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## Exploring interdisciplinarity through the prism of research objects

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### Abstract

Whereas articles about the rhetoric of interdisciplinarity abound, empirical evidence substantiating the value of its practices remains limited, at best conflicting. While most studies have focused on the natural and medical sciences, very few studies have focused on the social sciences and humanities. To better understand interdisciplinarity patterns observed in those disciplines, this paper explores how research objects can serve as a bridge between disciplines and specialties in the social sciences and humanities. Our results shows that certain social sciences disciplines, such as economics and management, and, to a lesser extent, education and literature, have objects, concepts and their own methods, that are not shared with other disciplines. In contrast, sociology and history have few specific objects, and are positioned at the heart of the network of undisciplined objects. On the whole, our results suggest that disciplines of the social sciences and humanities are not monolithic blocks and a strong interdisciplinarity is expressed through a wide selection of objects.

### Keywords

Interdisciplinarity; disciplines; objects; indicators; bibliometrics; social sciences.

### Introduction

Interdisciplinarity has been much in the news over the last fifty years (Frodeman, Klein & Pacheco, 2017). In the hope that combining knowledge and methods from different disciplines could result in greater scientific advances, interdisciplinarity appears on the science policy agenda of several governments, research councils and universities (Mugabushaka et al., 2016), particularly since the publication of the seminal book by Gibbons et al. (1994). Whereas articles about the rhetoric of interdisciplinarity abound, empirical evidence substantiating the value of its practices remains limited, at best conflicting (Wang, Thijs & Glänzel, 2015; Larivière & Gingras, 2014).

One source of explanations of the conflicting results is the polysemic nature of interdisciplinarity – a concept difficult to define; but also to measure. Using different measures (simple counts, network parameters, dynamic models, a combination), different scientometric indicators for different units of analysis (paper, journal, author, department, project, university, field) at different levels of aggregation (people, team, institution, country) with different types of normalization processes respecting the granularity of the different and relative above mentioned components of science across research fields, is another explanation of the often irreconcilable results (Wagner et al., 2011). To the point that in their critical review of literature, the authors conclude that “assessment of interdisciplinary research inputs, processes, outputs, and outcomes is still a work in process.” (p. 24) In parallel, the sometimes incantatory discourse fueled by public policy makers, granting agencies and scientific researchers does not exclude that we can draw from it rich lessons epistemologically, theoretically and methodologically. Interdisciplinarity is however not unanimously accepted, especially because of the structure, hegemony and resilience of the disciplinary system that prevails within universities. As the scientific debate on interdisciplinarity remain endemically nurtured by skepticism and idealism, one narrative feeding into the other, how can one be surprised by the prolificity of the literature on interdisciplinarity?

Science is divided into a multitude of scientific communities, characterized by an epistemic culture of their own (Knorr-Cetina, 1999). These communities are generally based on disciplinary paradigms grouping together cognitive and social dimensions, ranging from a habitus – specific skills – to theoretical frameworks and research methods, to distinctive study objects. For Whitley (1984), discipline appears as an organizing principle, an institutional innovation governing the collective appropriation of fields of research through precise regulation and control mechanisms, both in terms of institutionalisation at the cognitive (construction) and the social (legitimacy) levels. Abbott (2001) distinguishes the social from the cultural structures of the disciplinary system: “for the last century, the map of disciplinary social structures has been remarkably constant, even while the equivalent map of cultural structures—the pattern of knowledge itself—has greatly shifted.” (p. 122) Fundamental to Lenoir’s thesis is the sense of heterogeneity of the scientific disciplines wherein the complex architecture of the sciences, phenomena are not discovered, Lenoir (1997) indicates, they are created, hand in hand with several dimensions of context that evolve dynamically and are essential to the production of knowledge. “Discipline is crucial for organizing and stabilizing this heterogeneity. Silent but powerfully operating, discipline is what makes disunified science work.” (Lenoir, 1997, p. 51).

In contrast to the disciplinary organization of scientific work, many actors in the research system consider interdisciplinarity as the preferred mode for advancing knowledge on certain complex problems relating to health, energy, water, climate, climate change and nutrition (Nature, 2015, 305), where natural and social sciences are intermeshed. The National Academies (2005) defines interdisciplinary research as “a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice.” (p. 26) Such interdisciplinary linkages, however, are sometimes difficult to establish. According to Kuhn (1962), the incommensurability of the disciplinary paradigms would be the explanation for this difficult passage of knowledge from one discipline to another. Still, interdisciplinarity cannot be

dissociated from the nodal idea of discipline. In his book “In Defense of Disciplines” Jacobs states:

“Disciplines are not bad; they are good. They are not isolated silos but rather nodes in a remarkably vibrant web of scholarship. At major research universities, disciplines are connected by an extensive network of interdisciplinary research programs, centers, and institutes. Disciplines are broad, not narrow; they are dynamic, not static.” (2013, p. 224)

Practiced nowadays in virtually all countries in the world (UNESCO, 2016), social sciences and humanities (SSH) and their associated disciplines and specialties exemplify this remarkably vibrant web of scholarship in addition to being characterized by an increase of collaboration and of the scientific production over the past decades almost everywhere (Heilbron & Sapiro, 2017). The objective of this study is to explore how research objects can serve as a bridge between disciplines and specialties in the social sciences and humanities and to therefore shed light on the disciplinary and interdisciplinary organization of scientific work.

### **Methods**

Data for this study were retrieved for the period ranging from 1980 to 2015 from Clarivate Analytics Web of Science (WoS) core collection, including the Science Citation Index, Social Science Citation Index and Arts and Humanities Citation Index. A discipline is assigned to the publications based on the National Science Foundation's classification (NSF, 2006). To better understand interdisciplinary dynamics and their relation to objects, we retrieved noun phrases from the titles of articles. We converted plural noun phrases to their singular form, but did not further attempt to consolidate different noun phrases relating to the same object. This is a limitation of our analysis will we will tackle in further development of this work. We also chose to exclude psychology and health from this preliminary analysis, given their specific objects more related to the natural and medical sciences.

The data are presented in two-mode networks grouping noun phrases and disciplines. The networks were produced with Gephi because it is better suited for two-mode network visualization than VOSviewer, for instance. Figure 1 shows the “disciplined” words (N = 142); that is, those with 50% or more occurrences in one discipline only. A link appears between the discipline and the word when at least 3% of the occurrences are in the discipline. Figure 2 presents the 158 “undisciplined” words, for which no discipline contains more than 20% of the occurrences. A link appears between the discipline and the word when at least 5% of the occurrences are in the discipline. In both figures, the darker the link between the word and the discipline, the more the word is strongly associated with the discipline; the size of the word is a function of the total number of occurrences of the term.

### **Results**

Figure 1 presents “disciplined” objects. It shows a strong association between some noun phrases and specific disciplines. For instance, many noun phrases are clustered around economics and management, indicating that these disciplines use a large number of terms that are hardly used by other disciplines of the social sciences and humanities. We also observe several unsurprising strong associations between objects and disciplines, for instance lawyer and supreme court (law), school and student (education), library (information science), Jesus (religion) and poetry (literature). Some disciplines also appear to have very few specialized terms and are thus somewhat peripheral in the network. This is the case, for instance, of sociology, general social sciences, geography, area studies, and science studies.

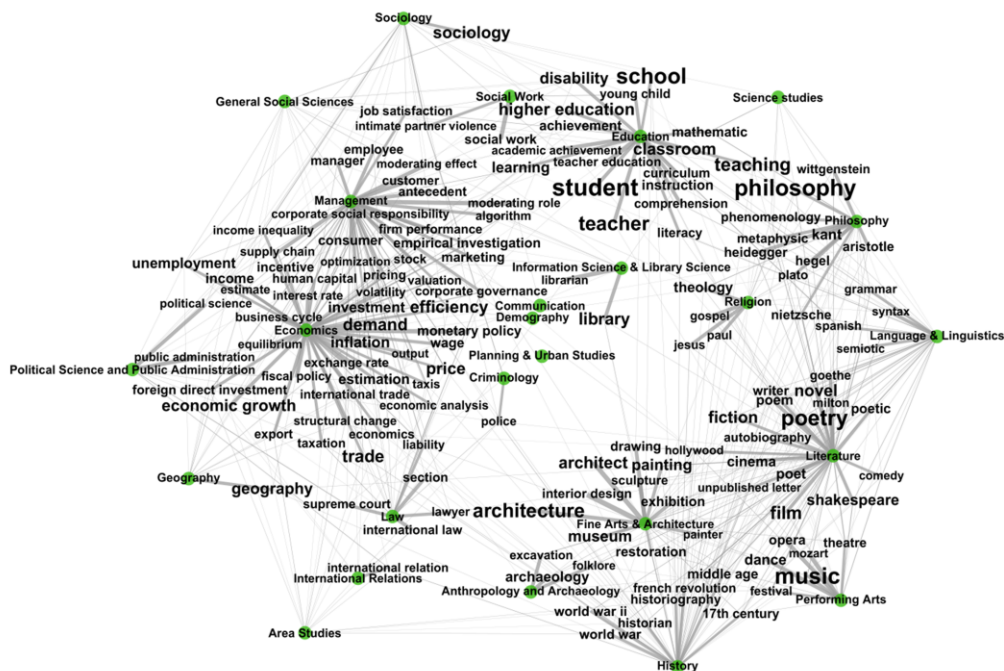


Figure 1. Bimodal network of SSH specialties and noun phrases that are strongly associated (1980-2015).

In contrast, Figure 2 presents the network of “undisciplined” objects (i.e., the noun phrases with no more than 20% of their occurrences in a single disciplines) and disciplines. The network is thus dominated by terms designating places, social groups, and other general concepts related to social sciences and humanities. As expected, the network is denser than the one in Figure 1 and showing that the disciplines have a lot of objects in common. While disciplines study similar objects, they might do so using their own discipline-specific methods, theories or research goals. For example, history and sociology are very close to each other on the map, meaning that they share a many objects. However, while sociologists may use methods such as surveys, interviews or observations, and build on sociological theories to produce knowledge related to these objects, historians may instead dig through archives and use different theoretical frameworks to produce knowledge related to those same objects. Another example is economics, with which other social sciences and humanities disciplines are primarily related through the use of geographical terms - a reminder that social science research tends to be culturally and geographically contextualized.



disciplines are more central in their common objects, and others more peripheral in their specific objects.

While exploratory, our preliminary data on disciplined and undisciplined objects demonstrates that disciplines of the social sciences and humanities are not monolithic blocks; a strong interdisciplinarity is even expressed through a wide selection of objects, as illustrated. One might therefore argue that the Kuhnian incommensurability between paradigms be first and foremost a function of the theoretical and methodological approaches rather than research objects.

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