophy of science journals strongly depends on the topics addressed by both categories of journals. Finally, part of the visibility of philosophy of science in STEM disciplines can be explained by contributions made by scientists in philosophy of science journals. But we've also uncovered the existence of an important community of philosophers of science who get cited in both philosophy of science and STEM fields. The two main factors explaining the ability of these authors to transcend the boundaries of their field are: 1) achieving very high visibility inside the field philosophy of science, or: 2) publishing simultaneously in both science journals and philosophy of science journals.

The overarching message that comes out of our detailed analysis of the growing visibility of philosophy of science in other scientific fields is that, contrary to what many may think, philosophy of science as a specialized field is far from autarchic and closed on itself. On the contrary, its work is in fact quite visible in many other scientific disciplines. Our results also suggest that abstract and general discussions on the usefulness or not of philosophical reflections for the work of practicing scientists should take these empirical results into account in future discussion.

This raises an important practical question: if one is convinced that philosophy of science can have a fruitful dialogue with the sciences, how may this dialogue be facilitated in practice? Part of the solution will certainly come from scientists themselves: by inviting philosophers of science to co-author papers, participate in scientific meetings, and so on. Needless to say, any influential scientist saying that philosophy of science has impacted their scientific research will be much more convincing to the scientific community than philosophers of science claiming that they have had such an impact. Another manner to increase our links with the sciences is the development of interdisciplinary curricula. Philosophers of science, especially the younger ones, already have, in most cases, a strong background in science. Yet this could be strengthened, and it could also be more valued in philosophy departments. In parallel, scientists should receive training in history and philosophy of science, not aiming to transform them or to challenge their practice, but rather to help them better understand how to use philosophers' unique competences to improve their scientific practice.

More work is now needed on the converse question: what is the place of the various sciences in philosophy of science? While the influence of individual scientists and scientific theories on the development of philosophy and philosophy of science has often been documented (e.g. Dewey 1910; Sanchez-Gonzalez 1990; Bitbol 1996; Stjernfelt 2011; Howard 2012), a macro-level analysis of the visibility of the sciences in contemporary philosophy of science, based on citation flows and networks, though probably more difficult to implement, could reveal specific properties of the field of philosophy of science that have not been made visible in our study or have also been ignored by qualitative studies.

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Appendix A - Top-10 journals citing philosophy of science and top-5 cited philosophy of science journals (by discipline)

PHILOSOPHY (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	PHILOSOPHICAL STUDIES	PHILOSOPHICAL STUDIES	PHILOSOPHICAL STUDIES	PHILOSOPHICAL STUDIES
2.	NOUS	NOUS	NOUS	PHILOSOPHY AND PHENOMENOLOGICAL RESEARCH
3.	JOURNAL OF PHILOSOPHY	JOURNAL OF PHILOSOPHY	PHILOSOPHY AND PHENOMENOLOGICAL RESEARCH	THEORIA
4.	AUSTRALASIAN JOURNAL OF PHILOSOPHY	PHILOSOPHY AND PHENOMENOLOGICAL RESEARCH	JOURNAL OF PHILOSOPHY	NOUS
5.	DIALOGUE-CANADIAN PHILOSOPHICAL REVIEW	AUSTRALASIAN JOURNAL OF PHILOSOPHY	THEORIA	JOURNAL OF PHILOSOPHICAL LOGIC
6.	CANADIAN JOURNAL OF PHILOSOPHY	MIND	AUSTRALASIAN JOURNAL OF PHILOSOPHY	AUSTRALASIAN JOURNAL OF PHILOSOPHY
7.	AMERICAN PHILOSOPHICAL QUARTERLY	SOUTHERN JOURNAL OF PHILOSOPHY	DIALECTICA	AXIOMATHES
8.	SOUTHERN JOURNAL OF PHILOSOPHY	ARBOR-CIENCIA PENSAMIENTO Y CULTURA	MIND	MIND
9.	MIDWEST STUDIES IN PHILOSOPHY	DIALECTICA	MONIST	JOURNAL OF PHILOSOPHY
10.	JOURNAL OF PHILOSOPHICAL LOGIC	JOURNAL OF PHILOSOPHICAL LOGIC	JOURNAL OF PHILOSOPHICAL LOGIC	ANALYSIS
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	SYNTHESE	SYNTHESE	SYNTHESE	SYNTHESE
2.	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE
3.	ERKENNTNIS	ERKENNTNIS	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	ERKENNTNIS
4.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	ERKENNTNIS	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE
5.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE

BIOLOGY (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	SYSTEMATIC ZOOLOGY	ACTA BIOTHEORETICA	ACTA BIOTHEORETICA	ACTA BIOTHEORETICA
2.	AMERICAN NATURALIST	JOURNAL OF THEORETICAL BIOLOGY	CLADISTICS	JOURNAL OF THEORETICAL BIOLOGY
3.	ACTA BIOTHEORETICA	SYSTEMATIC BIOLOGY	THEORY IN BIOSCIENCES	EVOLUTIONARY BIOLOGY
4.	JOURNAL OF THEORETICAL BIOLOGY	CLADISTICS	ZHURNAL OBSHCHEI BIOLOGII	THEORY IN BIOSCIENCES
5.	ECOLOGY	BIOSYSTEMS	JOURNAL OF THEORETICAL BIOLOGY	CLADISTICS
6.	AMERICAN ZOOLOGIST	ZHURNAL OBSHCHEI BIOLOGII	SYSTEMATIC BIOLOGY	EVOLUTION
7.	PALEOBIOLOGY	SYSTEMATIC BOTANY	EVOLUTION	BIOSYSTEMS
8.	OIKOS	THEORY IN BIOSCIENCES	QUART. REVIEW OF BIOLOGY	JOURNAL OF EXPERIMENTAL ZOOLOGY PART B
9.	TAXON	AMERICAN NATURALIST	ZOOLOGICA SCRIPTA	BIOLOGY DIRECT
10.	EVOLUTION	EVOLUTIONARY BIOLOGY	BIOSYSTEMS	JOURNAL OF EVOLUTIONARY BIOLOGY
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	SYNTHESE	BIOLOGY & PHILOSOPHY	BIOLOGY & PHILOSOPHY	BIOLOGY & PHILOSOPHY
2.	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE
3.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE – C
4.	BIOLOGY & PHILOSOPHY	SYNTHESE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE – C	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE
5.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	SYNTHESE	SYNTHESE

PHYSICS (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	FOUNDATIONS OF PHYSICS	FOUNDATIONS OF PHYSICS	FOUNDATIONS OF PHYSICS	FOUNDATIONS OF PHYSICS
2.	AMERICAN JOURNAL OF PHYSICS	INTERNATIONAL JOURNAL OF THEORETICAL PHYSICS	INTERNATIONAL JOURNAL OF THEORETICAL PHYSICS	ENTROPY
3.	JOURNAL OF MATHEMATICAL PHYSICS	AMERICAN JOURNAL OF PHYSICS	AMERICAN JOURNAL OF PHYSICS	PHYSICAL REVIEW D
4.	INTERNATIONAL JOURNAL OF THEORETICAL PHYSICS	PHYSICAL REVIEW A	FOUNDATIONS OF PHYSICS LETTERS	PHYSICAL REVIEW A
5.	NUOVO CIMENTO B	FOUNDATIONS OF PHYSICS LETTERS	PHYSICAL REVIEW A	INTERNATIONAL JOURNAL OF THEORETICAL PHYSICS
6.	PHYSICS LETTERS A	PHYSICS LETTERS A	CLASSICAL AND QUANTUM GRAVITY	PHILOSOPICAL TRANSACTIONS OF THE ROYAL SOCIETY PART A
7.	PHILOSOPICAL TRANSACTIONS OF THE ROYAL SOCIETY PART A	PHYSICS ESSAYS	PHYSICS IN PERSPECTIVE	AMERICAN JOURNAL OF PHYSICS
8.	PHYSICAL REVIEW D	NUOVO CIMENTO B	PHYSICAL REVIEW E	PHYSICA A
9.	ANNALEN DER PHYSIK	PHYSICS REPORTS	PHYSICS LETTERS A	EUROPEAN PHYSICAL JOURNAL H
10.	PHYSICA D	JOURNAL OF PHYSICS A	JOURNAL OF MATHEMATICAL PHYSICS	CLASSICAL AND QUANTUM GRAVITY
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE - B	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE - B
2.	SYNTHESE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE
3.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	SYNTHESE	PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE
4.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	SYNTHESE	SYNTHESE
5.	ERKENNTNIS	ERKENNTNIS	ERKENNTNIS	FOUNDATIONS OF SCIENCE

ENGINEERING AND TECHNOLOGY (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	FUZZY SETS AND SYSTEMS	MINDS AND MACHINES	MINDS AND MACHINES	MINDS AND MACHINES
2.	ARTIFICIAL INTELLIGENCE	FUZZY SETS AND SYSTEMS	LECTURE NOTES IN ARTIFICIAL INTELLIGENCE	INTERNATIONAL JOURNAL OF APPROXIMATE REASONING
3.	IEEE TRANSACTIONS ON SYSTEMS MAN AND CYBERNETICS	ARTIFICIAL INTELLIGENCE	LECTURE NOTES IN COMPUTER SCIENCE	JOURNAL OF LOGIC AND COMPUTATION
4.	INTERNATIONAL JOURNAL OF GENERAL SYSTEMS	INTERNATIONAL JOURNAL OF INTELLIGENT SYSTEMS	JOURNAL OF LOGIC AND COMPUTATION	KYBERNETES
5.	LECTURE NOTES IN COMPUTER SCIENCE	LECTURE NOTES IN ARTIFICIAL INTELLIGENCE	ARTIFICIAL INTELLIGENCE	APPLIED ONTOLOGY
6.	COMPUTERS & MATHEMATICS WITH APPLICATIONS	KYBERNETES	JOURNAL OF EXP. & THEOR. ARTIFICIAL INTELLIGENCE	ARTIFICIAL INTELLIGENCE
7.	IEEE TRANS. PATTERN ANALYSIS AND MACHINE INTELLIGENCE	INTERNATIONAL JOURNAL OF GENERAL SYSTEMS	FUZZY SETS AND SYSTEMS	JOURNAL OF EXP. & THEOR. ARTIFICIAL INTELLIGENCE
8.	CYBERNETICA	LECTURE NOTES IN COMPUTER SCIENCE	INTERNATIONAL JOURNAL OF APPROXIMATE REASONING	COGNITIVE SYSTEMS RESEARCH
9.	INTERNATIONAL JOURNAL OF INTELLIGENT SYSTEMS	INFORMATION SCIENCES	KYBERNETES	JOURNAL OF ARTIFICIAL INTELLIGENCE RESEARCH
10.	INFORMATION SCIENCES	JOURNAL OF EXP. & THEOR. ARTIFICIAL INTELLIGENCE	THEORETICAL COMPUTER SCIENCE	INFORMATION SCIENCES
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	SYNTHESE	SYNTHESE	SYNTHESE	SYNTHESE
2.	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE
3.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE
4.	ERKENNTNIS	ERKENNTNIS	ERKENNTNIS	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE
5.	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	ERKENNTNIS

MATHEMATICS (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION	JOURNAL OF SYMBOLIC LOGIC	LOGIC JOURNAL OF THE IGPL	REVIEW OF SYMBOLIC LOGIC
2.	JOURNAL OF SYMBOLIC LOGIC	JOURNAL OF STATISTICAL PLANNING AND INFERENCE	REVIEW OF SYMBOLIC LOGIC	STUDIA LOGICA
3.	ANNALS OF STATISTICS	ANNALS OF PURE AND APPLIED LOGIC	FUNDAMENTA INFORMATICAE	LOGIC JOURNAL OF THE IGPL
4.	ZEIT. FUR MATHEMATISCHE LOGIK UND GRUND. DER MATHEMATIK	STATISTICAL SCIENCE	BULLETIN OF SYMBOLIC LOGIC	JOURNAL OF APPLIED LOGIC
5.	INTERNATIONAL STATISTICAL REVIEW	ANNALS OF STATISTICS	APPLIED MATHEMATICS AND COMPUTATION	COMPLEXITY
6.	JOURNAL OF MATHEMATICAL ANALYSIS AND APPLICATIONS	JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION	ANNALS OF MATHEMATICS AND ARTIFICIAL INTELLIGENCE	ANNALS OF PURE AND APPLIED LOGIC
7.	JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B	MATHEMATICAL LOGIC QUARTERLY	ANNALS OF PURE AND APPLIED LOGIC	FUNDAMENTA INFORMATICAE
8.	MATHEMATICAL AND COMPUTER MODELLING	JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES A	STATISTICAL SCIENCE	NOTRE DAME JOURNAL OF FORMAL LOGIC
9.	JOURNAL OF STATISTICAL COMPUTATION AND SIMULATION	MATHEMATICAL INTELLIGENCER	JOURNAL OF SYMBOLIC LOGIC	BULLETIN OF SYMBOLIC LOGIC
10.	MATHEMATICAL MODELLING	BULLETIN OF SYMBOLIC LOGIC	INTERNATIONAL STATISTICAL REVIEW	ANNALS OF MATHEMATICS AND ARTIFICIAL INTELLIGENCE
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	SYNTHESE	SYNTHESE	SYNTHESE	SYNTHESE
2.	PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE
3.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	ERKENNTNIS
4.	ERKENNTNIS	ERKENNTNIS	ERKENNTNIS	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE
5.	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE

MEDICINE (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	PERSPECTIVES IN BIOLOGY AND MEDICINE	PERSPECTIVES IN BIOLOGY AND MEDICINE	PERSPECTIVES IN BIOLOGY AND MEDICINE	JOURNAL OF EVALUATION IN CLINICAL PRACTICE
2.	JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	ANNALS OF INTERNAL MEDICINE	JOURNAL OF EVALUATION IN CLINICAL PRACTICE	PERSPECTIVES IN BIOLOGY AND MEDICINE
3.	JOURNAL OF THE AMERICAN GERIATRICS SOCIETY	JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	ACADEMIC MEDICINE	FRONTIERS IN HUMAN NEUROSCIENCE
4.	ANNALS OF INTERNAL MEDICINE	BRITISH MEDICAL JOURNAL	JOURNAL OF EPIDEMIOLOGY AND COMMUNITY HEALTH	NEUROQUANTOLOGY
5.	BRITISH MEDICAL JOURNAL	JOURNAL OF THE AMERICAN GERIATRICS SOCIETY	CRITICAL CARE MEDICINE	PEDIATRICS
6.	AMERICAN JOURNAL OF PSYCHIATRY	ARCHIVES OF INTERNAL MEDICINE	JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	BMJ OPEN
7.	MEDICAL DECISION MAKING	CURRENT OPINION IN PSYCHIATRY	PEDIATRICS	PROGRESS IN BRAIN RESEARCH
8.	JOURNAL OF FAMILY PRACTICE	NEW ENGLAND JOURNAL OF MEDICINE	INT. JOURNAL OF TECHNOLOGY ASSESSMENT IN HEALTH CARE	JOURNAL OF PAIN AND SYMPTOM MANAGEMENT
9.	NEW ENGLAND JOURNAL OF MEDICINE	ACADEMIC MEDICINE	REPRODUCTIVE BIOMEDICINE ONLINE	INTERNATIONAL JOURNAL OF EPIDEMIOLOGY
10.	ARZNEIMITTEL-FORSCHUNG/DRUG RESEARCH	LANCET	JOURNAL OF GENERAL INTERNAL MEDICINE	NEUROSCIENCE AND BIOBEHAVIORAL REVIEWS
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY
2.	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	THEORETICAL MEDICINE AND BIOETHICS	MEDICINE HEALTH CARE AND PHILOSOPHY
3.	SYNTHESE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	MEDICINE HEALTH CARE AND PHILOSOPHY	THEORETICAL MEDICINE AND BIOETHICS
4.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	HISTORY AND PHILOSOPHY OF THE LIFE SCIENCES	PHILOSOPHY OF SCIENCE	SYNTHESE
5.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	SYNTHESE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE

HEALTH (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	SOCIAL SCIENCE & MEDICINE	JOURNAL OF MEDICAL ETHICS	JOURNAL OF MEDICAL ETHICS	JOURNAL OF MEDICAL ETHICS
2.	HASTINGS CENTER REPORT	SOCIAL SCIENCE & MEDICINE	BIOETHICS	BIOETHICS
3.	CULTURE MEDICINE AND PSYCHIATRY	BIOETHICS	AMERICAN JOURNAL OF BIOETHICS	AMERICAN JOURNAL OF BIOETHICS
4.	JOURNAL OF HEALTH POLITICS POLICY AND LAW	CAMBRIDGE QUARTERLY OF HEALTHCARE ETHICS	CAMBRIDGE QUARTERLY OF HEALTHCARE ETHICS	BMC MEDICAL ETHICS
5.	AMERICAN JOURNAL OF OCCUPATIONAL THERAPY	THEORETICAL MEDICINE AND BIOETHICS	SOCIAL SCIENCE & MEDICINE	CAMBRIDGE QUARTERLY OF HEALTHCARE ETHICS
6.	JOURNAL OF MEDICAL ETHICS	HASTINGS CENTER REPORT	NURSING ETHICS	HEALTH CARE ANALYSIS
7.	SOCIOLOGY OF HEALTH & ILLNESS	JOURNAL OF CLINICAL ETHICS	HEALTH CARE ANALYSIS	NURSING ETHICS
8.	PHYLON	AMERICAN JOURNAL OF LAW & MEDICINE	HASTINGS CENTER REPORT	JOURNAL OF BIOETHICAL INQUIRY
9.	JOURNAL OF RELIGION & HEALTH	NURSING ETHICS	JOURNAL OF CLINICAL ETHICS	SOCIAL SCIENCE & MEDICINE
10.	MEDICAL CARE	JOURNAL OF ADVANCED NURSING	JOURNAL OF ADVANCED NURSING	NURSING PHILOSOPHY
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY	MEDICINE HEALTH CARE AND PHILOSOPHY
2.	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	MEDICINE HEALTH CARE AND PHILOSOPHY	JOURNAL OF MEDICINE AND PHILOSOPHY
3.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THEORETICAL MEDICINE AND BIOETHICS	THEORETICAL MEDICINE AND BIOETHICS
4.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	SYNTHESE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE
5.	SYNTHESE	HISTORY AND PHILOSOPHY OF THE LIFE SCIENCES	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE

PSYCHOLOGY (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	BEHAVIORAL AND BRAIN SCIENCES	PHILOSOPHICAL PSYCHOLOGY	PHILOSOPHICAL PSYCHOLOGY	FRONTIERS IN PSYCHOLOGY
2.	BEHAVIOR AND PHILOSOPHY	BEHAVIORAL AND BRAIN SCIENCES	BEHAVIORAL AND BRAIN SCIENCES	PHILOSOPHICAL PSYCHOLOGY
3.	JOURNAL OF MIND AND BEHAVIOR	JOURNAL OF MIND AND BEHAVIOR	THEORY & PSYCHOLOGY	BEHAVIORAL AND BRAIN SCIENCES
4.	JOURNAL FOR THE THEORY OF SOCIAL BEHAVIOUR	THEORY & PSYCHOLOGY	JOURNAL OF MIND AND BEHAVIOR	THEORY & PSYCHOLOGY
5.	COMMUNICATION AND COGNITION	BEHAVIOR AND PHILOSOPHY	COGNITIVE SCIENCE	COGNITIVE SCIENCE
6.	INTERNATIONAL JOURNAL OF MAN-MACHINE STUDIES	PSYCHOLOGICAL REPORTS	NEW IDEAS IN PSYCHOLOGY	NEW IDEAS IN PSYCHOLOGY
7.	COGNITION	COGNITION	JOURNAL FOR THE THEORY OF SOCIAL BEHAVIOUR	COGNITION
8.	JOURNAL OF MATHEMATICAL PSYCHOLOGY	JOURNAL OF MATHEMATICAL PSYCHOLOGY	BEHAVIOR AND PHILOSOPHY	CONSCIOUSNESS AND COGNITION
9.	AMERICAN PSYCHOLOGIST	NEW IDEAS IN PSYCHOLOGY	CONSCIOUSNESS AND COGNITION	TOPICS IN COGNITIVE SCIENCE
10.	JOURNAL OF THE HISTORY OF THE BEHAVIORAL SCIENCES	AMERICAN PSYCHOLOGIST	TRENDS IN COGNITIVE SCIENCES	JOURNAL OF MATHEMATICAL PSYCHOLOGY
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	JOURNAL OF MEDICINE AND PHILOSOPHY	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	SYNTHESE
2.	PHILOSOPHY OF SCIENCE	SYNTHESE	SYNTHESE	PHILOSOPHY OF SCIENCE
3.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	BIOLOGY & PHILOSOPHY
4.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	JOURNAL OF MEDICINE AND PHILOSOPHY	BIOLOGY & PHILOSOPHY	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE
5.	SYNTHESE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE

SCIENCE STUDIES (CITING JOURNALS)				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	PHILOSOPHY OF THE SOCIAL SCIENCES	JOURNAL OF THE HISTORY OF BIOLOGY	JOURNAL OF THE HISTORY OF BIOLOGY	SCIENCE & EDUCATION
2.	SOCIAL STUDIES OF SCIENCE	SOCIAL STUDIES OF SCIENCE	PHILOSOPHY OF THE SOCIAL SCIENCES	PHILOSOPHY OF THE SOCIAL SCIENCES
3.	SCIENTIA	ISIS	SCIENCE IN CONTEXT	JOURNAL OF THE HISTORY OF BIOLOGY
4.	ANNALS OF SCIENCE	HISTORY OF SCIENCE	ISIS	SOCIAL STUDIES OF SCIENCE
5.	ARCHIVE FOR HISTORY OF EXACT SCIENCES	ANNALS OF SCIENCE	HISTORY OF SCIENCE	SCIENCE AND ENGINEERING ETHICS
6.	ISIS	SCIENCE IN CONTEXT	SOCIAL STUDIES OF SCIENCE	ISIS
7.	JOURNAL OF THE HISTORY OF BIOLOGY	BRITISH JOURNAL FOR THE HISTORY OF SCIENCE	BRITISH JOURNAL FOR THE HISTORY OF SCIENCE	SCIENCE IN CONTEXT
8.	BRITISH JOURNAL FOR THE HISTORY OF SCIENCE	HISTORY AND PHILOSOPHY OF LOGIC	ANNALS OF SCIENCE	HISTORICAL STUDIES IN THE NATURAL SCIENCES
9.	HISTORY OF SCIENCE	SCIENCE TECHNOLOGY & HUMAN VALUES	SCIENCE & EDUCATION	BRITISH JOURNAL FOR THE HISTORY OF SCIENCE
10.	CENTAURUS	OSIRIS	HIST. STUDIES IN THE PHYSICAL AND BIOLOGICAL SCIENCES	SCIENCE TECHNOLOGY & HUMAN VALUES
CITED JOURNALS				
Rank	**1980-1989**	**1990-1999**	**2000-2009**	**2010-2018**
1.	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE - A	STUDIES IN HISTORY AND PHILOSOPHY OF SCIENCE - A
2.	PHILOSOPHY OF SCIENCE	SYNTHESE	PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE
3.	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	PHILOSOPHY OF SCIENCE	BIOLOGY & PHILOSOPHY	SYNTHESE
4.	SYNTHESE	BIOLOGY & PHILOSOPHY	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	BIOLOGY & PHILOSOPHY
5.	ERKENNTNIS	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE	HISTORY AND PHILOSOPHY OF THE LIFE SCIENCES	THE BRITISH JOURNAL FOR THE PHILOSOPHY OF SCIENCE