ABSTRACT

XIAOQIN YAN. "American Sociology as a Cultural System: Examining Meaning Structure in Knowledge Production through Semantic Network Analysis" (Under the direction of Dr. Andrew P. Davis.)

Knowledge production is a complex social phenomenon. This study went beyond the structural model by addressing the duality between structural and cultural factors in shaping knowledge formation. I argue that research terminologies used in sociology research can be seen as the shared cultural beliefs that constitute our field as a cultural system. Based on 3,375 doctoral dissertations from 118 U.S. sociology departments completed between 2012 and 2019, I apply natural language processing and semantic network analysis to the dissertation abstracts to map the evolving knowledge backbone of American sociology through a relational lens. I advance Breiger's classic model of duality by examining and extending the person-to-group cultural interaction one step further to the word-to-text unit. I employ Mohr's conceptual framework of relationality and duality to develop theoretical and methodological applications to model knowledge production as a cultural practice. My results identified not only the key research themes in American sociology but also the dynamics of the meaning-making of research terminologies used in the dissertation abstract as the cultural elements.

Key Words: Semantic network analysis, sociology of knowledge, culture, duality

American Sociology as a Cultural System: Examining Meaning Structure in Knowledge Production through Semantic Network Analysis

by
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Introduction

Knowledge production is a social process (Ben-David and Collins 1996; Uzzi and Spiro 2005; Owen-Smith and Powell 2005). The emergence and evolution of scientific ideas is structured in relation to intellectual communities, where the set of beliefs and knowledge that scholars contribute are, in part, determined by the group of people they interact with (Merton, 1942; Bearman, 1993; Burt, 1987; Collins 1998). Sociologists studying knowledge production have recognized the vital role of social structure in shaping academic disciplines. Burt (1987) argues that knowledge is contagious, diffusing through interpersonal ties propelled by structural factors: cohesion (collaboration) and equivalence (competition). The cohesion model highlights that knowledge diffusion is more likely to occur among ego (a focal node) and alters (nodes that are directly connected to the ego) with close network connections. In contrast, the structural equivalence model proposes that the competition between ego and alter with identical network locations will also promote the diffusion of knowledge. Abbott (2001: Chapter 1) proposes the notion of fractal differentiation, where academic disciplines tend to merge or converge when scholars in different subfields start to address each other's inquiries with new methods. Similar to Abbott's arguments, using co-authorship data in sociology-related publications, Moody (2004) shows that the network structure has a significant impact on disciplinary cohesion, where the collaboration between scholars across different subfields unites their specialties and promotes the integration of the sociology discipline.

Yet, when attempting to elucidate the social construction of scientific knowledge, we must go beyond the structural model by addressing the duality between structural and cultural factors in shaping knowledge formation (Breiger 1974; Basov et al. 2020). Scholars are both products of their research community while also actively shaping the contours of that

community. According to Breiger (1974)'s classic theoretical model on duality, the cultural meaning of groups is determined by the subset of individual actors that are linked to, while the meaning of individual actors is shaped by the groups they belong to simultaneously. A complementary approach, John Mohr's (1998) meaning-structure institutionalism, provides a valuable set of tools and techniques for the interpretation of how institutional life is embedded within a cultural network. For Mohr, by examining the patterns of relationships that connect different elements within a cultural system, we can understand how cultural meanings are constructed in relation to structural differences. In the case of sociology, instead of seeing the different topics of interest in sociology as cultural templates with internally stable meanings, I conceive the interaction between sociological research terminologies as an instituted process. Specifically, when accessing the cultural meaning of a particular research terminology (i.e., *violence*), we must advance our understanding along with other relative terms/concepts embedded in configuration to that particular research terminology (i.e., *gender-based violence*).

In recent years, socio-semantic network analysis has drawn considerable attention from scholars across multiple disciplines. Building on the traditional network approach, socio-semantic network analysis brings together the discursive structure that links cultural schemas (ideas/opinions/values/concepts) with the social actors who share and produce these elements (Basov et al. 2020). A great deal of research has arisen from investigating the intersection between social relations and cultural systems. Some exemplars of this approach: Puetz et al.(2021) use semantic networks to examine the change in the meaning structure of human rights languages in peace agreements; Karell and Freedman (2020) show how the cultural domain entwines conflict through their socio-semantic network analysis of the social relationships between Afghan militants. Additionally, with the increasing availability of

bibliometrics data, sociologists can measure knowledge production as a cultural phenomenon using mathematical and computational models (Lee et al. 2021; Stolz and Tylor 2021; Lee and Martin, 2018).

In this study, I propose that research terminology in sociology cannot be viewed as an independent and self-contained entity; instead, its meaning is determined in relation to other concepts within its relational network. Categories that may appear to exist independently, with their inherent qualities, are more accurately understood as sets of relationships that are stabilized based on contingencies and historical factors that are constantly changing over time (Somers, 1995; White, 1997). On this basis, this study investigates the dynamic process of meaning-making and switching in knowledge production by seeing American sociology as a cultural system. I propose to compose the interaction between research terminologies used in sociology dissertations as a cultural and structural practice to construct the research agenda of sociology as a scientific discipline. I build the cultural corpus of American sociology based on dissertation abstracts produced in 118 US sociology departments from the 2012-2013 academic year until the 2018-2019 academic year. Using computational text analysis, I investigate the relational backbone of cultural elements (in my case, the research terminology based on the terms evoked in the dissertation abstracts themselves).

This paper is organized as follows. First, I began by building a comprehensive review of the literature on the social aspects of knowledge production, guided by the macro-relational lens in understanding the cultural interaction between person-to-group and group-to-field in yielding scientific knowledge. In the second section, I discuss my methodological choices and analytical strategies; as these data were collected by the team of researchers at NC State University, I also briefly address my data collection procedure. In the third section, I present the results of the

semantic networks analysis of the sociology dissertation abstracts from 2012 to 2019, followed by the network centrality measures in understanding the interplay between sociology research terminologies over time. I argue that the meaning-making and switching of research terminologies are driven by the word-to-unit of text duality, where the meaning of a word is determined by the unit of text it is connected to, while the meaning of the unit of text is shaped by the words it constituted of (Mohr, 1998; Breiger, 1974). I conclude this study by discussing the future direction in studying knowledge production and the theoretical and methodological implications to future research.

1. Theoretical backgrounds

1.1. Cultural and structural divide

Sociologists have long been interested in studying the socially interactive nature of scientific knowledge production. Multiple lines of research have derived from the traditional sociology of science approach in studying knowledge innovation with the intersection of the theoretical and methodological foundations in the sociology of culture, social network analysis, and organizational theory. The classic stream of research follows a diffusion model in elucidating how structural factors assist or impede the creation and transmission of new scientific ideas. Burt (1987)'s classic structural equivalence and cohesion model outlines the transmission of information is highly dependent upon the individual actor's position within its local network. While cohesion further promotes collaboration and structural equivalence raises competition, based on his analysis of the acceptance of the new antibiotic among physicians during the mid-1950s, Burt showed that knowledge diffusion is more likely triggered by structural equivalence (competition) than cohesion (collaboration). Additionally, Burt (2004)'s structural

hole model emphasizes the role of brokerage in accessing the unseen information between groups. In this model, the between-group actors (brokers) were exposed to more heterogeneous and diverse information than the within-group actors, which allows the broker more likely to express novel ideas that were otherwise unseen. Following Burt's diffusion model, this stream of research further investigates the knowledge production and transmission across diverse organizational settings, such as the creative industry (e.g. Uzzi and Spiro, 2005), commercial firms (e.g. Owen-Smith and Powell, 2005), and academia (e.g. Lamont, 1987). Additionally, a growing body of research derived from this structuralist approach by addressing the duality between cultural and structural factors that simultaneously facilitates knowledge production as a dynamic process. For instance, Lamont (1987) investigates the introduction and legitimation of French philosopher Jacques Derrida's work to the United States and its diffusion within U.S. academic institutions and research. One significant contribution of Lamont's study is that it extends the analysis of knowledge diffusion beyond the structural factors. According to Lamont's analysis, the successful legitimation of Derrida's work in the U.S. is linked to its adaptability to the institutional and cultural features of the American market, where Derrida's work demonstrates a substantive cultural fit with the intellectual themes that the American audiences collectively found important.

While Lamont's study elevates the diffusion model of knowledge transmission by addressing the role of knowledge reception, it also reveals the limitations of the diffusion model. As suggested by Lamont, success or failure in knowledge transmission is determined by not only the quality of the knowledge content but also its cultural fit with the audience's existing ideas and tastes. In this sense, the diffusion model is inherently limited in explaining the dynamic process of knowledge production and dissemination because it assumes knowledge as a static object and

thus can be easily transferred from one group to another through structural factors. Thereby, to address and further investigate knowledge production as a dynamic social phenomenon, the 'relational-constructivist' approach proposed by sociologists studying culture offers a valuable lens in explaining how shared beliefs and knowledge forge social relationships and how social relations cause changes in beliefs. Building upon Burt (2004)'s structural hole model, Pachucki and Breiger (2010) raise the notion of the 'cultural hole,' addressing the cultural contingency of social ties and network structure. According to Pachucki and Breiger (2010), a cultural hole presents the linkage between diverse cultural forms through shared cultural meanings, practices, and discourse. In the case of knowledge production, it can be seen as a cultural practice. On the one hand, scholars interact with each other on the basis of shared research interests and form social relationships; on the other hand, emergent scientific knowledge must demonstrate its cultural commonality with the existing research to be accepted and transmitted among the scholarly communities. Here, we see the links between culture and structure, where culture is organized by social ties, and the social ties are structured in relation to shared cultural beliefs.

Overall, this body of research highlights the important interplay between cultural and structural factors in shaping knowledge production and transmission. Much of this work draws on theoretical insights from Harrison White (1992, 2008 : Chapter 1)'s book *Identity and Control*, where he argues that network structure and culture exist and co-evolve simultaneously. Social actors have their own agency, and their interaction is managed through 'Netdoms', a mixture of network and cultural domains (White, 1992, p. 7-15). Following White's conceptualization, this stream of work proposes that cultural forms are not static or fixed but are shaped and maintained through social relationships and interactions within a network. The network acts as the host for cultural forms, providing the context and infrastructure for their

production and dissemination. Moreover, the domain of cultural forms itself can shape the network by influencing the formation of social ties and hierarchies within it. Cultural forms play a vital role in establishing the identity of individuals and groups within the network, creating a sense of belonging and differentiation from others and resulting in the reciprocal effects between cultural orientations and network composition. This stream of work presents the dynamic interplay between actors and cultural symbols, where actors are allowed to obtain different symbolic positions in networks and are able to switch between multiple different network domains with the diverse symbolic constellation (Emirbayer and Goodwin, 1994; Emirbayer, 1997; DiMaggio, 1993; Smith, 2003). In addition to the theoretical arguments, this body of work yields considerable methodological contributions in modeling the interaction between cultural and structural factors. For instance, Kathleen Carley (1986, 1991)'s constructural theory suggests that culture can be seen as the set of symbols (information) that is distributed across our social system, where the structure facilitates the potential social interactions between actors who obtain the shared understanding of information. In the case of knowledge production, actors with shared cultural symbols obtain more likelihood to form interaction and connections, which ultimately fosters the emergence of groups based on shared knowledge. Following this 'relational-constructivist' approach, studies in this tradition employ empirical data in examining the relationships between various cultural and structural factors, such as the socio-structural determinants of culture consumption patterns (Lizardo, 2006; Schultz and Breiger, 2010) and the role of moral value in influencing friendship network compositions (Vaisey and Lizardo, 2010).

This study uses American sociology as the empirical case to illustrate the interaction between cultural and structural factors that shape knowledge production. I argue that knowledge production in Academia is not only driven by structural factors (e.g. the mentorship between the

advisor and the grad student) but also cultural factors: where the research terminologies used in sociology research can be seen as the shared cultural beliefs that constitute our field as a cultural system. In this sense, when proposing a new research topic, a grad student must 1) perform scholarly communication with academic mentors (structural) and 2) be exposed to the existing scholarly literature (cultural). Thereby, structural factors and cultural factors work in conjunction to produce new scientific knowledge.

I follow the 'relational-constructivist' approach in constructing the knowledge network of American sociology. While the majority of studies in this tradition forces on inferring social ties among actors through their co-usage of cultural symbols (Lizardo, 2006; Vaisey and Lizardo, 2010). For instance, Lizardo (2006) shows that people who have a strong commitment to highbrow culture tend to have stronger ties with others, while those who prefer popular culture tend to have weaker ties. This study head to a reverse way to construct the knowledge network of research terminologies (cultural symbols) through their co-occurrence across dissertations (social actors). Specifically, I argue that research terminologies used in sociology dissertations are special forms of cultural symbols because they are closely interconnected and thus can not be easily sorted into distinct categories. Thereby, I employ the relational approach in elucidating the cultural meaning of sociology research terminologies through their co-usage of social actors. In the following section, I illustrate my methodological plan for constructing the knowledge network.

1.2. The social and cultural root of knowledge production in Academia

This study treats the meaning making within knowledge production as a fully interactive cultural practice. I went beyond the structuralist model by arguing that scientific ideas are

emergent not only through interpersonal communications with scholarly communities but also through the shared cognitive understanding of cultural elements. An individual's scholarly journey from attending graduate school to becoming a scholar is always featured by both structural and cultural factors. In terms of the structural factors, our field is operated under the mentor-to-mentee system, where a grad student will be first assigned to an advisor who is responsible for providing guidance and support for their research. A growing body of work has forced this social aspect of knowledge production. Some argue that in order to produce philosophical ideas, individual thinkers must interact with other thinkers verbally or textually (Collins, 1998). In this sense, the production of intellectual traditions and knowledge is not solely attributed to individual genius or natural talents. Rather, it is a collaborative process that is influenced by the social structures in which intellectuals are embedded. Intellectuals are not isolated entities but operate within the networks of other intellectuals, and the ideas and knowledge they produce are molded by the interactions and dynamics within this network. In other words, the development of knowledge is contingent upon the collective efforts of the intellectual community and the social context in which they operate. This body of work also emphasizes the role of power and status in shaping knowledge production. Intellectuals are not just motivated by a search for truth or objective knowledge but also by the desire for recognition and status within their intellectual communities. This drive for status and recognition leads intellectuals to engage in competition with each other, which can both facilitate and impede the development of new ideas and knowledge (Collins, 1998; Berger and Luckmann, 1967). Additionally, another body of work in this tradition proposes knowledge production can generate solidarity within groups, where the members work collectively to promote and defend their intellectual traditions. Therefore, knowledge becomes grouped based on the social networks of

intellectuals. Thus, we can infer the structure of intellectual networks in line with the structure of knowledge. This stream of work sheds light on the dynamic process of knowledge production, which is operated through an ecological system that is shaped by both internal and external factors. Thereby, knowledge is categorized and differentiated into discrete units or concepts. These distinctions are based on the recognition of similarities and differences between things, events, or phenomena, and they are used to organizing knowledge within a particular field of inquiry. Disciplines are defined by their own unique norms, practices, and theories, which enable and constrain knowledge production within that specific field. However, they are also influenced by external factors such as political and economic pressures, social changes, and scientific advancements. Hence, knowledge production is a complex and dynamic process that is not linear or straightforward. The interactions and relationships between different actors within the system are unpredictable and may lead to unexpected changes in the direction of knowledge production. The ecosystem of knowledge production is constantly evolving and responds rapidly to changing circumstances, making it a challenging and ever-changing field of study (Abbott, 1988, 2001; Ben-David and Collins, 1996; Moody, 2004).

This study extends this structuralist approach by introducing the cultural aspects of knowledge production. When entering graduate school, in addition to form mentorship with advisors and committee members, a grad student has first to identify a research agenda before attempting to yield scientific knowledge. I theorize this procedure of locating the research agenda as a cultural practice, where a graduate student must be exposed to the global knowledge network that is constructed collectively by scholars from the same discipline. I follow the relational approach in illustrating the meaning-structure of research terminologies through their connections with the neighbor terminologies. Likewise, I argue that the cultural meaning of

research terminologies used in sociology dissertations are inherently dynamic and contingent upon other relative terms/concepts embedded in configuration to that particular research terminology. For instance, if a graduate student decides to study gender, before proposing a specific research question, he/she has to first locate the topics and concepts that are related to gender that may span several distinct sub-fields (e.g. gender-based wage gap; gender-based violence). Here, the cultural meaning of 'gender' is determined in relation to its neighbor words/concepts. Furthermore, while 'gender' is a key research topic across multiple social science disciplines, by constructing the knowledge network using sociology dissertation abstracts, we will be able to access the unique cultural meaning of 'gender' and other research terminologies in sociology.

1.3. Measuring culture

The social structural and cultural order is intertwined and co-constituted, suggesting that we could not obtain the understanding of the social structure without knowing the semantic meanings of the cultural patterns embedded within it (Basov et al., 2020). In light of the relational nature of culture, scholars have been applying social network analysis and text analysis to computationally model culture. As an important component of John Mohr's formal analysis of the culture approach (1994, 1998), semantic networks analysis received considerable attention. Formal analysts view culture as a collection of relations rather than individual elements, with patterns emerging from these relations with the focus on developing theories of cultural mechanisms and applying formal methods to cultural data to identify corresponding patterns. This formal analyst approach is featured with inferring cultural relations between text-based elements based on the co-occurrences of terms in large text corpora (Evans and Aceves, 2016).

For Mohr, cultural meanings are built up out of structures of difference, this structure changes between cultural elements will lead to the meaning change in understanding those elements. For instance, in the case of sociology research terminologies, the word *'tea'* is frequently connected with *'consumption', 'company',* and *'flavor'*, representing the research on the sociology of food and the market. Meanwhile, *'tea'* is also frequently connected to the word *'party',* which completely changes its semantic meaning from food-related research to political-related research.

This co-occurrence approach also stimulates the discussion and application of Breiger (1974)'s classic duality model. While Breiger's approach focuses on the individual-to-group co-constitution. The words and text units display a similar duality where the meaning of a text unit is determined by the words it comprises, and text units are considered similar if they contain the same words. Conversely, the meaning of a word is established by the context in which it appears within text units, including the other words that surround it. Much empirical research has arisen from this stream of approach. Carley (1994) observes the cultural shift of the semantic meaning of 'robots' in science fiction from the 1950s to the 1980s. Mohr and Duquenne (1997) performed a formal analysis of the social welfare organizations in New York City between 1888 and 1917, where they found the meaning of various poverty classifications can be inferred through the classification structure, and the institutional logic shapes the actions and decisions of actors within the social organization and influence the strategies and practices they employ. This co-occurrence approach in outlining the socio-semantic relations between texts has received rapid growth in recent years with the advances in computational tools and the increasing availability of 'big data.' Following this relational approach, recent empirical works have modeled the multifaceted cultural phenomenon in human society through the various data

sources; such as newspaper press (DiMaggio et al., 2013); peace agreements (Puetz et al., 2021); political speeches (Fuhse et al., 2020; Padgett et al., 2020) and many others.

This study employs the co-occurrence approach to systematically examine the cultural relations/interactions between symbols and symbol systems (in my case, the research terminologies used in dissertation abstracts). Guided by Fuhse et al. (2020)'s cultural-relation model and Puetz et al. (2021)'s procedure in accessing the meaning-structure of cultural elements (in my case, the research terminologies used in sociology dissertation abstracts), I follow Breiger (1974, 2000)'s classic model to illustrate duality in knowledge production using the case of American sociology. In doing so, I explore the meaning-making and switching of research terminologies used in sociology dissertations by mapping its structural location within the semantic network. I apply centrality measures to locate the central research agenda of American sociology. Using seven years of dissertation data from 2012 to 2019, I present the cultural dynamic interaction and co-evolution between research terminologies in a longitudinal fashion.

As this study is constructed as an inductive practice, the results yielded from my analysis will be in general descriptive, with the following key expectations. First, using semantic network analysis, I construct the knowledge network of 'mainstream' American sociology from 2012 to 2019. Using the classic network centrality measures, I identify the most important nodes (research terminologies) which reflect the key research themes of American sociology. Secondly, as my data is structured in a longitudinal fashion, I could track the trends of the rising or the decline of certain subfields (if there are any) based on the aforementioned centrality measure. Thirdly, using the community detection algorithms, I further investigate the boundary between different sub-field of American sociology; thereby, this study responds to the 'generalist V.S.

specialist' debate that has been long held by sociologists studying scholars' academic careers (Moody, 2004; Heiberger et al , 2021)

2. Data and measurements

2.1. Data collection

This study uses American sociology as the empirical example in illustrating the structural and cultural basis of scientific discipline by mapping out the semantic networks of research terminology used in dissertation abstracts. My analysis is based on 3,375 doctoral dissertations abstracts from 118 U.S. sociology departments completed between 2012 and 2019. Data are drawn from the *ASA Guide to Graduate Programs in Sociology* from 2012 to 2019, where in each volume, schools report the cohort of doctorates awarded in the preceding year. The *ASA Guide* is a legitimate source for locating information on sociology Ph.D. graduates and has been used in several research articles on the academic job market in sociology (Burris 2004; Headworth and Freese 2016). After obtaining the information (name, tear being recorded into the ASA guide, year graduated, school name) of the Ph.D. graduates, I move forward to *Proquest* [1]to manually search the dissertations submitted by each sociology doctoral recipient. I collect and manage the dissertation abstract year-by-year, based on the graduation time recorded by the ASA Guide. For the dissertations that were not available on Proquest, I performed additional searches either through the school's e-library system or using an external dissertation database such as the *OhioLink.* I apply natural language processing and network analysis to the dissertation abstracts to analyze and formally model the meaning change of American sociology's research terminology through a relational lens. Instead of collecting the full text of the dissertation, I

[1] ProQuest is a global information and technology company that provides access to scholarly and research databases. It offers access to thousands of academic journals, newspapers, dissertations, and other publications, as well as primary sources such as historical newspapers, maps, and government documents.

follow Heiberger et al. (2021)'s strategy to use the abstract instead of the full text of the dissertation to construct my corpus; because abstracts are designed to provide readers with a quick overview of the entire dissertation, and contain a condensed version of the main research questions, methods, and findings. Therefore, using the abstracts is a sufficient and efficient way to extract the key information of each dissertation.

2.2. Measure

I follow Mohr (1998)'s measurement strategies for cultural systems. Mohr proposed four measures to assess the similarity and differences between cultural items: 1) subjective judgments, 2) common attributes, 3) relations to others, and 4) structural-functional profiles. Because the first two measures require a response from a third party (asking respondents to make judgments of items' cultural similarity), I focus on the latter two approaches. I measure the relational similarity and structural function similarity of a) research terminology (cultural elements) and b) sociology Ph.D. granting schools (social organizations). According to Mohr, when examining the relational similarity of a cultural element, we must consider the other cultural elements that are directly connected to that specific cultural element, the social relationships that link the cultural elements together reflect the similarity among them within a cultural system. Next, when demonstrating the similarity of structural function, Mohr suggested that we should go beyond the pairwise information to obtain a comprehensive context of the narrative of the cultural elements. In my case, to fulfill Mohr's measurement strategies, I use network analysis and natural language processing to produce the semantic networks of research terminology used in the dissertation abstracts. I explore the meaning-making and switching of the sociology research terminologies used in the dissertation abstract by constructing the semantic networks using the dissertation

submitted between 2012 and 2019. I demonstrate the words-to-text unit duality by analyzing the semantic ties that connect the words and their neighbor. I propose that the semantic meaning of research terminology is defined via the neighbor words they are connected to (a text unit), and the change in neighbor words will lead to changes in semantic meaning. At the same time, the semantic meaning of a text unity (a neighborhood unit of words) is determined by the research terminologies, and the change in the composition of research terminologies will lead to a change in the semantic meaning of that text unit. In addition, I apply network centrality measures to locate the most vital and influential topic of American sociology.

2.3. Analytical strategy

My computational text analysis for answering the proposed questions comprises two key components.

- **Information Extraction**:

  The text dataset for each year (2012-2019) comprises all dissertation abstracts in that academic year for graduates reported in the appropriate year's *Guide to Graduate Departments of Sociology*. This selection procedure mirrors the data collection process by others studying dynamics of job placement among sociology PhD recipients (Headworth and Freese 2016; Warren 2019). Abstracts of all sociology Ph.D. dissertations defended in the US during that year should uniquely represent the discipline's key research areas. I applied the tf-idf algorithm (Jockers & Thalken, 2020) to extract abstracts' most representative terms (words) using the widely applied Python package sklearn[2]. tf-idf algorithm considers not only the frequency of terms (tf: term-frequency) but also the

[2] https://scikit-learn.org/

amount of information each term gives, i.e., whether it is common or uncommon across all abstracts (idf: inverse document frequency).

- **Semantic Networks and the Backbone:**

Each important term retrieved from abstracts is regarded as a "node." Terms that appear in the same abstract are connected by a weighted edge. Thus, I design seven semantic networks of terms from dissertation abstracts to reflect American sociology each year (2012-2019). Following Puetz et al., I use pairwise distributional similarity scores (PDS) to represent edge weights (Puetz et al., 2021). PDS measures the extent to which two terms *i* and *j* appear given any third term *k*, or the context, using Equation 1:

$$PDS(i,\ j)\ =\ \frac{\sum_{k=1}^{|L|}(min\ (I(i,k),\ I(k,j)))}{I(i,\ k)}\ ,\qquad (1)$$

$$for\ any\ k\ \in\ L,\ k\ \neq\ i,\ j,\ and\ I(i,k)\ >\ 0.$$

Where I(*i*, *j*) is the mutual information between the terms *i* and *j*. L is a vector representing the appearance of every term among the most frequently appearing 100 terms in each abstract. This PDS captures not simply the co-occurrence of the terms *i* and *i* but the underlying semantic logic that constructs the network tie between the two terms.

I then extract the backbone structure of semantic networks. Existing research relies heavily on community detection to examine how subfields in sociology interact with and overlap other subfields within the semantic network. Here, I find that the overlap between different subfields in contemporary American sociology is fairly robust. I consider the overlap between communities to be an insufficiently fine-grained

measurement that disregards time-varying nuances. Thus, I use backbone algorithms (Neal, 2022; Serrano & Vespignani, 2009) to adaptively extract the semantic network's backbone (i.e., the set of most important edges). "Adaptive" indicates that I do not establish a unified threshold for importance to select edges but instead adaptively preserve the edges that represent statistically significant deviations by comparing to a null model in which a node's set of weights is uniformly distributed across its edges (more details see Neal, 2022 and Serrano & Vespignani, 2009). By extracting the backbone, I can not only examine the relative importance of different research areas using centrality measurements and how they overlap in a coarse-grained manner, but also determine which specific research *topics* are responsible for their interaction. I also conduct a comprehensive reading of the original text in order to comprehend the changes in meanings and term connections generated by computer algorithms.

3. Results

3.1. American sociology in a nutshell and the rise of environmental sociology

Overall, my analysis includes 3,374 sociology dissertation abstracts defended from 2012 to 2019. [3] To fully address meaning-making and changing driven by the duality between words and unit of text, I began with locating the central research theme in American sociology using the degree centrality measure for the 7 semantic networks.

Table 1 presents the top 30 most important worlds calculated using the degree centrality measure, calculating the number of direct connections a node has to other nodes in the semantic network. A node with a higher value of degree centrality means it was connected to many other

[3] 439 dissertations in 2012-2013; 454 dissertation in 2013-2014; 572 dissertations in 2014 to 2015; 486 dissertations in 2015 to 2016; 490 dissertations in 2016 to 2017; 511 dissertations in 2017 to 2018; 423 dissertation in 2018 to 2019

nodes, therefore is seen as more central and influential in the global network. By analyzing the top words measured by degree centrality from 2012 to 2019, I can obtain a more precise understanding of the central research theme of American sociology and how it's evolved over time.

To obtain a comprehensive understanding of the results, we can first take a look at the degree centrality output across seven networks. By ranking these research terminologies based on the value of their associated degree centrality, we can assess their prominence and the intellectual landscape of American sociology. Overall, we can see that American sociology placed a heavy focus on the following topics: *health, race and ethnicity, gender and sexuality, organizations, religion, global and transnational, education and learning, social mobility, immigrants, crime and social control, work and occupation.* While these research topics all obtained high degree centrality through the seven yearly semantic networks, indicating their prominence in American sociology's research agenda, my results, on the other hand, reveal another interesting pattern in which my measure captures a steady increase in environmental-related research in recent years. Specifically, according to my degree centrality measure, the word *'environmental'* scores 0.0090 in both 2012-2013 and 2013-2014, with a diminutive increase to 0.0108 in 2014-2015 and dropping to 0.0100 in 2015-2016. In 2016-2017, the word *'environmental'* slipped out from my semantic network, suggesting that it migrated to a more peripheral location in the global research landscape of American sociology. Meanwhile, in 2017-2018 and 2018-2019, the word *'environmental'* rushed back with a significant increase in degree centrality to 0.0224 in 2017-2018 and 0.0309 in 2018-2019; it seized the most central location within these two semantic networks, indicating its prominence.

Table 1. Top 25 words with the highest degree centrality measure (degree centrality in parentheses)

2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
health (0.0386)	school (0.0304)	health (0.0303)	Health (0.0537)	women (0.0360)	health (0.0383)	organization (0.0412)
race (0.0338)	neighborhood (0.0304)	women (0.0217)	Parent (0.0336)	sexual (0.0300)	immigrant (0.0319)	movement (0.0412)
children (0.0290)	student (0.0274)	movement (0.0195)	movement (0.0336)	student (0.0300)	women (0.0288)	migrant (0.0360)
marriage (0.0241)	organization (0.0213)	racial (0.0195)	child (0.0302)	labor (0.0300)	environmental (0.0224)	housing (0.0309)
organization (0.0241)	migration (0.0213)	immigrant (0.0195)	state (0.0235)	immigrant (0.0240)	crime (0.0192)	environmental (0.0309)
black (0.0241)	women (0.0213)	parent (0.0173)	sexual (0.0235)	movement (0.0240)	religious (0.0192)	school (0.0309)
education (0.0241)	gender (0.0213)	student (0.0173)	student (0.0235)	organizations (0.0210)	family (0.0192)	women (0.0258)
family (0.0241)	parent (0.0182)	black (0.0173)	college (0.0201)	marriage (0.0180)	black (0.0192)	black (0.0258)
student (0.0241)	mental (0.0182)	child (0.0151)	workers (0.0201)	college (0.0180)	migrant (0.0160)	workers (0.0258)
interracial (0.0241)	food (0.0182)	chinese (0.0151)	school (0.0201)	child (0.0180)	organization (0.0160)	activists (0.0258)
global (0.0241)	race (0.0182)	family (0.0130)	inequality (0.0201)	chinese (0.0150)	sex (0.0160)	men (0.0258)
incarcerated (0.0193)	movement (0.0182)	school (0.0130)	immigrant (0.0201)	gender (0.0150)	violence (0.0160)	chinese (0.0258)
participation (0.0193)	religious (0.0182)	violence (0.0130)	online (0.0168)	religion (0.0150)	technology (0.0160)	network (0.0206)
dating (0.0193)	sexual (0.0152)	organization (0.0108)	teacher (0.0168)	education (0.0150)	housing (0.0160)	state (0.0206)
criminal (0.0193)	teacher (0.0152)	rights (0.0108)	chinese (0.0168)	youth (0.0150)	civic (0.0160)	field (0.0206)
women (0.0193)	urban (0.0152)	undocumented (0.0108)	support (0.0168)	political (0.0150)	sexual (0.0160)	mother (0.0206)
parent (0.0193)	education (0.0152)	income (0.0108)	racial (0.0168)	activists (0.0120)	markets (0.0160)	religious (0.0206)
mexican (0.0193)	health (0.0152)	migrant (0.0108)	welfare (0.0134)	workers (0.0120)	police (0.0128)	workplace (0.0206)
parental (0.0193)	worker (0.0152)	mexican (0.0108)	marriage (0.0134)	black (0.0120)	pregnancy (0.0128)	climate (0.0206)
service (0.0193)	identity (0.0152)	worker (0.0108)	congregation (0.0134)	ethnic (0.0120)	korea (0.0128)	digital (0.0206)
conversation (0.0193)	violence (0.0152)	couples (0.0108)	stigma (0.0134)	urban (0.0120)	coffee (0.0128)	welfare (0.0154)
identity (0.0193)	immigrant (0.0152)	crime (0.0108)	fertility (0.0134)	illness (0.0120)	masculinity (0.0128)	work (0.0154)
income (0.0193)	youth (0.0152)	segregation (0.0108)	gay (0.0134)	conflict (0.0120)	integration (0.0128)	coal (0.0154)
father (0.0193)	family (0.0152)	sexual (0.0108)	black (0.0134)	power (0.0120)	mexican (0.0128)	gay (0.0154)
law (0.0193)	immigration (0.0122)	identity (0.0108)	young (0.0134)	mother (0.0120)	white (0.0128)	cultural (0.0154)

To fully capture the changes in environmental-related research, we can now return to the original text to perform qualitative interpretation to confirm and explore the patterns. In doing so, I manually counted the number of dissertation abstracts that mentioned *'environmental'* as a

legitimate research topic other than adjective words. I looked at the number of dissertation abstracts rather than the actual frequency of occurrence of *'environmental'* because the co-occurrence approach in constructing the semantic network extracts the important nodes only based on their joint occurrence across multiple texts. After identifying the clean texts, I read and summarized the information regarding the research agenda related to *'environmental'*. Overall, my interpretation reveals the following patterns:

1) A total of 25 dissertation abstracts that explicitly contain the word *'environmental'* and forces on environmental-related topics were found in the 2012-2013 and 2013-2014 corpus. In general, three streams of research derived from these abstracts: a) the social and economic impacts of climate change, attitudes towards climate change, and policy responses to mitigate its effects; b) environmental justice for the disproportionate exposure of marginalized communities to environmental hazards and pollution, the social, political, and economic factors that contribute to environmental injustice and the policies and strategies to address it; c) the sustainable development, environmental policy, and sustainable consumption and production.
2) A total of 36 dissertation abstracts were found in the 2014-2015 and 2015-2016 corpus that is associated with environmental-related research. Similar to the previous two corpora, the environmental-related research presented in the 2014-2015 and 2015-2016 corpus forces on topics on climate change, environmental justice, and environmental governance. Additionally, the abstracts from 2015-2016 corpus exhibit a great intersection with other subfields in sociology, including social movements, religion, and political sociology. For

instance, a number of dissertations looked at the influence of religious, social organizational, and political factors on people's participation in the environmentalist movement. Although the term *'environmental'* was omitted from the 2016-2017 semantic network based on the backbone procedure, I double-checked the 2016-2017 corpus and are able to locate a few (n=7) abstracts that are related to environmental sociology. Compared with the previous corpus, this research presents in the 2016-2017 corpus obtain an increasingly global and transnational lens in addressing environmental-related issues. For instance, two of dissertations looked at the influence of extreme rainfall caused by global warming on local agriculture and the economy.

3) Finally, as my degree centrality measure suggested a steady increase in environmental-related research within the 2017-2018 and 2018-2019 corpus. My qualitative reading & interpretation confirms this pattern. Specifically, I identified a total of 64 dissertation abstracts devoted to environmental-related research; almost double the size compared to the previous few years. Furthermore, through my reading, I found an increase in research topics in addition to the three streams of environmental-related research I identified in the previous year, I locate the following streams of research derived from the 2017-2018 and 2018-2019 corpus:

   a) social and cultural dimensions of environmental risk and disaster, including how risk is assessed, communicated, and responded to, the social construction of risk, the politics of disaster response and recovery, and the ways in which environmental disasters intersect with issues of social inequality; b) political and economic factors that shape environmental problems and their solutions the role

> of corporations and governments in creating environmental problems, the politics of natural resource extraction; c) the institutions and mechanisms through which environmental policies are developed and implemented, the role of international organizations in environmental governance, the effectiveness of different policy tools and approaches, and the challenges of implementing environmental policies at the local level; d) social and cultural factors that shape patterns of consumption and their environmental impacts, the links between consumerism and environmental degradation, and the potential for alternative forms of consumption to promote sustainability.

Scott and Johnson (2016) report an increase in the appearance of environmental sociology among top sociology journals, my results found similar patterns from the dissertation side. Through my semantic network analysis and qualitative reading, I show that environmental sociology has gained considerable popularity as the dissertation topic choice and has mobilized from the peripheral to the central part of the semantic network of American sociology. Bohr and Dunlap (2017) employ computational text analysis in detecting the key topics of environmental sociology; although my study did not compute the full topic matrices of American sociology, the results of my network measures and qualitative reading, in general, align with Bohr and Dunlap's finding in locating the key themes of environmental sociology among sociology dissertations.

3.2. The meaning structure of American sociology

As Mohr (1998) claims that the cultural meaning of an actor is inherently relational; Pachuki and Breiger (2010)'s conceptualization of cultural hole delivers a useful illustration of the analytical strategy using network analysis to locate and explain the linkage between deserve

cultural forms through a relational lens. In my empirical case of American sociology, to access the dynamic meaning-making and switching process of research terminologies, we need to identify: 1) prominent words with a high degree centrality measure across seven semantic networks; 2) prominent words with diverse cultural meaning that span several distinct communities (the broker). Building on my prior degree centrality measure, I follow Burt (2004)'s network constraint score to locate the broker within my semantic networks. For Burt, a less constrained node spanned more structural holes and is more likely to achieve better performance with access to more brokerage opportunities. In my case, a less constrained research terminology is more culturally diverse, allowing us to interpret its meaning-making and switching by examining its neighborhood words and communities. Following Pachcki and Breiger (2010) and Lizardo (2014)'s conceptualization of cultural holes, the network constraint measure allows us to detect the cultural elements (research terminologies) that operate as crucial links to otherwise disconnected cultural forms. While Lizardo (2014)'s illustration employs the two-mode network based on respondents' music tastes, my one-mode semantic network identified a unique structural position which I call it *'gatekeeper'*. Similar to the broker, a gatekeeper can connect two or multiple otherwise disconnected communities. At the same time, the gatekeeper is also the only node that connects every other node within its own community. Hence, the gatekeeper is a unique type of broker I found quite prevalent within my semantic network.

Table 2. Top 25 words with the lowest network constraint score (constraint score in parentheses)

2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
health (0.1641)	neighborhood (0.1000)	health (0.0714)	health (0.0625)	women (0.0833)	health (0.0833)	organization (0.1250)
organization (0.2000)	school (0.1169)	women (0.1000)	movement (0.1000)	student (0.1000)	immigrant (0.1000)	movement (0.1250)
education (0.2000)	student (0.1303)	movement (0.1111)	parent (0.1148)	labor (0.111)	women (0.1111)	migrant (0.1429)
interracial (0.2000)	organization (0.1429)	parent (0.1250)	child (0.1291)	sexual (0.1250)	environmental (0.1429)	housing (0.1667)
marriage (0.2000)	women (0.1429)	student (0.1250)	sexual (0.1429)	immigrant (0.1250)	crime (0.1667)	environmental (0.1667)
family (0.2000)	gender (0.1429)	black (0.1250)	student (0.1429)	movement (0.1250)	family (0.1667)	school (0.1667)
global (0.2000)	migration (0.1633)	racial (0.1277)	college (0.1667)	organizations (0.1250)	religious (0.1667)	men (0.2000)
children (0.2170)	food (0.1667)	child (0.1429)	workers (0.1667)	marriage (0.1666)	organization (0.2000)	workers (0.2000)
race (0.2212)	race (0.1667)	immigrant (0.1453)	inequality (0.1667)	child (0.1666)	migrant (0.2000)	women (0.2000)
dating (0.2500)	movement (0.1667)	family (0.1667)	school (0.1667)	college (0.1666)	technology (0.2000)	activists (0.2000)
identity (0.2500)	religious (0.1667)	school (0.667)	immigrant (0.1667)	youth (0.2000)	housing (0.2000)	chinese (0.2000)
law (0.2500)	sexual (0.2000)	violence (0.1667)	racial (0.2000)	political (0.2000)	civic (0.2000)	black (0.2000)
conversation (0.2500)	education (0.2000)	chinese (0.1789)	online (0.2000)	gender (0.2000)	violence (0.2000)	digital (0.2500)
parent (0.2500)	worker (0.2000)	organization (0.2000)	teacher (0.2000)	chinese (0.2000)	market (0.2000)	climate (0.2500)
income (0.2500)	identity (0.2000)	identity (0.2000)	chinese (0.2000)	education (0.2000)	masculinity (0.2500)	mother (0.2500)
participation (0.2500)	violence (0.2000)	crime (0.2000)	support (0.2000)	religious (0.2000)	pregnancy (0.2500)	state (0.2500)
father (0.2500)	immigrant (0.200)	migrant (0.2000)	state (0.2021)	activists (0.2500)	neighborhood (0.2500)	network (0.2500)
women (0.2500)	youth (0.2000)	worker (0.2000)	fertility (0.2500)	urban (0.2500)	work (0.2500)	religious (0.2500)
black (0.2500)	family (0.2000)	segregation (0.2000)	education (0.2500)	illness (0.2500)	exposure (0.2500)	field (0.2500)
student (0.2500)	mental (0.2136)	couples (0.2000)	ethnic (0.2500)	conflict (0.2500)	labor (0.2500)	workplace (0.2500)
television (0.3333)	parent (0.2230)	sexual (0.2000)	congregation (0.2500)	power (0.2500)	young (0.2500)	technology (0.3333)
fertility (0.3333)	immigration (0.2500)	environmental (0.2000)	gay (0.2500)	worker (0.2500)	integration (0.2500)	medical (0.3333)
foreign (0.3333)	disability (0.2500)	mexican (0.2270)	neighborhood (0.2500)	state (0.2500)	korea (0.2500)	party (0.3333)
men (0.3333)	veterans (0.2500)	digital (0.2500)	gender (0.2500)	ethnic (0.2500)	identities (0.2500)	gay (0.3333)
socialization (0.3333)	asian (0.2500)	food (0.2500)	protest (0.2500)	mother (0.2500)	police (0.2500)	sustainability (0.3333)

Table 2 presents the estimates for the constrained score of research terminologies across the seven semantic networks. We can see a negative association between the degree centrality measure and the constraint score, where the research terminologies with a higher degree

centrality are associated with lower constraint scores. Suggesting that a prominent word usually spans more communities, thus is less constrained in the global networks. Based on these two measures, we can now go ahead to pick a sample word to provide an empirical demonstration of the meaning-making and switching of research terminology in American sociology. Overall, *'health'* obtains the lowest constrained score and the highest degree centrality among four semantic networks (2012-2013, 2014-2015, 2015-2016, and 2017-2018), signifying that *'health'* is not only a central research theme of American sociology but also has multifarious cultural meanings.

Figure 1. Semantic network 2012-2013

Figure 1 presents the semantic network based on the dissertation (abstracts) completed in the 2012-2013 academic year. As shown in the network, *'health'* is connected to the following words: *'participation', 'urban', 'disparities', 'theory', 'inequities', 'literacy', 'returns', 'measures'*. Based on these neighbor words, we can return to the original corpus to perform human interpretation to further investigate and confirm the meaning structure of *'health'*. Overall, I

found 49 dissertation abstracts that explicitly forced on health-related topics. I identified the following streams of research that centered *'health'*: 1) the socioeconomic and environmental factors contributing to health disparities within and between urban and rural areas; 2) the relationship between income inequalities and health disparities; 3)the health disparities of marginalized groups; 4) people's participation in health-related social movements and its impact on health policies; and 5) the role of health literacy as social determinants of health disparities. Overall, based on the qualitative reading and the result of the semantic network, we see the meaning of *'health'* as a research terminology used in American sociology dissertation research is mostly defined through the intersection with the studying of inequality, social movement, race/ethnicity, and urban sociology. To capture the meaning-swicthing of *'health',* we can treat the meaning structure of *'health'* in my first semantic network (network 1) as a baseline model and further compare the change in component with the rest six semantic networks.

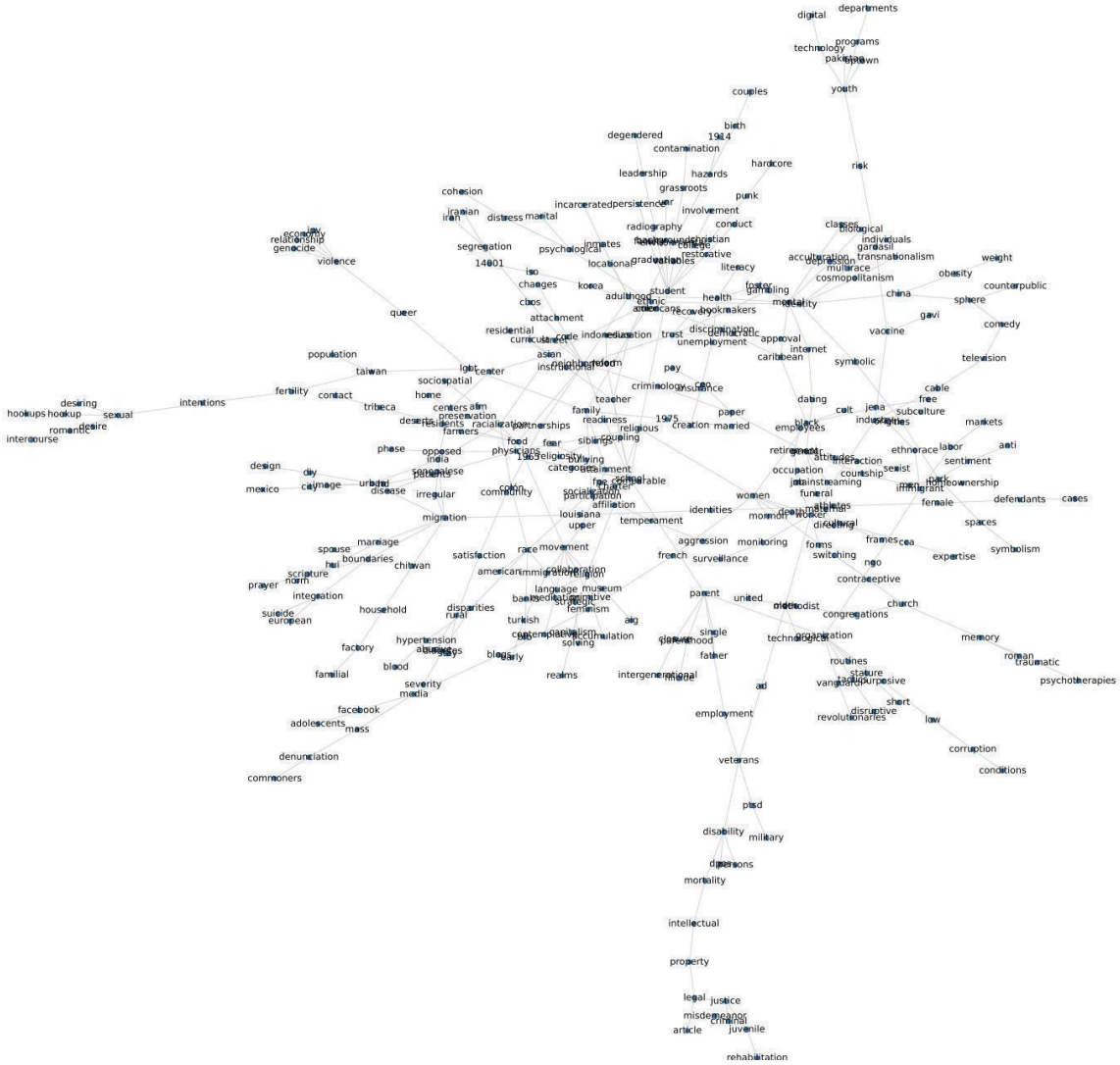


Figure 2. Semantic network 2013-2014

Moving ahead to the 2013-2014 semantic network, I found 62 dissertations (abstract) that explicitly examine health-related research questions. Here, I observed slight switching in the meaning structure of *'health'* compared to the 2012-2013 network. In this 2013-2014 network, *'health'* is connected to *'mental', 'adulthood', 'unemployment', 'foster', 'literacy'*. Through my reading, while health literacy, and racial-based health disparities remain as the key research

topics, I witness a crossover between health and labor market research through the neighboring words *'adulthood'* and *'unemployment.'* Returning to my original corpus, I found *'health'* in this period is embedded with research topics on labor force participation by studying the causal relationship with unemployment. I locate the following two topics that bridge health and labor force participation: 1) the association between self-report disability and unemployment; 2) adulthood poor health conditions and long-term unemployment. I also found a shrink of the intersection between health and social movement research in this period, with only 2 dissertation abstracts narrowly touching the relationship between participation in movement and health policies.

Figure 3. Semantic network 2014-2015

The 2014-2015 semantic network witnesses an expansion of the semantic meaning of *'health'*. In this period, *'health'* is connected to *'acculturation', 'tobacco', 'healthcare', 'cda', 'care', 'people', 'mental', 'degrees', 'transitions', 'civic', 'cohorts', 'adversity', 'eastern',* and *'pregnancy'*. 67 dissertation abstracts were identified that explicitly examine health-related research questions. Multiple notable developments of the semantic meaning of *'health'* derived

from this period's corpus. First, the term *'acculturation'* serves as a broker which connects *'health'* to the *'immigration and immigrants'* semantic cluster. Here, I saw a vein of research focusing on immigrant health disparities raised from the spanning tie between the two semantic clusters, with a strong emphasis on the influence of acculturation on immigrants' health outcomes. Secondly, I saw a rise in health-related research through the organizational/structural perspective. Specifically, I found multiple dissertations explore the relationship between civic structure, and highlight the importance of understanding the role of political and economic institutions, community engagement, and social capital in shaping health outcomes and healthcare policies. In addition to the organizational perspective, another major development of the semantic meaning for *'health'* is the emerging overlap with social demographic topics through the term *'healthcare', 'cohorts', 'adversity',* and *'pregnancy'*. The key research agenda framed in this vein of research investigates how social and demographic factors, including age, race/ethnicity, education, income, and geographic location, influence health outcomes and healthcare utilization, with particular forces on women's reproductive health and fertility. Finally, consistent with the 2013-2014 semantic network, I saw a detachment of *'health'* from the social movement semantic community, where I did not locate any dissertations in this period that mainly looked into the classic social movement-and-health policies research agenda.

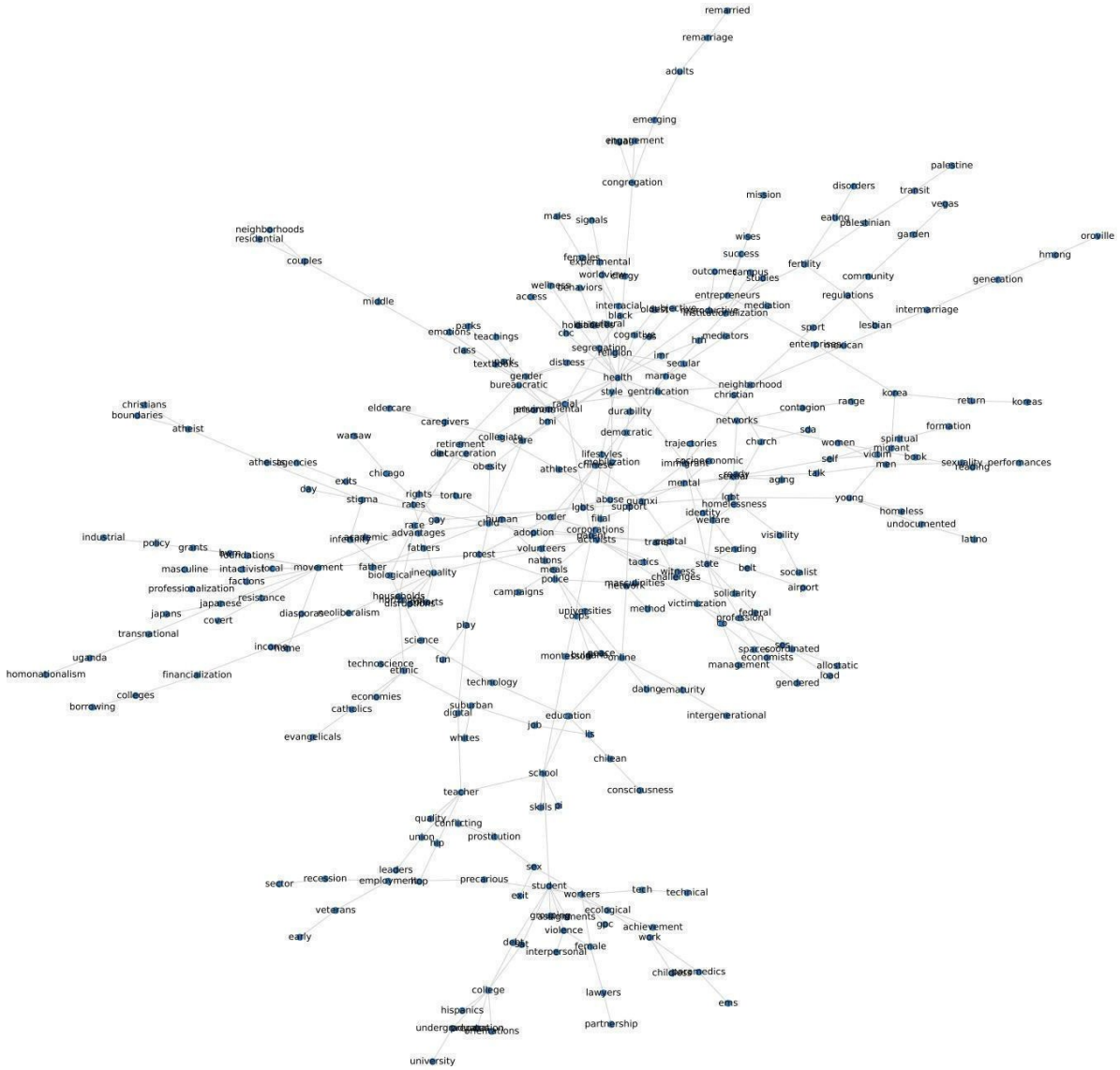


Figure 4. Semantic network 2015-2016

Similar to the 2014-2015 semantic network, I saw a continuous expansion of the semantic meaning of *'health'* within the 2015-2016 network connecting to the following neighboring words: *'clergy', 'care', 'segregation', 'immigrant', 'networks', 'lifestyles', 'distress', 'imr', 'diabetes', 'prisoners', 'bmi', 'holistic', 'sss', 'cognitive', 'reproductive', 'chc'*. Through my reading, I identified 63 dissertations that explicitly examine health-related research questions.

The overall meaning structure of *'health'* remain the same compared to the previous 2014-2015 network. The research overlap between health and immigrants remains stable and prominent; looking at the social demographic side, I saw a close integration with health in examining questions related to women's reproductive health, child-bearing, and children's cognitive development. Additionally, I found another spanning tie that connects *'health'* to the crime and social control semantic cluster through the broker word *'prisoners'*. Through my qualitative interpretation, this vein of research that intersects social control and crime investigates the social exclusion of prisoners and their access to healthcare resources, with special focus on older prisoners.

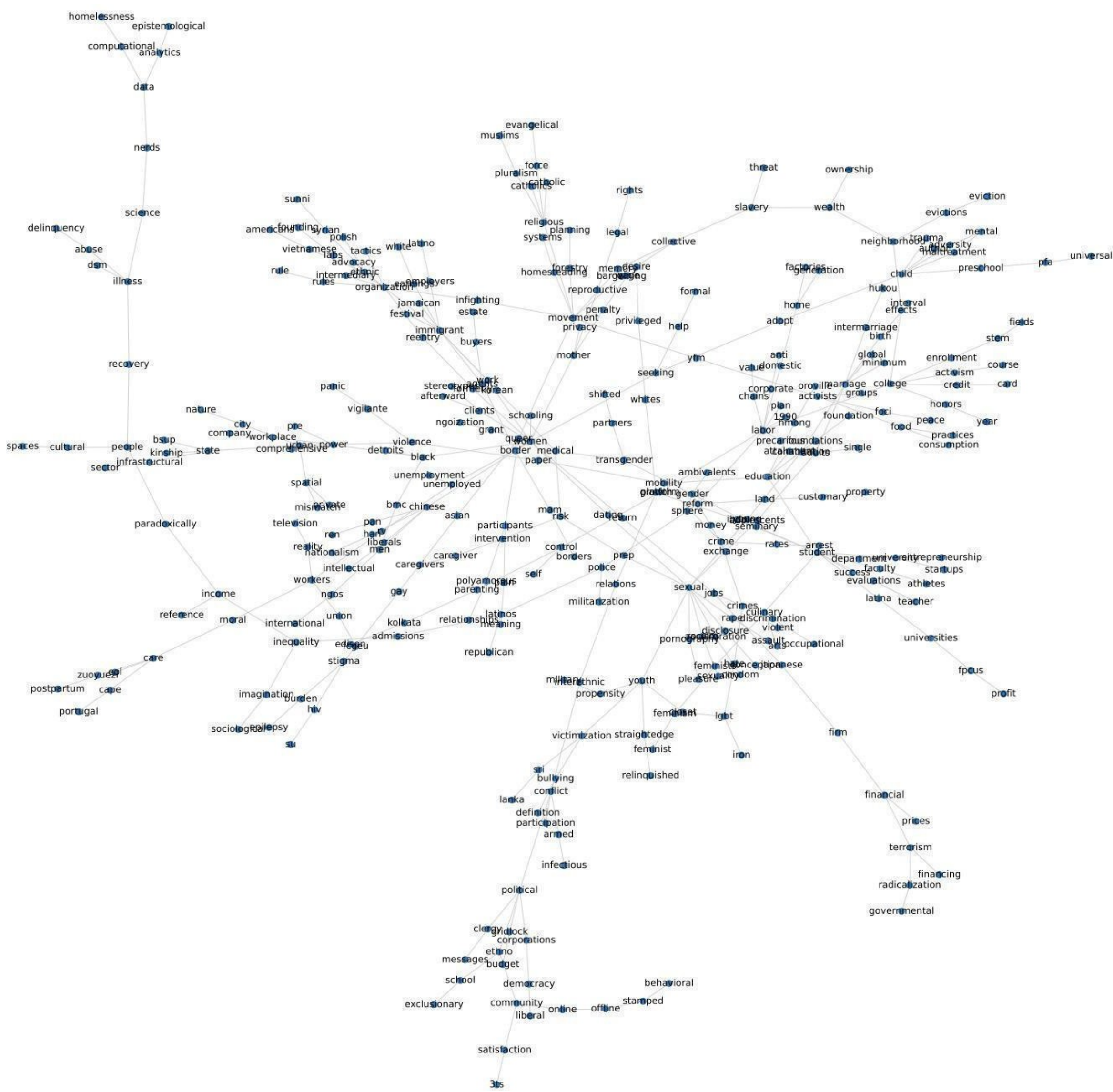


Figure 5. Semantic network 2016-2017

In the 2016-2017 semantic network, I observed a tightening of the semantic neighborhood for health as only three neighboring words (*'married', 'ghana', 'holistic'*) were found connected to *'health'*. At the same time, *'health'* was omitted from my degree centrality measure, which suggests that health is moved to a less prominent network position. Despite the decline in the number of neighboring words, through my qualitative interpretation, I located 56

dissertations that mainly forces on health-related questions. Here, I saw a slight mismatch between my degree centrality measure and the actual dissertation number that associate with health-related research. This is because my network analysis algorithm only counts the literal presence of *'health'*. Yet, some dissertation abstracts may include *'health'* but do not necessarily examine health-related topics. For instance, I found a good amount of studies that list the National Longitudinal Study of Adolescent to Adult Health (Add Health) as their data source because Add Health is a giant and comprehensive data set. Those studies use Add Health to investigate other research topics other than health. My qualitative interpretation, in this sense, helped us to remove this technical bias and maintain the authenticity of my results. Moving back to my 2016-2017 network, I once again observed the meaning change of *'health'* based on the change in its meaning structure. Here, I found significant research overlap between health and the sociology of marriage. Several streams of topics derived from my qualitative reading: 1) the impact of marriage on women's health; 2) partnership exogamy and health; 3) same-sex marriage and the health outcome for same-sex couples. I also observed a rising in applying global/transnational comparative perspectives in accessing these questions; for instance, multiple dissertations looked at countries in the global south, such as China, Ghana, and India.

Figure 6. Semantic network 2017-2018

The 2017-2018 network showed us another expansion of the semantic meaning of *'health'*. Here, *'health'* is connected to *'income', 'sss', 'igmvs', 'knowledges', 'employment', 'marriage', 'behaviors', 'stigma', 'lgb', 'transgender', 'visits', 'violence',* and *'mexican'*. My qualitative reading located 77 dissertations with a diverse meaning structure of *'health'*. Firstly, my observation confirms my semantic network which I found a continuous integration between

health and the sociology of gender, word, and family semantic clusters through the broker words *'employment', 'marriage', 'lgb',* and *'transgender'* (see figure 6). I identified the following streams of research topics that highlight such intersection: 1) the impact of the structural stigma over sexual minorities' health outcomes; 2) the marriage-health association based on SES and race; 3) older adults' employment and health; 4) women's employment and childbearing, and it's relation to motherhood mental health. Secondly, I locate a small intersection between health and the sociology of knowledge in this period's dissertation abstract. Through my qualitative reading, I found the following two veins of research topic: 1) the production and diffusion of health knowledge in the global south; 2) adolescent health education and their access to sexual knowledge. Finally and most importantly, as I identified an overlap between health and social control research area in the previous 2015-2016 semantic network, here, I found another increasing overlap between health and the crime and social control semantic cluster through the broker word *'violence.'* Following topics derived from this vein of intersection: 1) individual's exposure to domestic violence, physical and sexual abuse, and its association with adulthood health outcomes, including chronic illness, mental health issues, and addiction; 2) gender-based violence and its impact on victim's mental health; 3) Incarceration and health disparities among minority prisoners.

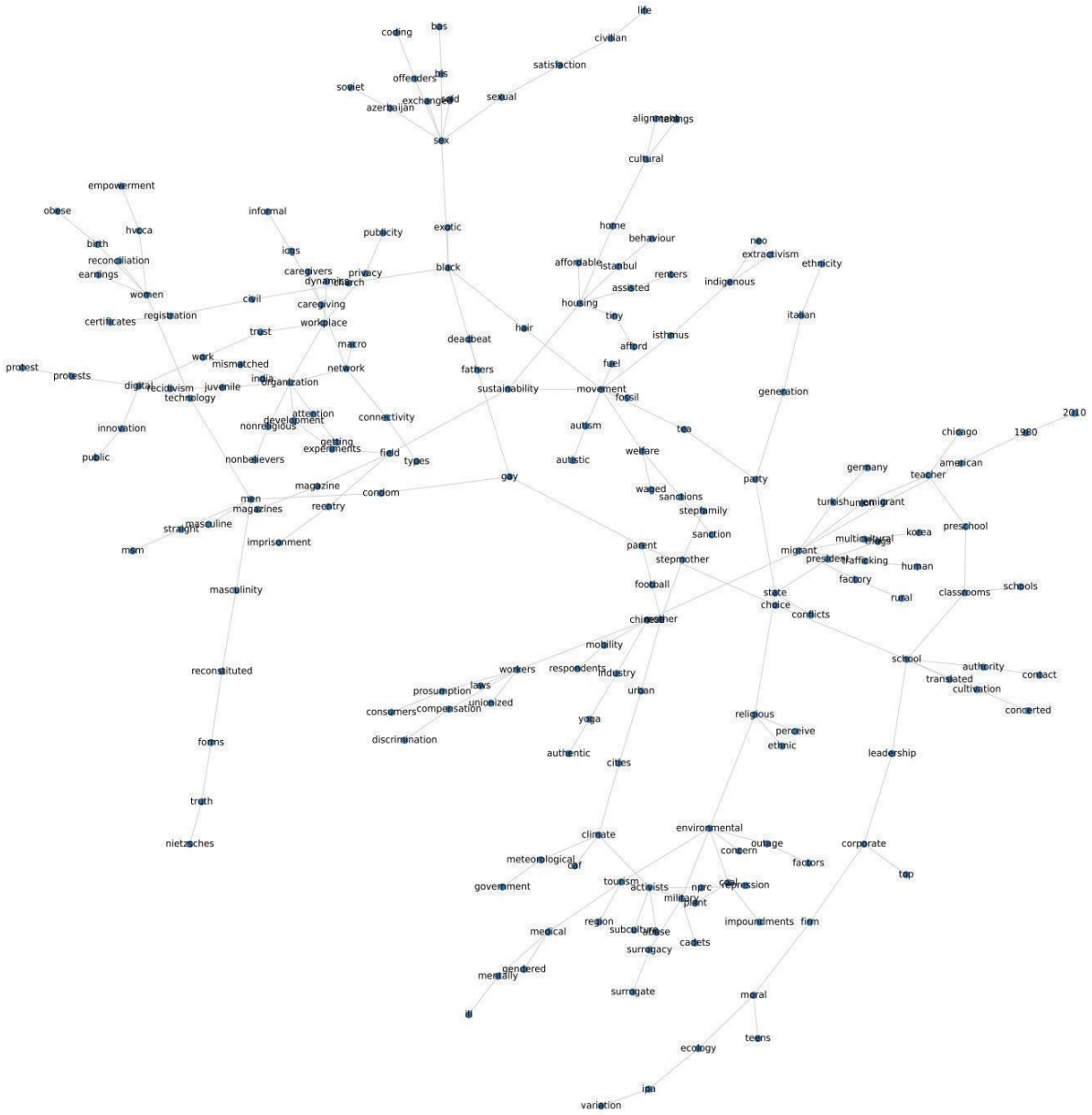


Figure 7. Semantic network 2018-2019

My last semantic network features another retreat in the diversity of topics associated with *'health'*. In the 2018-2019 network, *'health'* is connected to *'aces*[4]*', 'chronic', 'mortality', 'regional', 'mental',* and *'ncrs*[5]*'*. Although *'health'* was omitted from my degree centrality

[4] aces: Childhood Adverse Experiences
[5] ncsr: Non-cognitive resource

measure again, my qualitative reading located 46 dissertations with following streams of research topics: 1) adult diseases and health disparities in late life; 2) older adults' risk of disability due to early life experience (with a special force on US Veteran); and 3) risk of maternal mortality among minority women (particularly Black women).

To sum up my results, building upon Mohr (1998)'s meaning-structure institutionalism that interprets the meaning of concepts in relation to those concepts' shifting semantic meaning structure, I empirically examine the meaning-making and switching of research terminologies in American sociology through the example of *'health.'* Following Puetz et al. (2021)'s procedure in accessing the meaning structure of cultural elements, my results demonstrate the dynamic meaning-making process of *'health'* across time and find different research styles in articulating *'health'* in sociology dissertation. The semantic meaning of *'health'* is multifaceted and connected to substantively disparate topics in different periods of time. In 2012-2013 and 2013-2014, the semantic meaning of *'health'* is not thickly defined, in which it appears only as the social determinant and measure of inequalities. Moving to 2014-2015 and 2015-2016, my observation showed an increase in the connection of *'health'* to the social demographic and social control semantic clusters, with a decent integration of health with research that examine women's reproductive health, incarceration and health disparities, and organizational health policies. While the term *'health'* experienced a major shrink of its semantic meaning in 2016-2017, I saw a conceptual restoration of *'health'* in the following 2017-2018 and 2018-2019 networks. More specifically, through the spanning connections of brokers, *'health'* became more deeply entangled with the research on work, gender, family, violence, social control, and the sociology of knowledge.

4. Discussion

4.1. Conclusion

Through my empirical examination of the knowledge backbone of American sociology using semantic network analysis, I show that the relational methodologies proposed by cultural scholars in locating the themes and boundaries of cultural symbols are also useful in detecting the knowledge structure by modeling knowledge production as a cultural practice (Mohr, 1998; Pachuki and Breiger, 2010; Lizardo, 2014). Although I have a relatively short period of observation, my relational approach succeeds in capturing not only the dominant research topics in American sociology but also the changes in the meaning structures of particular research terminologies. Specifically,I show that despite being an interdisciplinary field, American sociology, in general, obtains its own primary interests of study. Based on my two network measures: degree centrality and constraint score, my results demonstrate that the following research topics held the dominant positions across the whole semantic networks of American sociology: work, organizations, and occupation; gender and sexualities; education and social mobility; race and ethnicity; crime and social control; immigrants and immigration. Additionally, my results confirm with Scott & Johnson (2016) and Bohr & Dunlap (2017)'s findings on the rise of environmental sociology. I show that beyond the publication side, environmental sociology has also experienced a considerable expansion as the topic of choice for sociology dissertations.

Methodologically, I found network constraint serves as an efficient measure within my semantic networks in detecting the 'gatekeepers' that span several distant meaning communities. By employing the structuralist point of view in studying knowledge production as a cultural phenomenon, my approach demonstrates the socio-semantic interactions between cultural

symbols (research terminologies) through a relational lens. I found that terminologies with low constraint scores obtain diverse semantic meanings by functioning as 'gatekeepers' of their semantic community and the 'brokers' by connecting their semantic community with other communities which were otherwise disconnected. For instance, in my 2014-2015 network, *'racial'* is among the top 10 terms with the lowest constraint score, in which it is not only the gatekeeper for the race and ethnicity semantic community but also further connects the social control and the sociology of health communities through its brokerage connection with *'law'* and *'health.'* More importantly, this relational method allows us to further interpret the epistemological relations between the research terminologies and understand the global landscape of American sociology.

Finally, my results facilitate the discussion between 'generalist and specialist' that has been long held among sociologists studying knowledge production and academic career path in our field. While Moody (2004) took a structuralist approach and found the overall disciplinary cohesion of sociology through the increasing co-authorship in peer-reviewed journal publications, my results confirm Moody's findings from the cultural perspective, where I found the boundaries between sociology sub-fields were not firmly constructed. More recently, Heiberger et al (2021) found the target specializations on certain research topics are positively contributing to sociology grad students' likelihood of being an advisor. In this sense, being a specialist with a target research specialization is beneficial for a scholar's academic career in the long run. My results complement this finding. Based on my results, I argue that the relationship between generalists and specialists may be less contradictory–while my measure succeeds in locating the most popular (important) topics that constitute each sub-field; I also found considerable overlap between each sub-field, which further suggested that, in order to become a

'specialist' with a target research specialization, scholars may have to first immerse themselves into the broader knowledge network of the discipline to understand the *'backbone'* across different sub-fields through a relational lens.

Ennis (1992) presents an essentially static picture of the specialty network of our discipline; my study advances Ennis's finding into a dynamic dimension in modeling the interaction and co-evaluation of different sub-fields in American sociology over time. Here, I observed another layer of duality arising from the interaction between the sub-fields and the whole discipline: sub-fields constitute the discipline and are shaped by the overall landscape of the discipline; at the same time, the academic identity of a discipline is also determined by its sub-fields. Furthermore, as noted by Smith-Lovin (1999), the between-discipline interaction may facilitate within-discipline change through the emergence of a new paradigm. For instance, I have seen a continuing migration of organizational sociologists to business schools since the early 90s. On the one hand, such scholarly migration increases the interdisciplinary ties between sociology and management (AKA 'Organizational Behavior'). It also differentiated the business schools' approach to studying work and occupation away from sociology's disciplinary niche. Although my study does not intend to map the decades-long disciplinary history of sociology, it is worth noting for future research to investigate how external incentives, such as NSF grants, influence disciplinary development.

4.2. Limitation

While my results yield substantial support in 1) outlining the global landscape of American sociology's research and 2) the meaning-making and switching of research

terminologies used in sociology dissertation abstracts through semantic network analysis, I noted the following limitations of my current approach.

The first major limitation exposed in this study is that my empirical case, American sociology, is inherently interdisciplinary, where the research clusters are deeply interconnected. Therefore, I failed to detect coherent semantic communities based on research theme. For instance, despite the modularity method detected 14 semantic communities using the 2012-2013 dissertation corpus (see appendix), none of these semantic communities were thematically coherent and distinctive from each other. While the Louvain modularity method identifies communities based on the expected density of edges that would occur if the edges were randomly distributed across the network (Newman, 2006), because the sociology dissertation corpus is naturally complicated, and the research terminologies are intrinsically intertwined; thus, it is technically challenging to sort a dissertation into one specific semantic community. For example, a study focusing on gender-based health disparities in the workplace spans three research communities: work/occupation, gender, and health. Ultimately, the boundaries between different semantic communities based on research topics were blurred. Hence, the Louvain modularity method may be insufficient in detecting the communities within my dissertation corpus, given its complexity. Future research could address this limitation by employing a more advanced community detection method, such as the Leiden, which adds a refinement step that allows for larger and more complex communities to be detected by aggregating small and loose communities into larger ones (see Traag et al., 2019).

Another limitation arises from my degree centrality measure. While the degree centrality is overall accurate in reflecting the prominence of research terminologies that are used in the dissertation abstract. Yet, because my degree centrality measure is built upon the co-occurrence

approach, it will count into every word with the exact spelling regardless of its true semantic meaning. For instance, when accessing the meaning structure of *'health,'* I intend to locate the dissertation abstracts that list *'health'* as a research topic. However, my degree centrality measure includes the dissertation abstracts that list *'Add-health',* which is a large national survey data set rather than an explicit research topic. Although Add-health obtains a good amount of health-related modules, and a dissertation using Add-health will likely cover some health-related research topics, this limitation in accurately locating the research terminology with valid semantic meaning might confound my final results. In my case, I address this limitation by performing the qualitative interpretation of my original corpus and manually counting down the actual number of dissertations that are related to health to remove such bias. Future research could take additional steps to remove such bias; for instance, employing advanced natural language processing techniques to detect and sort out words that contribute comparatively little to the meaning network. Additionally, because I intended to map the global landscape of American sociology, in my empirical analysis, I did not create the ego-centric networks for *'health'* across seven years because I only used *'health'* as an example for illustration purposes. Future research that is interested in specifically examining the meaning structure of certain topics in sociology should construct an ego-centric network to obtain a more precise understanding and interpretation.

For my final note, the eigenvector centrality measure is a very useful tool in examining the prominence of nodes through their connection to other important nodes. For instance, Puetz, Davis and Kinney (2021) use the eigenvector centrality measure to demonstrate the overall importance of human-rights terminology in the world's peace agreement. Yet, I choose to drop the eigenvector centrality and employ the degree centrality and my measure for the node's

prominence because, as I previously mentioned, my semantic network obtains a dense structure, and the nodes are not clearly organized into separate semantic clusters. Hence, the degree centrality is more appropriate as a centrality measure compared to eigenvector centrality, in which nodes are ranked based on the total number of links they have to other nodes in the network, regardless of the quality or significance of those links.

4.3. Contribution and future implication

My study yields both theoretical and methodological contributions to the current literature discussing knowledge production and cultural-structural dualism.

Following Lee and Martin (2018)'s elongation of duality, I further extend Breiger's classic person-to-group model to word-to-text unit to formally model knowledge production as a cultural practice through the empirical example of American sociology. Building upon the '*bag-of-words*' approach, I propose that the meaning of a unit of text is not inherent in the unit itself but is instead derived from the words that compose it. Similarly, the similarity between units of text can be determined by the words they share; I highlight the duality between words and text units, where words provide meaning to the text units in which they appear, and the text units provide context to the words (Fuhse et al. 2020; Puetz at al. 2021). My results also provide substantial support for John Mohr (1998)'s meaning-structural institutionalism. For Mohr, cultural networks are seen as the building blocks of institutional life, forming the basis for the creation and maintenance of the relational social structure, connecting cultural symbols such as meanings, values, and beliefs into various structured configurations. In my case, I argue that research terminology cannot be viewed in isolation from the cultural networks and relational structures within which it is embedded, I view the sociology dissertation abstracts as a cultural

web with interconnected meanings that are evolving over time along with the structural change of the meaning network. I demonstrate the meaning-making and switching of the term *'health'* by locating and analyzing its neighboring words and semantic cluster. Through my qualitative reading of the original corpus, I confirm the results from my semantic network analysis where the meaning structure of research terminologies is inherently dynamic and is constructed in relation to its semantic communities. In the case of *'health,'* I show that the overall meaning structure of health is constituted with the intersection of the sociology of immigration, gender, work, family, and social control. Based on my measure across seven semantic networks, I found changes in the semantic meaning of *'health'* through the change in its semantic neighbors.

My study is among the very few studies, if not the only study, that employs Burt (2004)'s constraint score in measuring the switching in the meaning of cultural concepts through its spanning positions across the whole network. While most organizational studies use network constraint as a measure to investigate various organizational phenomena, such as innovation, knowledge transfer, power and influence, and performance (Aral and Van Alstyne, 2011; Obstfeld, 2005). My approach applies this structuralist point of view to illustrate knowledge production as a dynamic cultural phenomenon. Under the organizational settings, the network constraint measures the extent to which a manager or an organization is embedded within a network of relationships, in which a low network constraint indicates that the manager's network spans many structural holes between otherwise disconnected actors. In my case, by substituting the nodes from managers to research terminologies, the research terminologies with lower constraint measure span more network clusters and serve as the brokers in connecting clusters with distinct semantic meanings. These terms operate as crucial links in the semantic network and facilitate the interaction between distant communities, which ultimately gives rise of new

scientific knowledge. I respond to Lizardo (2014) and Pachucki and Breiger (2010)'s methodological call for mapping the culture-to-network linkage by bridging the cultural-structural dualism through my analysis of the research terminologies' meaning structure.

Although I pick American sociology dissertations as my empirical example primarily for illustration purposes, my results provide practical insights for junior scholars and graduate students in navigating the academic world. When sociology Ph.D. students enter graduate school, they are often asked to specialize in a particular area of sociology. Yet, my results show that the boundary between the semantic communities of American sociology is not firmly structured, with a significant overlap between different research topics. In this sense, recognizing these boundary-spanning concepts is critical for fostering innovation and advancing knowledge creation within the field of sociology. By identifying these key terms and understanding their relationship to different research areas, junior scholars and grad students can develop a more nuanced understanding of the field and identify novel research directions that bridge disciplinary boundaries.

References

1. Abbott, Andrew. "Transcending general linear reality." Sociological Theory (1988): 169-186.
2. Abbott, Andrew. 2010. Chaos of disciplines. University of Chicago Press.
3. Aral, Sinan, and Marshall Van Alstyne. "The diversity-bandwidth trade-off." American Journal of Sociology 117, no. 1 (2011): 90-171.
4. Basov, Nikita, Ronald Breiger, and Lina Hellsten. 2020. “Socio-semantic and other dualities.” Poetics 78, 101433.
5. Bearman, P. S. 1993. Relations into rhetorics: Local elite social structure in Norfolk, England, 1540-1640 (p. 10). New Brunswick, NJ: Rutgers University Press.
6. Ben-David, Joseph, and Randall Collins. 1966. "Social factors in the origins of a new science: The case of psychology." American Sociological Review: 451-465.
7. Berger, Peter L., and Thomas Luckmann. The social construction of reality: A treatise in the sociology of knowledge. Anchor, 1967.
8. Bohr, Jeremiah, and Riley E. Dunlap. "Key topics in environmental sociology, 1990–2014: Results from a computational text analysis." Environmental Sociology 4, no. 2 (2018): 181-195.
9. Boutyline, Andrei, and Stephen Vaisey. "Belief network analysis: A relational approach to understanding the structure of attitudes." American Journal of Sociology 122, no. 5 (2017): 1371-1447.
10. Breiger, Ronald L. "A tool kit for practice theory." Poetics 27, no. 2-3 (2000): 91-115.

11. Breiger, Ronald L. 1974. "The duality of persons and groups." Social Forces 53, no. 2: 181-190.
12. Burris, Val. "The academic caste system: Prestige hierarchies in PhD exchange networks." American Sociological Review 69, no. 2 (2004): 239-264.
13. Burt, Ronald S. "Structural holes and good ideas." American Journal of Sociology 110, no. 2 (2004): 349-399.
14. Burt, Ronald S. 1987. "Social contagion and innovation: Cohesion versus structural equivalence." American Journal of Sociology 92, no. 6: 1287-1335.
15. Carley, Kathleen. "A theory of group stability." American Sociological Review (1991): 331-354.
16. Carley, Kathleen. "An approach for relating social structure to cognitive structure." Journal of Mathematical Sociology 12, no. 2 (1986): 137-189.
17. Carley, Kathleen. "Extracting culture through textual analysis." Poetics 22, no. 4 (1994): 291-312.
18. Collins, Randall. 1998. The sociology of philosophies: A global theory of intellectual change, Belknap Press of Harvard University Press; Revised edition.
19. DiMaggio, Paul, Manish Nag, and David Blei. "Exploiting affinities between topic modeling and the sociological perspective on culture: Application to newspaper coverage of US government arts funding." Poetics 41, no. 6 (2013): 570-606.
20. DiMaggio, Paul. "Nadel's paradox revisited: relational and cultural aspects of organizational structures." In Networks and organization. Harvard Business School Press, 1993.

21. Emirbayer, Mustafa, and Jeff Goodwin. "Network analysis, culture, and the problem of agency." American Journal of Sociology 99, no. 6 (1994): 1411-1454.
22. Emirbayer, Mustafa. "Manifesto for a relational sociology." American Journal of Sociology 103, no. 2 (1997): 281-317.
23. Ennis, James G. "The social organization of sociological knowledge: Modeling the intersection of specialties." American Sociological Review (1992): 259-265.
24. Evans, James A., and Pedro Aceves. "Machine translation: Mining text for social theory." Annual Review of Sociology 42 (2016): 21-50.
25. Fuhse, Jan, Oscar Stuhler, Jan Riebling, and John Levi Martin. "Relating social and symbolic relations in quantitative text analysis. A study of parliamentary discourse in the Weimar Republic." Poetics 78 (2020): 101363.
26. Headworth, Spencer and Jeremy Freese. 2016. “Credential Privilege or Cumulative Advantage? Prestige, Productivity, and Placement in the Academic Sociology Job Market.” Social Forces.
27. Heiberger, Raphael H., Sebastian Munoz-Najar Galvez, and Daniel A. McFarland. "Facets of specialization and its relation to career success: An analysis of US Sociology, 1980 to 2015." American Sociological Review 86, no. 6 (2021): 1164-1192.
28. Jockers, Matthew L., and Rosamond Thalken. 2020. Text analysis with R. Springer International Publishing.
29. Karell, Daniel, and Michael Freedman. 2020. "Sociocultural mechanisms of conflict: Combining topic and stochastic actor-oriented models in an analysis of Afghanistan, 1979–2001." Poetics 78: 101403.

30. Lamont, Michèle. "How to become a dominant French philosopher: The case of Jacques Derrida." American Journal of Sociology 93, no. 3 (1987): 584-622.
31. Lee, Monica, Amaç Herdağdelen, Minsu Park, and John Levi Martin. 2021. "Measuring Mohr social capital." Poetics 88: 101596.
32. Lee, Monica, and John Levi Martin. 2018. "Doorway to the dharma of duality." Poetics 68: 18-30.
33. Lizardo, Omar. "How cultural tastes shape personal networks." American Sociological Review 71, no. 5 (2006): 778-807.
34. Lizardo, Omar. "Omnivorousness as the bridging of cultural holes: A measurement strategy." *Theory and Society* 43 (2014): 395-419.
35. Merton, Robert K. 1979."The normative structure of science." The sociology of science: Theoretical and empirical investigations: 267-278.
36. Mohr, John W. 1998. "Measuring meaning structures." Annual Review of Sociology 24, no. 1 (1998): 345-370.
37. Mohr, John W. "Soldiers, mothers, tramps and others: Discourse roles in the 1907 New York City charity directory." Poetics 22, no. 4 (1994): 327-357.
38. Moody, James. 2004. "The structure of a social science collaboration network: Disciplinary cohesion from 1963 to 1999." American Sociological Review 69, no. 2: 213-238.
39. Neal, Z. P. 2022. Backbone: An R package to extract network backbones. PloS One, 17(5), e0269137.
40. Obstfeld, David. "Social networks, the tertius iungens orientation, and involvement in innovation." Administrative Science Quarterly 50, no. 1 (2005): 100-130.

41. Pachucki, Mark A., and Ronald L. Breiger. "Cultural holes: Beyond relationality in social networks and culture." Annual Review of Sociology 36 (2010): 205-224.
42. Padgett, John F., Katalin Prajda, Benjamin Rohr, and Jonathan Schoots. "Political discussion and debate in narrative time: The Florentine Consulte e Pratiche, 1376–1378." *Poetics* 78 (2020): 101377.
43. Pardo-Guerra, Juan Pablo. 2022. The quantified scholar: How research evaluations transformed the British social sciences. Columbia University Press.
44. Park, Michael, Erin Leahey, and Russell J. Funk. 2023. "Papers and patents are becoming less disruptive over time." Nature 613, no. 7942: 138-144.
45. Puetz, Kyle, Andrew P. Davis, and Alexander B. Kinney. 2021. "Meaning structures in the world polity: A semantic network analysis of human rights terminology in the world's peace agreements." Poetics 88: 101598.
46. Schultz, Jennifer, and Ronald L. Breiger. "The strength of weak culture." Poetics 38, no. 6 (2010): 610-624.
47. Scott, Lauren N., and Erik W. Johnson. "From fringe to core? The integration of environmental sociology." Environmental Sociology 3, no. 1 (2017): 17-29.
48. Serrano, M. Á., Boguná, M., & Vespignani, A. 2009. Extracting the multiscale backbone of complex weighted networks. Proceedings of the National Academy of Sciences, 106(16), 6483-6488.
49. Smith-Lovin, Lynn. "Core concepts and common ground: The relational basis of our discipline." Social Forces 78, no. 1 (1999): 1-23.
50. Smith, Christian. Moral, believing animals: Human personhood and culture. Oxford University Press, 2003.

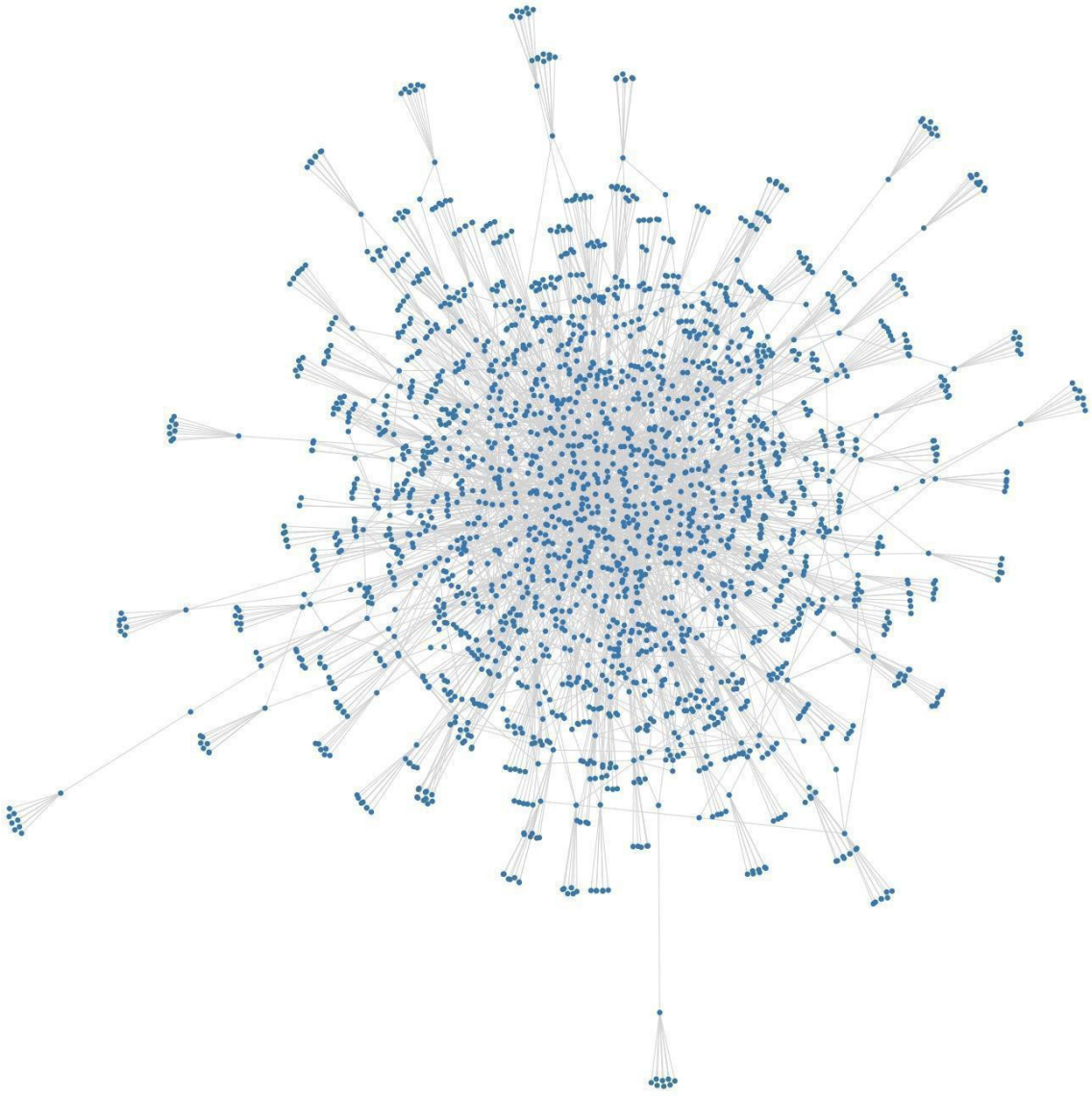
51. Somers, Margaret R. 1995. "What's political or cultural about political culture and the public sphere? Toward an historical sociology of concept formation." Sociological Theory: 113-144.
52. Stoltz, Dustin S., and Marshall A. Taylor. 2021. "Cultural cartography with word embeddings." Poetics 88: 101567.
53. Uzzi, Brian, and Jarrett Spiro. 2005. "Collaboration and creativity: The small world problem." American Journal of Sociology 111, no. 2: 447-504.
54. Vaisey, Stephen, and Omar Lizardo. "Can cultural worldviews influence network composition?." Social Forces 88, no. 4 (2010): 1595-1618.
55. Warren, John Robert. 2019. “How Much Do You Have to Publish to Get a Job in a Top Sociology Department? Or to Get Tenure? Trends over a Generation.” Sociological Science.
56. White, Harrison C. 1997. "Can mathematics be social? Flexible representations for interaction process and its sociocultural constructions." Sociological Forum, vol. 12, pp. 53-71.
57. White, Harrison C. Identity and control: How social formations emerge. Princeton university press, 2008.

APPENDICES

APPENDICES

The following appendices show the full semantic network for 2012-2013, which visualize the whole landscape of the semantic network before applying the backbone method. The centrality and constraint score measure of the whole network and be read in complementary to the results in the full text and the robustness check

Appendix 1. Robustness test: Full semantic network, 2012-2013



Appendix 2. Robustness test: Network measure of the full semantic network, 2012-2013

Centrality	Constraint
health	health
(0.0108)	(0.0459)
organization	organization
(0.0100)	(0.0486)
race	race
(0.0100)	(0.0495)
movement	movement
(0.0094)	(0.0526)
immigrant	identity
(0.0094)	(0.0526)
school	school
(0.0094)	(0.0526)
education	immigrant
(0.0090)	(0.0536)
global	education
(0.0085)	(0.0536)
identity	children
(0.0085)	(0.0543)
criminal	criminal
(0.0081)	(0.0569)
state	global
(0.0081)	(0.0574)
men	state
(0.0081)	(0.0584)
women	risk
(0.0076)	(0.0602)
class	men
(0.0076)	(0.0612)
student	development
(0.0076)	(0.0625)
mother	participants
(0.0076)	(0.0625)
risk	student
(0.0076)	(0.0627)
white	family
(0.0076)	(0.0634)
parent	women
(0.0076)	(0.0651)
development	white
(0.0072)	(0.0664)
family	religious
(0.0072)	(0.0667)
participants	class
(0.0072)	(0.0672)
care	law
(0.0067)	(0.0682)
gender	gender
(0.0067)	(0.0682)
law	care
(0.0067)	(0.0700)

Degree centrality and constraint score from the 2013-2013 whole semantic network

Top 25 terms with the higher degree centrality and lowest constraint