



Universiteit
Leiden
The Netherlands

Science and its significant other: representing the humanities in bibliometric scholarship

Franssen, T.; Wouters, P.

Citation

Franssen, T., & Wouters, P. (2019). Science and its significant other: representing the humanities in bibliometric scholarship. *Journal Of The Association For Information Science And Technology*, 70(10), 1124-1137. doi:10.1002/asi.24206

Version: Publisher's Version

License: [Creative Commons CC BY-NC-ND 4.0 license](#)

Downloaded from: <https://hdl.handle.net/1887/3217496>

Note: To cite this publication please use the final published version (if applicable).

Science and Its Significant Other: Representing the Humanities in Bibliometric Scholarship

Thomas Franssen 

Centre for Science and Technology Studies, Leiden University, P.O. Box 905, 2300 AX, Leiden, The Netherlands. E-mail: t.p.franssen@cwts.leidenuniv.nl

Paul Wouters 

Centre for Science and Technology Studies, Leiden University, P.O. Box 905, 2300 AX, Leiden, The Netherlands. E-mail: p.f.wouters@cwts.leidenuniv.nl

The cognitive and social structures, and publication practices, of the humanities have been studied bibliometrically for the past 50 years. This article explores the conceptual frameworks, methods, and data sources used in bibliometrics to study the nature of the humanities, and its differences and similarities in comparison with other scientific domains. We give a historical overview of bibliometric scholarship between 1965 and 2018 that studies the humanities empirically and distinguishes between two periods in which the configuration of the bibliometric system differs remarkably. The first period, 1965 to the 1980s, is characterized by bibliometric methods embedded in a sociological theoretical framework, the development and use of the Price Index, and small samples of journal publications from which references are used as data sources. The second period, the 1980s to the present day, is characterized by a new intellectual hinterland—that of science policy and research evaluation—in which bibliometric methods become embedded. Here metadata of publications becomes the primary data source with which publication profiles of humanistic scholarly communities are analyzed. We unpack the differences between these two periods and critically discuss the analytical avenues that different approaches offer.

Introduction

How can we characterize the humanities and what sets it apart from other scientific domains? This question has burdened both historians and sociologists of science for the past decades. Although some, such as Rens Bod (2013), trace a history in humanities research that shows commonalities between the humanities and other scientific domains, others point to Snow (1959) and declare the humanities a different form of inquiry altogether. When the humanities are largely similar to other forms of scientific enquiry, how should we understand their differences? If the humanities cannot be characterized as scientific at all, how then should they be characterized?

These questions are also important for bibliometricians. Price (1970) studied this question explicitly, developed an operationalization of scientificness, and analyzed how the humanities are indeed distinct from other forms of scientific inquiry. In other bibliometric studies the empirical investigation of a particular aspect of the humanities, its publication practices, or social and cognitive structure, are a by-product of the development of bibliometric data sets, methods, and indicators primarily used for research evaluation and science policy development. These studies do not explicitly engage with the question of what characterizes the humanities but, also for these scholars, we argue, an answer to this question is important.

Nowadays, within the humanities bibliometric methods are often mistrusted because of their performative effects as bibliometric indicators. Bibliometric methods offer a particular representation of science (Nicolaisen, 2007; Wouters, 1999) and bibliometric representations are always performative; they potentially influence the science system itself (for example, Wyatt, Milojević, Park, & Leydesdorff, 2017). The performative effects of bibliometrics have been documented

Received May 2, 2018; revised November 2, 2018; accepted December 26, 2018

© 2019 The Authors. *Journal of the Association for Information Science and Technology* published by Wiley Periodicals, Inc. on behalf of ASIS&T. • Published online March 13, 2019 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/asi.24206

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

primarily in relation to processes of research evaluation and how pervasive representations (and particular bibliometric indicators) might influence research practices (De Rijcke, Wouters, Rushforth, Franssen, & Hammarfelt, 2016).

However, bibliometric analyses also offer insights into broader questions regarding the nature of the humanities. We are in particular interested in the ways the social and cognitive structures and publication practices of the humanities have been studied throughout the history of bibliometrics, often in comparison to other scientific domains or to a general notion of “the sciences.” Earlier reviews of bibliometric literature pertaining to the humanities exist (Ardanuy, 2013; Huang & Chang, 2008; Nederhof, 2006; part 2.3 in Moed, 2006), but have been predominantly related to research evaluation. Previous reviews ask which bibliometric indicators are suitable to use for evaluative purposes in the humanities (and social sciences; exceptions being Colavizza, 2017a; Hammarfelt, 2016).

In this article we have two goals: (a) to distinguish the main conceptual framework, methods, and data sources used to study the humanities, and (b) to reflect on the analytical value of different approaches to understand the nature of the humanities. In light of the first goal, we consider three key aspects of bibliometric studies. The first is the theoretical concept around which an analysis is developed such as “scientificness” or “internationality,” and to understand part of the theoretical hinterland (Law, 2004) in which bibliometric studies are embedded. The second is the bibliometric method that is developed to operationalize the theoretical concept. The third element is the data source(s) used to empirically develop the bibliometric method. We understand combinations of a conceptual framework, bibliometric method, and data source as the configuration of the bibliometric system, inspired by the work of Rheinberger (2010; see also Wouters, 2006). We argue that there are two distinct configurations of the bibliometric system, in two periods of scholarship that are markedly different in their approach.

The first period, spanning from 1965 to the 1980s, is characterized by a sociological framework, the development and use of the Price Index, and small samples of journal publications from which the references are used as data. We also distinguish between two scholarly communities that employ bibliometric methods during this period of time—sociologists and library and information science scholars.

The second period, from the mid-1980s to the present day, is characterized by a new intellectual hinterland—that of science policy and research evaluation—in which bibliometric methods become embedded. Within this context, the metadata of publications (type of publication outlet, language), rather than their references, become the main data source (with the exception of the science mapping literature). This focus on the publication profile rather than the profile of references has important consequences for how the humanities are characterized. We distinguish between three types of bibliometric studies in this period conducted by partly overlapping scholarly communities, all embedded in the field of library and information science. These three types of study include: bibliometric indicators and research

evaluation in the humanities; science mapping techniques to study the cognitive structure of the humanities; and the use of new national and regional databases to study publication practices of humanities scholars.

The second goal of this article is to reflect on the analytical value of different approaches to understand the nature of the humanities. We identify new analytical avenues, and question the underpinnings of the concept of internationality and how it is intertwined with scientificness. We aim to stimulate debate in the bibliometric community about the concepts and empirical measures that we utilize in studies regarding the humanities, and argue for more (comparative) research into the cognitive and social structure of the humanities.

Methods

We collected bibliometric publications that employ bibliometric methods to study the cognitive or social structures of the humanities and its publication practices published between 1965 and 2018. Our search strategy combined various methods. We drew on earlier attempts to collect all publications in bibliometrics pertaining to the humanities, notably from Ardanuy (2013) and Nederhof (2006). Searches included the use of Web of Science (WoS) and Google Scholar, with CitNetExplorer (Van Eck & Waltman, 2014), to explore the citation network of collected publications to identify important missing links (we manually included bibliographic information of publications from which we could not access bibliographic information through WoS).

Within the field of research evaluation, we were very selective. Publications not included are those in which new bibliometric indicators are developed but in which these are not used to analyze the social or cognitive structures and publication practices of the humanities. The focus remained on the earliest publications where the concept of internationality is developed both conceptually and empirically. Also included are publications from the field of research evaluation that include a large empirical study; these are often case studies of humanities publishing in particular countries.

Selected publications are in English and are journal publications. We acknowledge that we will have missed publications in other languages that study the cognitive or social structures of the humanities as represented through publications in a particular language. We do not expect that we have missed entirely different types of bibliometric research. The important research on notions of quality in the humanities (for example, Hug, Ochsner, & Daniel, 2013; Ochsner, Hug, & Daniel, 2012, 2016) does not employ bibliometric methods, and is, therefore, also omitted from this study.

In total, we selected 64 publications (see the list at the end of the article). We read all publications and coded them for important concepts, data sources, and methods. These publications were manually clustered to visualize their citation relations using CitNetExplorer (Figure 1). The visualization of clusters in Figure 1 show the reader

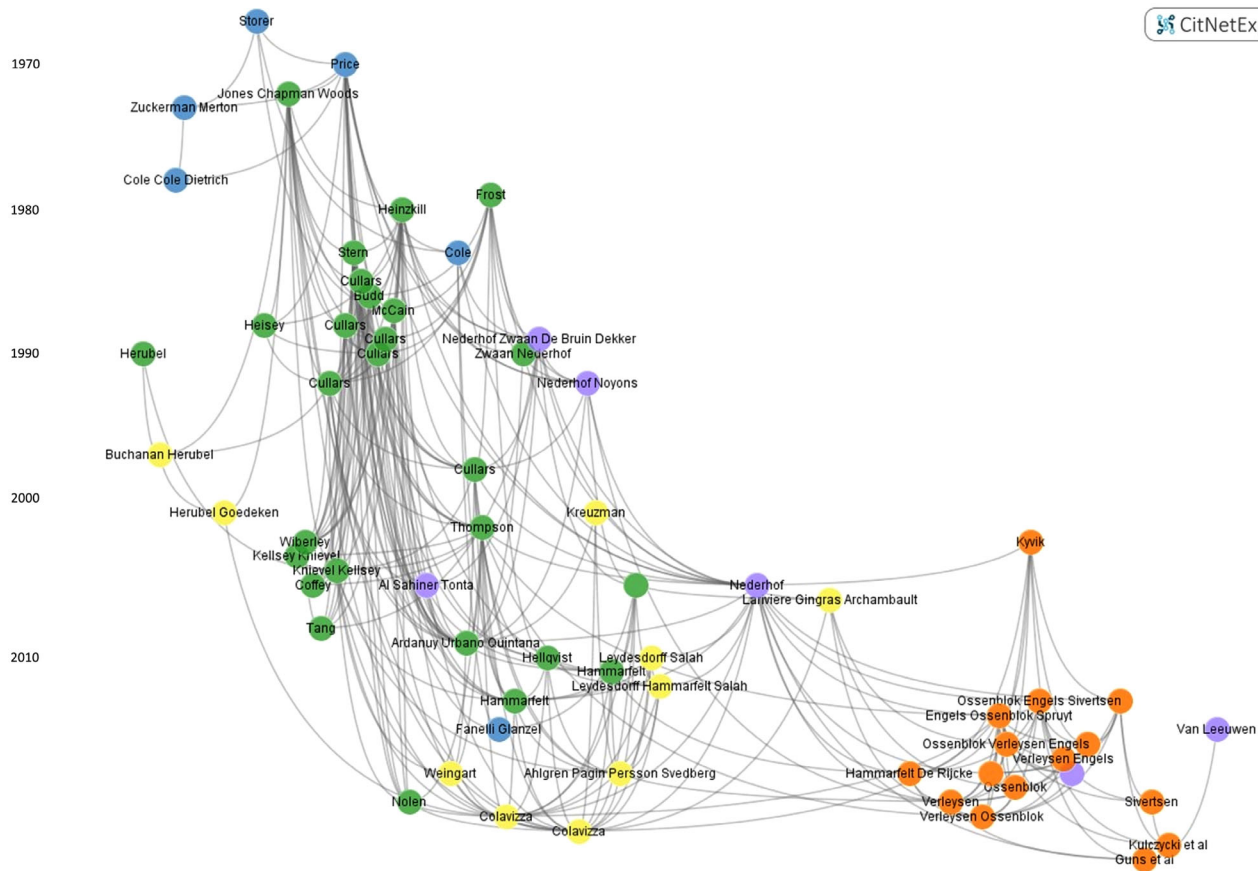


FIG. 1. Visualization of full citation network 1965–2018. Publications are clustered manually in five types of bibliometric studies. Details of articles can be found in the list at the end of the article. Blue = sociological studies, Green = library and information science, Purple = studies in research evaluation, Yellow = science mapping, Orange = studies using national and regional publication databases. [Color figure can be viewed at wileyonlinelibrary.com]

the development over time of the use of bibliometrics. Figure 2 shows in more detail the citation network of the scholarly communities prevalent in the first period of the field. Figure 3 does so for the second period.

The First Period of Bibliometric Scholarship

An empirical hierarchy of sciences in sociology. The first bibliometric studies were developed by early bibliometricians and sociologists in the 1960s and 1970s (see Cronin, 1984; Garfield, Malin, & Small, 1978; Godin, 2005; Narin, 1976). In these first two decades, mainstream bibliometric research was primarily based on data extracted from the Science Citation Index (SCI). However, as humanities journals are not included in the SCI, with the exception of history and philosophy of science journals, bibliometric research that includes the humanities in this period was based on small samples of bibliometric information gathered manually. Overall, very little attention was paid to the humanities in these early bibliometric studies. Only four publications from this time include the humanities empirically and discuss them in some detail (the study on the humanities presented in Cole, 1983, is identical to the one in Cole, Cole, & Dietrich, 1978). In them we find a common theoretical framework, bibliometric method, and data sources as

well as a common aim; the humanities are analyzed in relation to a particular notion of what constitutes scientificness. The four empirical studies we will briefly discuss are Storer's "The Hard Sciences and the Soft: Some Sociological Observations" (1967), Price's "Citation Measures of Hard Science, Soft Science, Technology and Nonscience" (1970), followed by Zuckerman and Merton's "Age, Aging and Age Structure in Science" (Zuckerman & Merton, 1973) and, lastly, "Measuring the Cognitive State of Scientific Disciplines" written by Cole, Cole, and Dietrich (1978).

These scholars employ an explorative and data-driven approach, which consists of putting forward certain variables that match their "intuitive" ideas or folk theories of (the organization of) the sciences. The study by sociologist Norman Storer, for example, explains the data and approach in the following way: he extracts bibliometric information from "two journals for each of ten fields of science, ranging from history to physics ... one issue of each for the years 1926, 1936, 1946, 1956, and 1966, and [then we] counted things" (Storer, 1967, p. 80).

Storer's text is relatively short—nine pages in length—and is based on a talk he gave to medical librarians in 1966. Storer aims to offer analysis of "the differences in the *qualities* of social relationships in the different sciences, or, perhaps, in the 'atmospheres' or 'moods' that

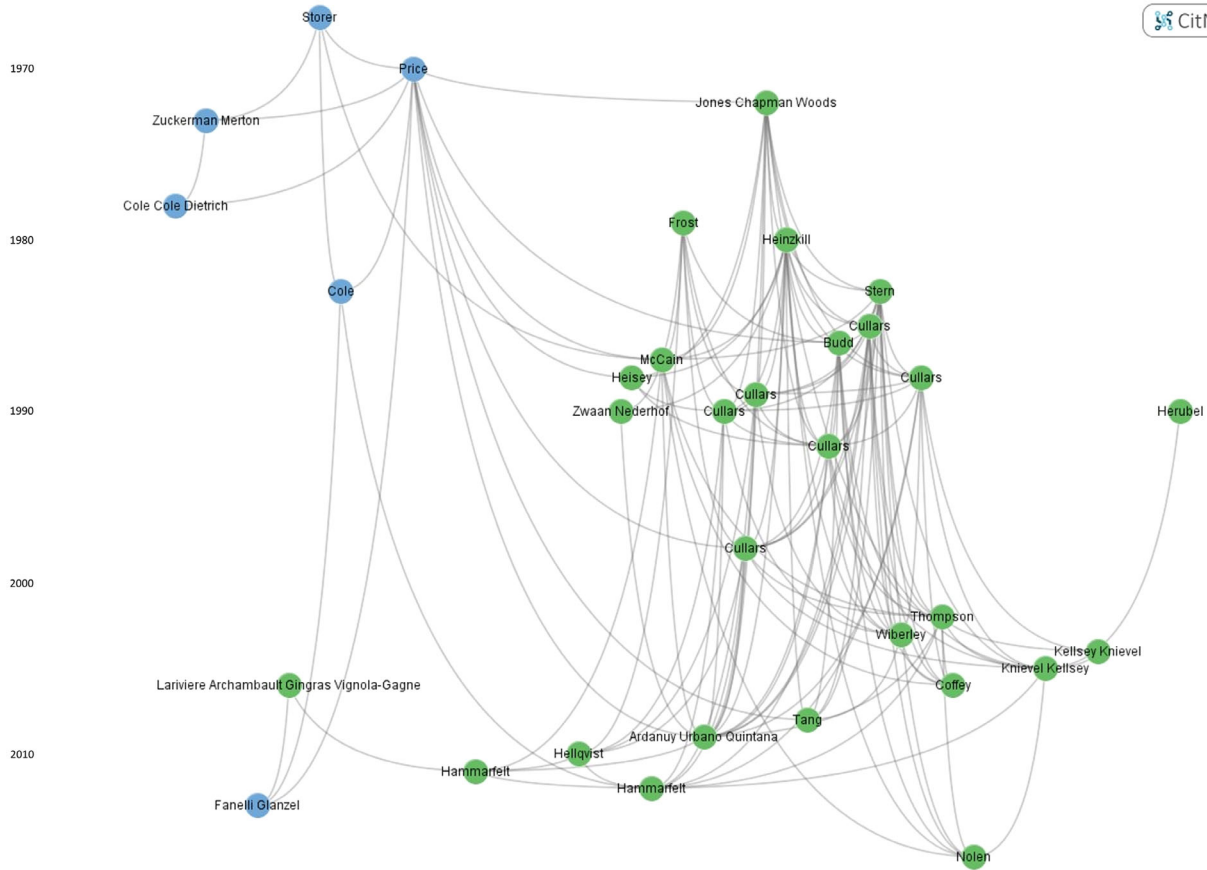


FIG. 2. Visualization of the citation network of the two scholarly communities that are prevalent in the first period of the field. This visualization includes those published during the second period. Blue = sociological studies, Green = library and information science. [Color figure can be viewed at wileyonlinelibrary.com]

characterize different fields of science” (Storer, 1967, p. 75, *italics in original*). The quality that is operationalized empirically in this article is “hardness.” Storer opens with a comparison of the connotations of “hard,” which implies “tough,” “impenetrable,” and “impersonal.” He then discusses the ways in which contributions to science are evaluated, and argues that an evaluation always rests upon a relation between the recent contribution and what was previously known. It is this relation that Storer argues is different in “hard” versus “soft” sciences. Harder sciences have a more tightly integrated body of knowledge, often because of the use of mathematics, which can, according to him, be operationalized as a measure of “rigor.” Therefore, in the hard sciences it is clearer whether a new contribution is correct or incorrect than in the soft sciences. Storer explains:

I am proposing that the use of mathematics in a science provides a greater degree of precision in organizing its body of knowledge and, thus, a ‘tougher’ set of criteria for the evaluation of new contributions. ... I am suggesting that, through some faculty of folk-wisdom, we have hit upon a way to characterize different branches of science in terms of a continuum that measures essentially the tightness of integration of their various bodies of knowledge. (Storer, 1967, pp. 78–79)

Interestingly, hardness is not only expressed as a characteristic of a cognitive body of knowledge, but also implies different evaluation criteria and social relations between scientists. Storer argues that because in the hard sciences evaluation criteria are more rigorous, it is more easily apparent whether a contribution is correct or incorrect. Therefore, the risk of making a contribution is greater because colleagues can, more easily than in the soft sciences, “hurt you,” which for Storer implies that social relations will be more impersonal. Therefore, next to the use of mathematics as a measure of rigor, Storer interprets the use of initials, instead of full names, in reference lists as a measure of impersonality. Storer then tests these two measures (the data used are outlined above) and shows that they indeed fit with his intuitive hierarchy of scientific disciplines. History journals used so few tables and had so few references with only initials that they were excluded from his analysis. This leaves us with the following classification of the sciences: sociology, political science, and psychology as soft sciences; botany, zoology, and economics as medium-hard sciences; and physics, chemistry, and biochemistry as the hard sciences.

For Storer, it is clear that classification of the sciences in this way is indeed a hierarchy and not just a differentiation. In his conclusion, Storer writes that he hopes the

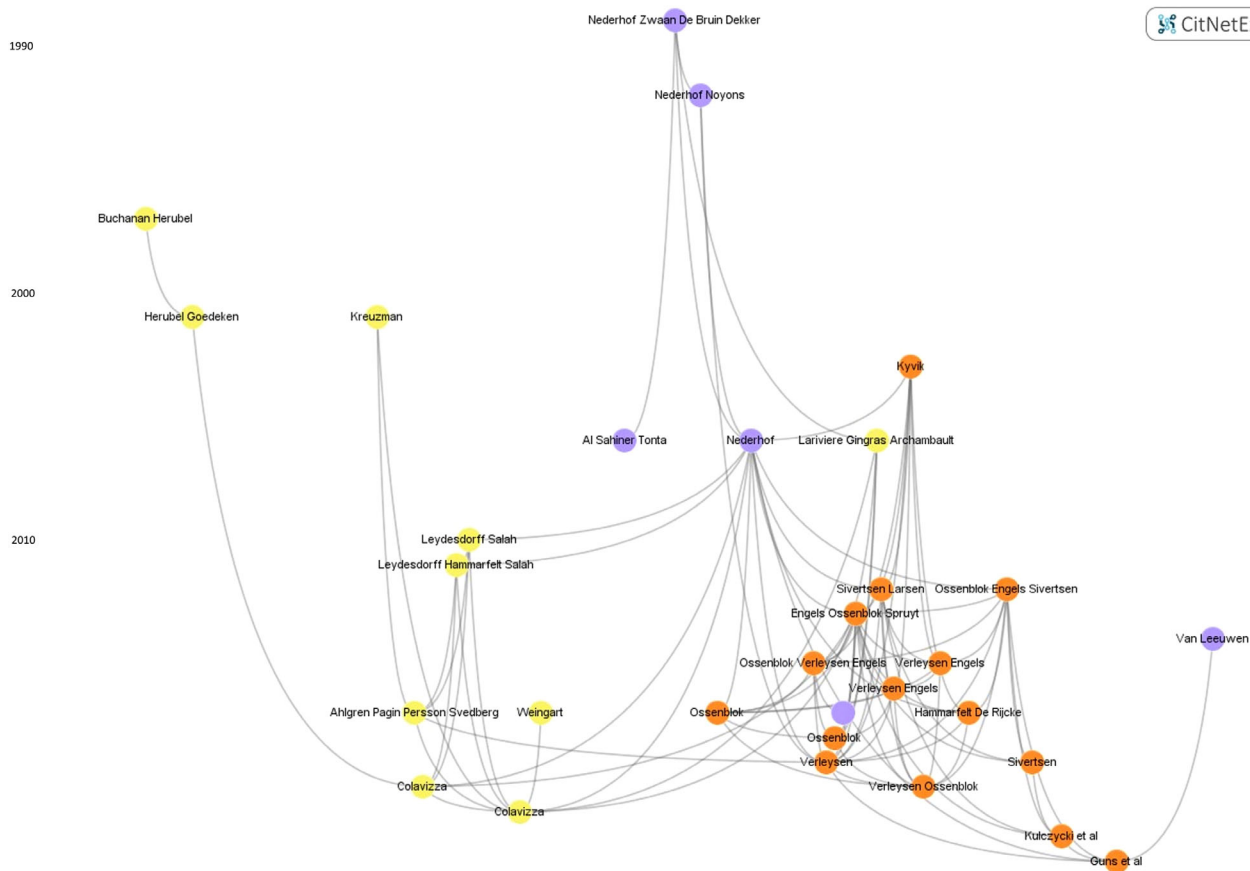


FIG. 3. Visualization of the citation network of the scholarly communities that define the second period. Purple = studies in research evaluation, Yellow = science mapping, Orange = studies using national and regional publication databases. [Color figure can be viewed at wileyonlinelibrary.com]

reader now understands more of “the drive in the softer sciences to become more rigorous through the use of mathematics. This is not simply a desire to emulate the more successful sciences, but rather a desire for more effective grounds on which to organize the collective efforts of many scientists” (Storer, 1967, p. 83).

Three years later, Price follows with the only text¹ in which he goes into detail about the humanities using bibliometric data. He attempts to differentiate between forms of scholarship—ranging from hard science to soft science to nonscience. For Price, Storer’s article is an initial point for discussion and is included as a background to Price’s own work. Although Storer operationalized hardness, Price aims to operationalize the extent to which knowledge is “cumulative.” He explains:

A now classical article by Deutsch worked out in some detail the implications of a suggestion by Conant that the essential difference between the two modes of scholarship was that of “cumulation” versus “noncumulation.” It was seen that

¹ This text was published three times: as a chapter in an edited book, as part of a conference proceeding of a world conference in sociology, and as part of the extended edition (1986) of Price’s celebrated book *Little Science, Big Science*.

cumulation in this sense implies not merely growth, nor indeed growth at compound interest, but rather the existence of a tightly integrated structure for the sciences. Evidently, the prototypes of the other side, identified as “the humanities” grew (perhaps almost as fast), contained specialties and fashions just as science, but had something different from the integrated structure of cumulation (Price, 1970, p. 4).

It is important to note that for both Price and Storer, an interrelation exists between the *social relations* within a domain of scholarship and the *knowledge* produced in that domain. Price (1970, p. 5) explains:

At this point it becomes evident that we cannot and should not artificially separate the matter of substantive content from that of social behavior. In order to deal with quantitative, highly ordered, rather certain findings, a special sort of social relation between participants is called for.

The idea of a “tightly integrated structure for the sciences” is therefore as much a social conceptualization as a cognitive one explicating the differences between varying forms of scholarship. This idea of different levels of structural integration is developed empirically through a study of references in articles in different domains (including the

humanities) using the Price Index.² The index measures the percentage of references in articles to sources that are no more than 5 years older than the citing article. The higher this score, the more the discipline has a distinguishable “research front” and therefore a specific type of citation structure in terms of age of references. For humanistic scholarship, Price finds that there is no distinguishable research front. In this study, he comes to his most explicit statement of how the humanities and sciences distinguish themselves and their processes from each other. Price explains, based on his empirical analysis of differences in the Price Index, that there are two metabolisms:

It would seem that this index provides a good diagnostic for the extent to which a subject is attempting, so to speak, to grow from the skin rather than from the body. With a low index one has a humanistic type of metabolism in which the scholar has to digest all that has gone before, let it mature gently in the cellar of his wisdom, and then distill forth new words of wisdom about the same sorts of questions. In hard science the positiveness of the knowledge and its short term permanence enable ... to emerge at the research front where interaction with one’s peers is as important as the storehouse of conventional wisdom. (Price, 1970, p. 15)

For both Storer and Price, reference behavior is an indicator of the social and cognitive structure of scientific disciplines. Only particular and tightly integrated social structures can sustain knowledge production with a research front, which is what sets scientific knowledge production apart from humanistic knowledge production.

After “hardness” and “cumulativeness,” a third concept was operationalized using bibliometric data: the concept of “codification.” Zuckerman and Merton, in their 1973 publication “Age, Aging and Age Structure in Science,” define codification as “the consolidation of empirical knowledge into succinct and interdependent theoretical formulations” (p. 303). This concept echoes both Storer’s interest in the use of mathematics and Price’s ideas on the “tight integration of fields.” Indeed, both are cited in Zuckerman and Merton’s article. However, codification is more explicitly cognitive than the measures developed by Storer and Price (see also Cozzens, 1985). Zuckerman and Merton argue that highly “codified fields tend to obliterate the original versions of past contributions by incorporating their essentials in the new formulations” (p. 303). This makes citation analysis a useful measure, as differences in codification are visible in the age of references. Drawing on Price’s data, and adding some of their own, Zuckerman and Merton use the Price Index to measure codification.

The fourth publication in this period brings together the earlier work. Stephen Cole, Jonathan Cole, and Lorraine Dietrich published their “Measuring the Cognitive State of Disciplines” in 1978 as a chapter in an edited volume,³ reflecting on the 1972 Science Indicators report and including contributions by

people such as Eugene Garfield, Derek Price, and John Ziman. The authors take a broad, more reflexive perspective on the development of bibliometric methods. Their analysis revolves around the notion of codification and its relation to the cumulative and progressive nature of different disciplines. They explain:

In the work of Kuhn, and of Zuckerman and Merton, the suggestion is at least implicit that rapid incorporation of old work makes the discovery of new ideas more probable, since workers in these fields need not continually return to first principles, or develop their own logical framework. Rapid incorporation and a corresponding high immediacy of citations is an indicator of the extent to which a science is growing in a cumulative fashion. The extent to which recent work is utilized in current research may thus be seen as an indicator of the presence of conditions necessary for rapid scientific advance. (Cole et al., 1978, p. 222)

The authors employ the measure developed by Price, but also improve it by controlling for the total size of the literature in each discipline. Their findings are surprising. Between the natural and social sciences they find little difference in the “immediacy effect” and, importantly, larger variances between journals within the same field than between fields. In a separate analysis of two English literature journals, the only empirical engagement with the humanities, they find very low scores for the Price Index. This leads them to conclude that:

The immediacy effect may enable us to distinguish between a literature that is scientific and one that is not, even if it may not allow us to distinguish between highly codified and less codified scientific fields. (Cole et al., 1978, p. 226)

The four studies show a common analytical strategy. The researchers collect sets of articles published in particular journals (assigned to a scientific domain) and analyze particular elements of these articles: the use of tables, the use of initials for first names of authors on reference lists, and the age of references. These elements are accorded significance, as they are understood to offer a window into the social and/or cognitive structure of a (scientific) community. Price, for instance, writes: “A scholarly publication is not a piece of information but an expression of the state of a scholar or a group of scholars at a particular time ... we can tell something about the relations amongst the people from the papers themselves” (Price, 1970, p. 6).

In this way, references are used to operationalize three closely related concepts—hardness, cumulativeness, and codification—with which the scholars in question want to compare the social and/or cognitive structure (or metabolism) of scientific domains. This research strategy was partially successful, but the issue of within-discipline variation of the

²This measure was introduced in Price (1965) but this article did not empirically study differences between disciplines.

³The edited volume entitled *Toward a Metric of Science* was edited by Yehuda Elkana, Joshua Lederberg, Robert Merton, Arnold Thackray, and Harriet Zuckerman.

Price Index could not be explained with the intuitive hierarchy of disciplines that was at the basis of the theoretical framework. However, a general differentiation between (hard) sciences and the humanities was established, and present-day scholars continue to use the Price Index to study this difference. At the same time, by the end of the 1970s we saw the rise of competing citation theories (see Cozzens, 1981; Wyatt et al., 2017) and a more general decline of the Mertonian school in the sociology of science to which all these authors belong (Luukkonen, 1997).

Librarians who study the humanities. The second community of bibliometric scholars in this period builds on the work of Price. This literature emerges from library science, specifically around collection management. In order to inform librarians, library and information scholars analyze the types of references included in reference lists of publications from various disciplines (the earliest examples are Gross & Gross, 1927, and Gross & Woodford, 1931). Most publications in this body of literature are descriptive, in-depth case studies of the characteristics of references in a particular research area or discipline. Many of these studies make use of the Price Index and include tables in which the percentage of references that are a maximum of 5 or 10 years older than the citing articles are compared between disciplines. Although, empirically, these studies offer more depth, theoretically there is little development to be discerned.

The first of such studies that includes the humanities was written by Jones, Chapman, and Woods (1972), who analyze references of articles in English history, distinguishing between medieval, early modern, and late modern history. They write:

Price suggested that the concentration of references to material published in the recent past, that is at the 'research front' of a subject, is the characteristic of a 'hard science,' and that a 'soft science' or non-science has a high degree of archival literature. If a subject has approximately 42% of its references dated within the last 5 years, then it is a hard science; if it has between 42% and 21%, then it is a soft science; and if it has less than 21%, it is a non-science. By this standard, English history is clearly a non-science, a finding which will surprise nobody. (Jones et al., 1972, p. 153)

The authors then present a table of percentages found in other studies for different disciplines. This research design is repeated in subsequent studies. Frost (1979) studied the function of citations in German literary research and makes a comparison, based on earlier research, with "scientific" disciplines. Heinzkill (1980) studied a large sample of references in English literary research. While this study is descriptive for the most part, Heinzkill compares the age of references in his sample with earlier studies in the same way as Jones et al. (1972). Stern (1983), in a study of literary scholarship of specific authors and literary movements, even reproduces the table produced by Jones, Chapman,

and Woods, and includes the results found in her study. Cullars (1985) analyzed references in monographs within American and British literary research and contextualizes these in comparison with other humanities disciplines, comparing his results with, among others, Heinzkill (1980) and Stern (1983). Other studies of a similar design include Budd (1986), Cullars (1988, 1992, 1998), Thompson (2002), and Tang (2008). More recently, a similar approach has been used by Ardanuy, Urbano, and Quintana (2009) to study Catalan literary studies, and by Hammarfelt (2012) to analyze references in Swedish literary studies.

Some studies that can be characterized as in-depth case studies of reference lists stand out, methodologically or theoretically, from the above-mentioned group of studies. Heisey's (1988) study is designed to deductively test Kuhn's paradigm theory and Price's metabolism theory. He studies publications on the Dead Sea Scrolls in biblical archeology (as an example of a scientific research area) and biblical criticism (as an example of a humanistic research area) to empirically test the difference between scientific publication, humanistic publication, and reference patterns. His analysis confirms that references in biblical archeology are much younger and are more often journal articles, as he expected. Moreover, he shows that there is a concentration of scientific archeology articles within the first years after the discovery of the Dead Sea Scrolls, which is not the case for biblical criticism. Heisey argues that this shows that Price was correct in his assertion concerning the two ways in which literatures grow. In biblical archeology there is a research front that "died" after a few years when the most important research puzzles were solved. In biblical criticism, on the other hand, such an effect is not observed, as new perspectives continue to generate publications in the field. While archeology would not be seen as a nonhumanities discipline by most, the difference between the two research areas are striking.

Zwaan and Nederhof (1990) assert that previous research has, unjustly, argued that all humanities disciplines lack core journals (Cullars, 1985, makes this argument explicitly). In their study of theoretical linguistics, Zwaan and Nederhof show that scholars do recognize a particular set of journals as core, and they show that the Price Index in theoretical linguistics is much higher than in other humanities disciplines. They conclude that compared with other disciplines, theoretical linguistics does not fit with the "humanistic stereotype." Wiberley (2003) develops a bibliometric analysis of five types of scholarship, showing that in literary studies there are strong bibliometric differences between descriptive "bibliographies," "editing," "historical studies," "criticism," and "theory." Hammarfelt draws on a wider analytical framework than the other studies and is, comparatively, most sociological in his approach. He develops a better understanding of referencing in the humanities (Hammarfelt, 2012; Hellqvist, 2010), and uses bibliometric data to study the intellectual structure of literary studies (Hammarfelt, 2011).

This second body of literature shares with the first an interest in the use of reference lists to describe and

compare disciplines, and sometimes even to develop and/or test theories. They employ the Price Index and other measures to analyze bibliometric differences and interpret these in terms of disciplinary differences. They are typically more interested in a diverse descriptive analysis of these reference lists, in terms of the type of publication cited, age, language, and source type (for example, Kellsey & Knievel, 2004; Knievel & Kellsey, 2005).

Conceptually, it is especially the general opposition between science and the humanities that survives, including the Price Index as a valid but rough measure used to compare disciplines. The studies engage with this opposition in different ways. Most of them take the opposition between science and the humanities as a given (for example, Cullars, 1985; Heinzkill, 1980; Jones et al., 1972; Stern, 1983), empirically test it (Heisey, 1988; Hammarfelt, 2011), or refute it for specific humanities disciplines that behave more “scientifically” than previously assumed (Zwaan & Nederhof, 1990). However, there is little independent theoretical development beyond this general opposition of scientific domains, which might be due to the different scholarly backgrounds of many of these authors (being primarily situated in library and information science).

The Second Period of Bibliometric Scholarship

Bibliometrics becomes a tool for research evaluation. By the end of the 1970s, the field of bibliometrics became established as a subfield of the larger field of library and information science, and gradually distanced itself from sociology and science and technology studies. The commencement of the journal *Scientometrics* in 1978 was an important moment for scholars, as it gave them a specialized outlet. The 1970s also saw the emergence of two new databases next to the SCI: the Social Sciences Citation Index (SSCI) and, more crucially for this article, the Arts & Humanities Citation Index (A&HCI).⁴ The community of bibliometric scholars grew and bibliometric analyses became increasingly important in the field of science policy. This had a profound influence on the development of bibliometric scholarship. The evaluation of research performance (for example, Moed, Burger, Frankfort, & Van Raan, 1985) was an increasingly important context for which bibliometric methods were developed and used, and one in which bibliometric methods are primarily understood today.

Bibliometric studies became, within this new context, more technical and policy focused. This shift had important implications for the intellectual hinterland invoked, types of bibliometric methods used, and its data sources. First, concepts were no longer explicitly embedded in a sociological understanding of science (for example, a Mertonian, interpretivist, or constructivist framework), but drew on a science policy discourse in which bibliometric methods were used to operationalize policy-relevant notions such as “academic

quality” or “internationality.” Second, the analysis of publication profiles of particular communities (universities, countries) became the most important bibliometric method of analysis in the humanities. Third, differentiating between the humanities and other scientific domains then happened through the analysis of publication types and the assumed nature of their audience rather than characteristics of references.

We first discuss the earliest bibliometric studies that explore the use of bibliometrics in the humanities for the purpose of research evaluation, and analyze the origin of “internationality” as a new concept in bibliometric studies of the humanities as well as its relation to “scientificness.” In this section, we draw on the first studies from bibliometricians occupied with research evaluation that rely on WoS databases in the 1980s and 1990s.

We then discuss more recent bibliometric studies. A community of scholars uses science mapping techniques to explore, through the analysis of citation relations, the cognitive structure of the humanities. These mainly draw on the earlier sociological framework. From there, we discuss new analytical opportunities that have recently emerged because of the development of regional or national databases in, notably but not exclusively, Flanders and Norway. These provide a fuller coverage of publications in the humanities to develop more thorough analysis of publication profiles. Although these studies take up a research evaluation framework, they ask a broader range of research questions regarding the social structure and publishing practices of the humanities.

Internationalism instead of scientificness. Two concepts were invoked in the early bibliometric literature on the use of bibliometrics in research evaluation in the humanities. The first was scientificness. This concept remained important; however, was no longer a character of the cognitive and social structure of a discipline (which was the case in the first period for “hardness,” “cumulativeness,” and “codification”). Rather, scientificness was defined first and foremost as a characteristic of the intended audience of publications. Publications aimed at a scientific audience were contrasted with publications aimed at a general or local audience. The second concept that emerged was internationality. As we shall show, the extent to which publications were “international” became a new dividing line between the humanities and other domains and within the humanities itself. Furthermore, internationality and scientificness often intersected. A local orientation was assumed to also be directed to a nonscientific audience, while an international orientation always invoked a scientific audience.

The research program of Nederhof and his colleagues in the Netherlands in the second half of the 1980s is the earliest example of this shift. At LISBON (which became CWTS in 1989), Nederhof, Zwaan, de Bruin, and Dekker (1988, 1989) studied the usefulness of bibliometric indicators for research evaluation in the humanities and social sciences. In their research, Nederhof et al. (1989) discuss Price (1970) and Cole (1983) and argue that the work of these scholars shows that the rate of scientific development in the

⁴In the remainder of the article we use the term *WoS databases* to denote the three together.

humanities is slower. They then explain that there are two mechanisms responsible for this slower rate of development. First, humanities (and social science) researchers are argued to be more involved in “enlightenment” of the nonscientific public. Second, these researchers argued to publish more for a local scientific public, which also “leads to a slower growth of knowledge.”

Nederhof et al. thus build on the work of Price and Cole and their ideas on scientificness. However, they point to the intended audience of publications as the primary difference between the sciences and the humanities, a notion that is absent in the work of Price and Cole. Including nonjournal publications and non-English publications is necessary to give recognition to the research culture of the humanities in research evaluation, according to Nederhof and colleagues. This aim can be seen as a response to criticisms of the use of bibliometrics in research evaluation in the humanities (for example, Petrey, 1980). The differentiation that is argued for between international and local, in relation to scientificness, is, however, problematic.

Nederhof et al. (1989) studied publication profiles in eight disciplines across the social sciences and the humanities. Data were gathered from annual reports from universities in which particular departments (or parts of departments) could be connected to particular disciplines as well as from the A&HCI. The “locality” of a publication plays a role in two ways. Publications can be local because they are aimed at a general public (so-called enlightenment publications), and publications can be “local” because they are written in a local language for a scientific public. The counterpoint for these two forms of locality is one form of internationality. Nederhof et al. take the language of publications, the nationality of the medium of publication, and coverage of articles in the WoS databases as variables in the operationalization of this notion of “international.”

Nederhof et al. (1989) develop a differentiation between disciplines or departments that publish more for a general audience versus ones that publish mainly scientific publications, and second, within scientific publications between a local and an international orientation. They relate this to the extent to which a discipline is “hard” or “soft.” Hence, being of a local nature, independent of the scholarly content of the publication becomes intertwined with the idea of non-scientificness and, vice versa, internationality becomes intertwined with scientificness. They write in the conclusion:

With regard to disciplines, we found that monographs and popularizing articles were more important outlets in ‘softer’ fields than in ‘harder’ ones. The enlightenment function of scholarship was especially evident in Dutch Literature, Dutch Language, and Public Administration. (p. 433)

We see a similar interest in the local–international distinction in Nederhof and Noyons (1992), but operationalized in an entirely different way. Drawing on the A&HCI, Nederhof and Noyons compare the citation impact of different general linguistics and general literature departments, and the extent to which publications are cited (in the A&HCI) by international

or local authors. Here, “international” comes to mean citations from outside the country of a department (or even only outside the continent).

Nederhof (2006) contains the most explicit explanation of the link between internationality and the earlier research on scientificness when he explains the differences between science, social sciences, and the humanities:

Primarily, many sciences cater to an international public of scientists. Basic research in fields such as physics or chemistry has an international research frontier (Price, 1963). The research frontier refers to all the work currently being done by all active researchers in a discipline (cf. Cole, 1983). In contrast, a considerable part of the output in many social sciences and humanities fields is primarily oriented at national or regional topics and a local public, and they appear frequently in regional or national serials, monographs, and reports. (Nederhof, 2006, p. 83)

As becomes clear in the above quotation, Nederhof equates internationality with the research front by arguing that this frontier is not a local matter, but an international matter of which the humanities are without. Instead, of the two metabolisms Price conceptualizes as two distinct forms of knowledge production, in this bibliometric literature, humanistic knowledge production is primarily understood in relation to an assumed nonscientific and/or local audience and an overall more diverse pallet of publication outlets. However, the nature of the audience never played a role in the notions of “hardness,” “cumulativeness,” and “codification” as conceptualized and operationalized in the earlier sociological literature. Instead, these terms referred to a particular cognitive (and social) structure of knowledge production. Similar to studies using the Price Index to analyze the degree to which a humanistic discipline is “like the sciences,” studies based on publication profiles have a similar tendency to compare whether or not a publication profile is more or less “scientific.” It is, however, questionable to what extent publication types and cognitive properties of the research described in it correlate. Is the Price Index of books lower than that of journal articles? Is knowledge contained in books written in a “local” language qualitatively different from books written in English?

Sivertsen and Larsen (2012) argue that it makes sense, from a scholarly perspective, to publish in a particular language to reach a particular scholarly audience. It is the tendency of bibliometricians to see each publication as a distinct unit of analysis that prevents a deeper understanding of publication practices of humanities scholars. It is, for instance, completely possible that a publication written in a language for a small audience contains the same ideas as publications written in English for an audience that is equally scholarly but cannot otherwise be reached. Sivertsen (2016a) recently showed that authors tend to diversify their publication outlets simultaneously (see also Verleysen & Weeren, 2016). His findings thus suggest that it is highly problematic to understand each publication independently from all others. Colavizza (2017b), as

we will show below, argued that monographs play a distinct role in the cognitive network of history publications and that this role is different from journal publications. There is then evidence that the diversity of publication types serves a particular function in the cognitive structure of the humanities that would, therefore, be qualitatively different from the cognitive structure of the other scientific domains.

Science mapping: An emergent field in bibliometrics of the humanities. The 1980s and 1990s were a time in which the research agenda of bibliometrics became increasingly focused on research evaluation. In the development of bibliometrics for research evaluation, however, science mapping techniques emerged (Chen, 2017) that do offer new insights in the humanities using references and citation relations as their primary data sources.

Most of these mapping studies are exploratory and have a proof-of-concept format; they show that bibliometrics can be used in a particular way in the humanities. These studies aim to identify social or cognitive communities and (interdisciplinary) relationships between such communities. Some do so by mapping the authors who publish in a particular journal (Buchanan & Herubel, 1997; Herubel & Goedeken, 2001), while other studies investigate the interdisciplinary space between established scholarly communities (Ahlgren, Pagin, Persson, & Svedberg, 2015; Kreuzman, 2001; Weingart, 2015). Larivière, Gingras, and Archambault (2006) map relations between institutions through coauthorship to explore the humanities with a more macro-sociological perspective.

A few scholars aim to add to our theoretical understanding of the cognitive structure of the humanities, and build on the earlier sociological literature. Leydesdorff and Salah (2010) map the cognitive structure of a small part of the humanities—two journals—and show that the role of the journal does not provide the same socio-cognitive structure as journals do in other scientific domains. In a larger study, Leydesdorff, Hammarfelt, and Salah (2011) did an explorative analysis of the cognitive structure of the entire A&HCI and compared this to various other proposed structures of the humanities (for instance, a departmental structure of a faculty; see also Guns, Sile, Eykens, Verleysen, & Engels, 2018).

Lastly, recent work by Colavizza (2017a, 2017b) aimed to study the role of core sources in cognitive networks in history. He shows, using a newly developed database of publications, including monographs of the history of Venice, that various types of core sources play different roles in the cognitive structure of history. Monographs, for instance, primarily create global connectivity, while journal articles are used more often for smaller local clusters.

Through science mapping techniques we gain new insights into the cognitive structure of the humanities. Until this decade, this literature has been mostly exploratory, without explicit theorizing or explicit comparisons with other scientific domains. These methods, however, provide exciting opportunities for a comparative approach

across disciplines to compare and contrast various cognitive structures. Doing so would enable us to understand, for instance, the distinct roles of journals in scientific domains, variances in the cognitive and social integration of scientific domains (for example, Whitley, 1984), and changes of time in the cognitive and social structure of the humanities itself. These insights are crucial to developing a deeper understanding of the ecology of publication outlets that humanities scholars use.

New databases, new research questions? With the emergence of regional and national publication databases in Denmark, Norway, and Flanders, new data sources have become available for studies of humanities publication practices and profiles. These databases, and related university repositories that offer more or less complete publication records, provide new opportunities for the bibliometric research community. The origin of these databases is described elsewhere (Engels, Ossenblok, & Spruyt, 2012; Sile, Guns, Sivertsen, & Engels, 2017; Sivertsen, 2016b). What interests us is the type of bibliometric studies these databases make possible.

The new databases allow for studies of publication profiles on larger scales (comparisons between institutions, disciplines, and countries) and benefit from far better coverage than earlier studies, which means they also offer a more detailed understanding of publication practices. This has led to a body of new publications that use these data to analyze various aspects of publication practices in the humanities (and social sciences).

These studies have a predominantly descriptive character. Some study the science system itself and the performative effects that performance-based funding mechanisms might have on publication practices (for example, Hammarfelt & De Rijcke, 2015; Ossenblok, Engels, & Sivertsen, 2012). Other studies analyze the role of edited books, the characteristics of book editors and monograph writers (Ossenblok & Engels, 2015; Ossenblok, Verleysen, & Engels, 2014; Verleysen & Ossenblok, 2017), internationalization of publication practices by looking at locations of book publication (Verleysen & Engels, 2014a, 2014b), and publication styles (Verleysen & Weeren, 2016). In the latter, Verleysen and Weeren (2016) show that two distinct publication styles (based on variation in language and publication outlet) exist in both the humanities and the social sciences, but that these also cut across all disciplines. The authors, however, are unable to assess differences in the content of these publications or differences in knowledge base; for instance, through comparisons using the Price Index, because reference data are lacking.

These new studies approach bibliometric data with novel methods, such as principal component analysis (Verleysen & Weeren, 2016) and the barycenter method (Verleysen & Engels, 2014a, 2014b). They are also empirically much more extensive and less focused on the development of bibliometric indicators. While this new body of literature shows an increasing diversity in data sources and methods, conceptual

development is slow. The lack of novel research questions might be due to the descriptive nature of these studies as well as the lack of reference data. Compared with the science mapping literature, these studies provide insights into the social structure of the humanities as well as publication practices and profiles, but not in the cognitive structure of the humanities.

However, two recent articles might provide exciting new analytical avenues, including for the cognitive structures of the humanities. In a 2018 study by Kulczycki et al., publication practices are compared across eight countries. Characteristics of the science system as well as the countries are included in the discussion to explain variation in publication profiles across places and disciplines. By including characteristics of the science system in bibliometric studies on a macro-level, the relation between research governance and publication practices in the humanities can be studied in much greater detail (see also Gläser & Laudel, 2016).

Another 2018 article, by Guns et al., introduces a new way of comparing the cognitive and social structure of the humanities. By comparing the cognitive and organizational categorization of publications of Flemish authors in the social sciences and the humanities, Guns et al. show that there is a disparity between the social and cognitive structure of the humanities. These results confirm the earlier work in science mapping by Leydesdorff, Hammarfelt & Salah (2011) and open up a new avenue of research. While they still lack reference data, Guns et al. (2018) have found a way to study the cognitive structure of the humanities and relate it to its social structure without reference data.

Conclusion

The Need for a Renewed Theoretization of the Humanities

In this article we analyzed how bibliometric methods have been used to study the cognitive and social structures and publication practices of the humanities. We distinguish two periods of bibliometric scholarship, in which we present five types of bibliometric studies. In the first period, spanning 1965 to the 1980s, sociologists developed bibliometric methods to test sociological theories. Library and information scientists draw on these early sociological attempts, but employ bibliometric methods to study the nature of referencing behavior in the humanities in much more detail.

In the second period, spanning from the 1980s to the present, bibliometrics becomes embedded in library and information sciences and is increasingly distant from the sociology of science. It is in this second period where we see three types of studies, performed by partly overlapping scholarly communities: research evaluation, science mapping, and studies involving new national or regional publication databases.

The most significant change between these two periods is the shifting conceptual hinterland in which bibliometric studies are embedded. In the first period, bibliometric

studies are embedded in a theoretical framework derived from the sociology of science. This changes from the 1980s onward, when bibliometric methods are increasingly used within the context of science policy and research evaluation.

Price (1970) argued that the humanities have a different metabolism of knowledge growth than the natural sciences. This was the basis for much of the bibliometric studies that we explored in the 1960s and 1970s, and continued to be important in later bibliometric explorations. Within the context of bibliometrics for research evaluation and the study of publication profiles, the humanities have been shown to inhabit diverse publication types. This diversity has, however, been conceptualized in a very limited way. Bibliometricians have compared publication practices to an ideal-typical notion of publication practices in the natural sciences (that is, English-language journal publications). They have yet to study the cognitive differences between publication types (see Colavizza, 2017b) or the role of different publication types (Sivertsen, 2016a). What urgently needs investigation and proper conceptualization is the way publication practices relate to the cognitive and social structures that we find in the humanities.

Taking on these more fundamental questions regarding the cognitive and social structures of the humanities, as well as publication practices, would require the development of new data sets and the combination of bibliometrics with other (qualitative) methods. Doing so will offer exciting new answers for research questions in the sociology of science, history of science, and science policy studies.

Acknowledgments

We thank the participants of the CWTS seminar, audiences at the RESSH conference, and the Making of the Humanities conference as well as Ludo Waltman, Björn Hammarfelt, Thed van Leeuwen, Giovanni Colavizza, and Sarah de Rijcke for their comments. We thank Mandy DeWilde for editing. This article was supported by the Swedish Foundation for Social Science and Humanities Research, grant number FSK15-0881:1 (KNOWSCIENCE) and the Research Council of Norway, grant number 256223 (R-QUEST).

References

List of Selected Publications (Clustered)

Cluster 1: Sociological studies

- Cole, S. (1983). The hierarchy of the sciences? *American Journal of Sociology*, 89(1), 111–139.
- Cole, S., Cole, J., & Dietrich, L. (1978). Measuring the cognitive state of disciplines. In Y. Elkana, J. Lederberg, R. Merton, A. Thackray, & H. Zuckerman. (Eds.), *Toward a metric of science: The advent of science indicators* (pp. 209–251). New York: John Wiley & Sons.
- Fanelli, D., & Glänzel, W. (2013). Bibliometric evidence for a hierarchy of the sciences. *PLoS One*, 8(6), e66938.

- Price, D. (1970). Citation measures of hard science, soft science, technology and non-science. In C. Nelson & D. Pollock (Eds.), *Communication amongst scientists and engineers* (pp. 3–22). Lexington, KY: Heath Lexington.
- Storer, N.W. (1967). The hard sciences and the soft: Some sociological observations. *Bulletin of the Medical Library Association*, 55(1), 75–84.
- Zuckerman, H., & Merton, R.K. (1973). Age aging and age structure in science. In R. Merton & N. Storer (Eds.), *The sociology of science. Theoretical and empirical investigations* (pp. 497–539). Chicago: University of Chicago Press.

Cluster 2: Library and information science

- Ardanuy, J., Urbano, C., & Quintana, L. (2009). A citation analysis of Catalan literary studies (1974–2003): Towards a bibliometrics of humanities studies in minority languages. *Scientometrics*, 81(2), 347–366.
- Budd, J. (1986). Characteristics of written scholarship in American literature: A citation study. *Library and Information Science Research*, 8(2), 189–211.
- Coffey, D.P. (2006). A Discipline's composition: A citation analysis of composition studies. *The Journal of Academic Librarianship*, 32(2), 155–165.
- Cullars, J. (1985). Characteristics of the monographic literature of British and American literary studies. *College and Research Libraries*, 46, 511–522.
- Cullars, J. (1988). Characteristics of the monographic scholarship of foreign literary studies by native speakers of English. *College and Research Libraries*, 49(2), 157–170.
- Cullars, J. (1989). Citation characteristics of French and German literary monographs. *The Library Quarterly*, 59(4), 305–325.
- Cullars, J. (1990). Citation characteristics of Italian and Spanish literary monographs. *The Library Quarterly*, 60(4), 337–356.
- Cullars, J. (1992). Citation characteristics of monographs in the fine arts. *The Library Quarterly*, 62(3), 325–342.
- Cullars, J.M. (1998). Citation characteristics of English-language monographs in philosophy. *Library & Information Science Research*, 20(1), 41–68.
- Frost, C. (1979). The use of citations in literary research: A preliminary classification of citation functions. *The Library Quarterly*, 49(4), 399–414.
- Hammarfelt, B. (2011). Interdisciplinarity and the intellectual base of literature studies: Citation analysis of highly cited monographs. *Scientometrics*, 86(3), 705–725.
- Hammarfelt, B. (2012). Harvesting footnotes in a rural field: Citation patterns in Swedish literary studies. *Journal of Documentation*, 68(4), 536–558.
- Heinzkill, R. (1980). Characteristics of references in selected scholarly English literary journals. *The Library Quarterly*, 50(3), 352–365.
- Heisey, T. (1988). Paradigm agreement and literature obsolescence: A comparative study in the literature of the dead sea scrolls. *Journal of Documentation*, 22(3), 266–268.
- Hellqvist, B. (2010). Referencing in the humanities and its implications for citation analysis. *Journal of the Association for Information Science and Technology*, 61(2), 310–318.
- Herubel, J.-P.V.M. (1990). The nature of three history journals: A citation experiment. *Collection Management*, 12(3/4), 37–41.
- Jones, C., Chapman, M., & Woods, P.C. (1972). The characteristics of the literature used by historians. *Journal of Librarianship and Information Science*, 4(3), 137–156.
- Kellsey, C., & Knievel, J.E. (2004). Global English in the humanities? A longitudinal citation study of foreign-language use by humanities scholars. *College and Research Libraries*, 65(3), 194–204.
- Knievel, J.E., & Kellsey, C. (2005). Citation analysis for collection development: A comparative study of eight humanities fields. *The Library Quarterly*, 75(2), 142–168.
- Larivière, V., Archambault, É., Gingras, Y., & Vignola-Gagné, É. (2006). The place of serials in referencing practices: Comparing natural sciences

- and engineering with social sciences and humanities. *Journal of the Association for Information Science and Technology*, 57(8), 997–1004.
- McCain, K.W. (1987). Citation patterns in the history of technology. *Library and Information Science Research*, 9(1), 41–59.
- Nolen, D.S., & Richardson, H.A.H. (2016). The search for landmark works in English literary studies: A citation analysis. *Journal of Academic Librarianship*, 42(4), 453–458.
- Stern, M. (1983). Characteristics of the literature of literary scholarship. *College & Research Libraries*, 44(4), 199–209.
- Tang, R. (2008). Citation characteristics and intellectual acceptance of scholarly monographs. *College & Research Libraries*, 69(4), 356–369.
- Thompson, J.W. (2002). The death of the scholarly monograph in the humanities? Citation patterns in literary scholarship. *Libri*, 52(3), 121–136.
- Wiberley, S.E.J. (2003). A methodological approach to developing Bibliometric models of types of humanities scholarship. *The Library Quarterly*, 73(2), 121–159.
- Zwaan, R., & Nederhof, A. (1990). Some aspects of scholarly communication. *Language*, 84(3), 474–496.

Cluster 3: Studies in research evaluation

- Al, U., Şahiner, M., & Tonta, Y. (2006). Arts and humanities literature: Bibliometric characteristics of contributions by Turkish authors. *Journal of the Association for Information Science and Technology*, 57(8), 1011–1022.
- Chinchilla-Rodríguez, Z., Miguel, S., & de Moya-Anegón, F. (2015). What factors affect the visibility of Argentinean publications in humanities and social sciences in Scopus? Some evidence beyond the geographic realm of research. *Scientometrics*, 102(1), 789–810.
- Nederhof, A. (2006). Bibliometric monitoring of research performance in the social sciences and the humanities: A review. *Scientometrics*, 66(1), 81–100.
- Nederhof, A., Zwaan, R., De Bruin, R., & Dekker, P. (1989). Assessing the usefulness of bibliometric indicators for the humanities and the social and behavioural sciences: A comparative study. *Scientometrics*, 15(5–6), 423–435.
- Nederhof, A.J., & Noyons, E.C.M. (1992). International comparison of departments' research performance in the humanities. *Journal of the American Society for Information Science*, 43(3), 249–256.
- Van Leeuwen, T. (2013). Bibliometric research evaluations, web of science and the social sciences and humanities: A problematic relationship? *Bibliometrie-Praxis und Forschung*, 2, 1–18.

Cluster 4: Science mapping

- Ahlgren, P., Pagin, P., Persson, O., & Svedberg, M. (2015). Bibliometric analysis of two subdomains in philosophy: Free will and sorites. *Scientometrics*, 103(1), 47–73.
- Buchanan, A., & Herubel, J.-P. (1997). Disciplinary culture, bibliometrics and historical studies. *Behavioral and Social Sciences Librarian*, 15(2), 37–53.
- Colavizza, G. (2017a). The structural role of the core literature in history. *Scientometrics*, 113(3), 1787–1809.
- Colavizza, G. (2017b). The core literature of the historians of Venice. *Frontiers in Digital Humanities*, 4(3), 14.
- Herubel, J.-P., & Goedeken, E. (2001). Using the arts and humanities citation index to identify a community of interdisciplinary historians. *The Serials Librarian*, 41(1), 85–98.
- Kreuzman, H. (2001). A co-citation analysis of representative authors in philosophy: Examining the relationship between epistemologists and philosophers of science. *Scientometrics*, 51(3), 525–539.
- Larivière, V., Gingras, Y., & Archambault, É. (2006). Canadian collaboration networks: A comparative analysis of the natural sciences, social sciences and the humanities. *Scientometrics*, 68(3), 519–533.
- Leydesdorff, L., Hammarfelt, B., & Salah, A. (2011). The structure of the Arts & Humanities Citation Index: A mapping on the basis of

aggregated citations among 1157 journals. *Journal of the American Society for Information Science*, 62(12), 2414–2426.

Leydesdorff, L., & Salah, A.A.A. (2010). Maps on the basis of the Arts & Humanities Citation Index: The journals Leonardo and art journal versus “digital humanities” as a topic. *Journal of the American Society for Information Science and Technology*, 61(4), 787–801.

Weingart, S.B. (2015). Finding the history and philosophy of science. *Erkenntnis*, 80(1), 201–213.

Cluster 5: Studies using national and regional publication databases

Engels, T.C.E., Ossenblok, T.L.B., & Spruyt, E.H.J. (2012). Changing publication patterns in the social sciences and humanities, 2000–2009. *Scientometrics*, 93(2), 373–390.

Guns, R., Sile, L., Eykens, J., Verleysen, F.T., & Engels, T.C. (2018). A comparison of cognitive and organizational classification of publications in the social sciences and humanities. *Scientometrics*, 116(2), 1093–1111.

Hammarfelt, B., & De Rijcke, S. (2015). Accountability in context: Effects of research evaluation systems on publication practices, disciplinary norms, and individual working routines in the faculty of arts at Uppsala University. *Research Evaluation*, 24(1), 63–77.

Kulczycki, E., Engels, T.C.E., Pölonen, J., Bruun, K., Dušková, M., Guns, R., ... Zuccala, A. (2018). Publication patterns in the social sciences and humanities: Evidence from eight European countries. *Scientometrics*, 116(1), 463–486.

Kyvik, S. (2003). Changing trends in publishing behaviour among university faculty, 1980–2000. *Scientometrics*, 58(1), 35–48.

Ossenblok, T.L., & Engels, T.C. (2015). Edited books in the social sciences and humanities: Characteristics and collaboration analysis. *Scientometrics*, 104(1), 219–237.

Ossenblok, T.L., Verleysen, F.T., & Engels, T.C. (2014). Coauthorship of journal articles and book chapters in the social sciences and humanities (2000–2010). *Journal of the Association for Information Science and Technology*, 65(5), 882–897.

Ossenblok, T.L.B., Engels, T.C.E., & Sivertsen, G. (2012). The representation of the social sciences and humanities in the web of science — A comparison of publication patterns and incentive structures in Flanders and Norway (2005–9). *Research Evaluation*, 21(4), 280–290.

Ossenblok, T.L.B., Guns, R., & Thelwall, M. (2015). Book editors in the social sciences and humanities: An analysis of publication and collaboration patterns of established researchers in Flanders. *Learned Publishing*, 28(4), 261–273.

Sivertsen, G. (2016a). Patterns of internationalization and criteria for research assessment in the social sciences and humanities. *Scientometrics*, 107(2), 357–368.

Sivertsen, G., & Larsen, B. (2012). Comprehensive bibliographic coverage of the social sciences and humanities in a citation index: An empirical analysis of the potential. *Scientometrics*, 91(2), 567–575.

Verleysen, F.T., & Engels, T.C.E. (2014a). Barycenter representation of book publishing internationalization in the social sciences and humanities. *Journal of Informetrics*, 8(1), 234–240.

Verleysen, F.T., & Engels, T.C.E. (2014b). Internationalization of peer reviewed and non-peer reviewed book publications in the social sciences and humanities. *Scientometrics*, 101(2), 1431–1444.

Verleysen, F.T., & Ossenblok, T.L. (2017). Profiles of monograph authors in the social sciences and humanities: An analysis of productivity, career stage, co-authorship, disciplinary affiliation and gender, based on a regional bibliographic database. *Scientometrics*, 111(3), 1673–1686.

Verleysen, F.T., & Weeren, A. (2016). Clustering by publication patterns of senior authors in the social sciences and humanities. *Journal of Informetrics*, 10(1), 254–272.

Additional References

Ardanuy, J. (2013). Sixty years of citation analysis studies in the humanities (1951–2010). *Journal of the American Society for Information Science*, 64(8), 1751–1755.

Bod, R. (2013). *A new history of the humanities: The search for principles and patterns from antiquity to the present*. Oxford, UK: Oxford University Press.

Chen, C. (2017). Science mapping: a systematic review of the literature. *Journal of Data and Information Science*, 2(2), 1–40.

Cozzens, S. (1981). Taking the measure of science: A review of citation theories. *International Society for the Sociology of Knowledge*, 7(1–2), 16–20.

Cozzens, S. (1985). Using the archive: Derek Price’s theory of differences among the sciences. *Scientometrics*, 7(3–6), 431–441.

Cronin, B. (1984). *The citation process: The role and significance of citations in scientific communication*. London: Taylor Graham.

De Rijcke, S., Wouters, P., Rushforth, A., Franssen, T., & Hammarfelt, B. (2016). Evaluation practices and effects of indicator use—A literature review. *Research Evaluation*, 25(2), 161–169.

Garfield, E., Malin, M., & Small, H. (1978). The advent of science indicators. In Y. Elkana, J. Lederberg, R. Merton, A. Thackray, & H. Zuckerman (Eds.), *Toward a metric of science: The advent of science indicators* (pp. 179–208). New York: John Wiley & Sons.

Gläser, J., & Laudel, G. (2016). Governing science. *European Journal of Sociology*, 57(1), 117–168.

Godin, B. (2005). *Measurement and statistics on science and technology: 1920 to the present*. London: Routledge.

Gross, P.L., & Gross, E.M. (1927). College libraries and chemical education. *Science*, 66(1713), 385–389.

Gross, P.L.K., & Woodford, A.O. (1931). Serial literature used by American geologists. *Science*, 73(1903), 660–664.

Hammarfelt, B. (2016). Beyond coverage: Toward a bibliometrics for the humanities. In M. Ochsner, S.E. Hug, & H.D. Daniel (Eds.), *Research assessment in the humanities. Towards criteria and procedures* (pp. 115–131). Cham, Switzerland: Springer.

Huang, M.H., & Chang, Y.W. (2008). Characteristics of research output in social sciences and humanities: From a research evaluation perspective. *Journal of the Association for Information Science and Technology*, 59(11), 1819–1828.

Hug, S.E., Ochsner, M., & Daniel, H.D. (2013). Criteria for assessing research quality in the humanities: A Delphi study among scholars of English literature, German literature and art history. *Research Evaluation*, 22(5), 369–383.

Law, J. (2004). *After method: Mess in social science research*. London: Routledge.

Luukkonen, T. (1997). Why has Latour’s theory of citations been ignored by the bibliometric community? *Scientometrics*, 38(1), 27–37.

Moed, H. (2006). *Citation analysis in research evaluation*. Dordrecht, The Netherlands: Springer.

Moed, H., Burger, W., Frankfort, J., & Van Raan, A. (1985). The use of bibliometric data for the measurement of university research performance. *Research Policy*, 14(3), 131–149.

Narin, F. (1976). *Evaluative bibliometrics: The use of publication and citation analysis in the evaluation of scientific activity*. Washington, DC: National Science Foundation.

Nederhof, A., Zwaan, R., De Bruin, R., & Dekker, P. (1988). *Productiviteit en kwaliteit in alfa-en gammawetenschappen; een haalbaarheidsonderzoek*. Den Haag, The Netherlands: Staatsuitgeverij.

Nicolaisen, J. (2007). *Citation analysis. Annual Review of Information Science and Technology*, 41, 609–642.

Ochsner, M., Hug, S.E., & Daniel, H.D. (2012). Four types of research in the humanities: Setting the stage for research quality criteria in the humanities. *Research Evaluation*, 22(2), 79–92.

Ochsner, M., Hug, S.E., & Daniel, H.D. (2016). *Research assessment in the humanities: Towards criteria and procedures*. Cham, Switzerland: Springer.

Petrey, S. (1980). The whole mirth catalogue. *The French Review*, 54(1), 117–121.

- Price, D. (1965). Networks of scientific papers. *Science*, 149(3683), 510–515.
- Price, D. (1986). *Little science, big science...and beyond*. New York: Columbia University Press.
- Rheinberger, H. (2010). *On historicizing epistemology: An essay*. Stanford, CA: Stanford University Press.
- Sile, L., Guns, R., Sivertsen, G., & Engels, T. (2017). *European databases and repositories for social sciences and humanities research output*. Antwerp, Belgium: ECOOM & ENRESSH.
- Sivertsen, G. (2016b). Data integration in Scandinavia. *Scientometrics*, 106(2), 849–855.
- Snow, C. (1959). *The two cultures*. Cambridge, UK: Cambridge University Press.
- Van Eck, N., & Waltman, L. (2014). CitNetExplorer: A new software tool for analyzing and visualizing citation networks. *Journal of Informetrics*, 8(4), 802–823.
- Whitley, R. (1984). *The social and intellectual organization of the sciences*. Oxford, UK: Oxford University Press.
- Wouters, P. (1999). *The citation culture* (Doctoral dissertation). The Netherlands: University of Amsterdam.
- Wouters, P. (2006). What is the matter with e-science: Thinking aloud about informatization in knowledge creation. *Pantaneto Forum*, 23. Retrieved from <http://pantaneto.co.uk/issue-23/>
- Wyatt, S., Milojević, S., Park, H., & Leydesdorff, L. (2017). The intellectual and practical contributions of scientometrics to STS. In U. Felt, R. Fouché, C. Miller, & L. Smith-Doerr (Eds.), *2016 The handbook of science and technology studies* (pp. 87–112). Cambridge, MA: MIT Press.