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Socio-semantic and other dualities

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ABSTRACT

The social and the cultural orders are dual – that is, they constitute each other. To understand either we need to account for both. Socio-semantic network analysis brings together the study of relations among actors (social networks), relations among elements of actors' cultural structures (their semantic networks), and relations among these two orders of networks. In this introductory essay, we describe how the duality of the social and semantic networks that constitute each other, as well as other related dualities (including material / symbolic, micro / macro, computational / qualitative, in-presence contexts / online contexts, 'Big' data / '**thick**' data), have evolved in recent decades to mold socio-semantic network analysis into its present form. In doing so, we delineate the current state of the art and the main features of socio-semantic network analysis as highlighted by the papers included in this Special Issue. These articles range from in-depth analysis of '**thick**' data on small group interactions to automated analysis of 'Big' online data in contexts extending from Renaissance parliamentary discussions to cutting-edge global scientific fields of the 21st century. We conclude by delineating current problems of and future prospects for socio-semantic network analysis.

1. Introduction

A new interdisciplinary research area has emerged in recent decades: socio-semantic network analysis. This stream of studies combines analysis of social ties such as friendship, collaboration, information exchange, or co-citations among actors (be they individuals, social groups, or organizations) with structural analysis of actors' cultural expressions represented as semantic associations. Semantic associations are understood as co-definitions or similarities between cultural elements (e.g. symbols, ideas, meanings). Socio-semantic network analysis thus offers conceptual frameworks and relational methodologies to analyze structurally not only social connections, and not only the content of texts, discourses, and meaning systems, but also and simultaneously the linkages between social and cultural relations. This is a crucial step in the understanding of society because social actors and cultural elements alike are ontologically defined by their relative structural positions *both* within *and* across the two orders, the social and the cultural. Social actors formulate relations between cultural elements with regard to particular social contexts, even as the meaning of relations between social actors depends on the cultural spaces where they interact (Basov & Brennecke, 2017; Breiger, 2010; Fuhse, 2009; Godart & White, 2010; Lee & Martin, 2018; Mische, 2003; Mohr & Duquenne, 1997). Thus, the social and the cultural orders are dual – that is, constitute each other – and to understand either we need to account for both.

Correspondingly, the main object of socio-semantic network analysis is the fundamental relationship between culture, represented by connections linking discoursive structures that capture opinions, views, values, cultural schemes, concepts, frames, or

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ideas, and social ties between the actors, who share, produce, or oppose these elements. Socio-semantic scholars try to find specific mechanisms channeling how the relationship between the social and the cultural operates. They do so by theorizing and investigating concrete patterns of associations between verbal elements (usually, words or phrases) and social network ties between actors who communicate these associations. Accordingly, socio-semantic network analysis asks, for instance: How do similar political expressions and friendship ties interplay? How do co-authorships in a scientific field relate to the use of (dis)similar keywords? (Note the bidirectional, dual perspective inherent in the question, instead of prioritizing either the verbal elements or the social ties). Applications are diverse, ranging from global online communication in social media to creative collaborations in small groups of artists, from ancient history to cutting-edge scientific fields.

While researchers have been calling for such a perspective for several decades (DiMaggio, 1987; Kirchner & Mohr, 2010; White, 1992), the field of socio-semantic network analysis is still nascent and disparate. The aim of this Special Issue is to pull together and highlight some of the key developments made in recent years by researchers from all over the world who share an ambition to combine social and semantic networks while working on a broad variety of topics within and across different scientific disciplines, focusing diverse domains of application and applying a variety of methods.

The focal duality of socio-semantic network analysis is connecting social and cultural orders. Making use of this principal duality is particularly effective in bridging different research foci, each with its own theories, methods and applications. The focal duality highlights a multitude of other dualities, conceptually and substantially different yet central for science in general and for social science in particular. One of these is the *duality of structure and content*. Here, structure is conceptualized as social ties and semantic links. Content, in turn, is constituted by the nature of social ties and the meaning inherent in semantic relationships. These two (structure and content) interplay in complex ways, and their mutual effect, although seemingly obvious (e.g., information dissemination relies on information channels and existence of these channels often depends on the peculiarities of information being disseminated), is far from trivial. For example, semantic association between the notions 'social network' and 'semantics' is a link, but it also represents semantics as having to do with networks. This example illustrates how content is simultaneously a structure. Socio-semantic duality explicitly brings this phenomenology to the forefront of analysis.

Another duality highlighted by the framework of socio-semantic networks is a methodological one, well known in social science: *the duality of quantitative, statistical or computational analysis and qualitative, ethnography-based analysis*. The socio-semantic framework, as several of the papers in this Special Issue showcase, is particularly productive in giving an additional impulse to thinking about the relationship between these two analytical perspectives, emphasizing the need for both and, moreover, a mixture of both. On one hand, in order to find regularities in the interplay between social ties and semantic associations, formal data and statistical analyses are essential. On the other hand, however, to understand what the identified patterns really 'mean' in specific local lifeworlds, contextual, in-depth data are crucial. For instance, we may find statistical evidence that two academics who share an interest in socio-semantic networks, and who hence share a semantic association between the terms 'social network' and 'semantics', tend to collaborate. However, to gain insight into how this shared association arises and shapes research collaboration, we need to look into a number of interrelated features: the nature of the practice of these academics in conducting socio-semantic network analysis together, the history of this practice, the discoursive field each of them refers to when speaking about socio-semantic network analysis, their personal scientific careers, and so on. And these features will not be the same across all dyads of collaborators sharing the link 'social network – semantics'. Hence, study of the context of meaningful practices should be inseparable from adequate design and interpretation of statistical analysis.

A related duality inherently associated with this methodological framework is *the duality of 'Big' data and '**thick**' data*. Quantitative statistical and computational approaches benefit from cross-case analyses of multiple actors, contexts, and time periods, which are enabled by standardized, often automated, data collection. Growing availability of data on social media relations and textual data increase interest in mapping global online socio-semantic landscapes, and have led to advances in capabilities for doing so. Meanwhile, qualitative data and its interpretation require in-depth case-specific manual observation by highly qualified researchers. Conventionally, these types of data are kept distinct. Their combination in socio-semantic network analysis is, however, appealing. On the one hand, generalization requires capturing stable socio-semantic patterns observed in large sets of data, possibly in multiple languages, or diverse types of social ties and multiple frames of communication and social interaction, produced by social actors who belong to dissimilar cultures. On the other hand, insightful interpretation of socio-semantic patterns, which involves both concrete social ties and cultural patterns specific to them, requires in-depth case studies of the diverse local contexts where these patterns operate. Hence, socio-semantic scholars are more and more often pushed towards looking into smaller-scale settings to observe how socio-semantic structures come into being and work in practice.

This takes us to *the duality of social macro structure and social micro structure*. Local idiocultures emerge through social interactions in small groups, yet structural positions in social fields or classes, inevitably – and dually – affect this local interplay of social and cultural structures. Moreover, these 'large' structures are, perhaps, gradually molded by the multitude of local socio-cultural contexts. Indeed, the junction of socio-semantic duality and micro and macro duality may be key to resolving the dilemma of structure and action. After all, this junction sheds light on the relationship between imposed cultural schemas associated with social macro structure, even as such schemas regulate local social (inter)action and local cultures, enabling emergence of social structures alternative to impositions of the social macro structure.

This, in turn, links to yet another duality: *the duality of the sciences and the humanities*. The former tend to prefer statistical, or large-scale computational analyses of 'Big' social and cultural data while the latter opt for hermeneutic qualitative analysis of '**thick**' data in small-scale settings. Simultaneously with drawing on cutting-edge formal and statistical analysis methods to examine society, the socio-semantic approach also inevitably involves an attempt to deeply understand human nature, not only in the present day but also looking into history, diving into text archives to map both social and semantic structures; to discover, for example, how the duality of

culture and interpersonal relationships evolved over centuries.

Of course, none of these related yet conceptually and substantially diverse dualities has been invented by socio-semantic analysts or conditioned by the duality of the social and the semantic. Rather, the latter highlights the need to address these associated dualities. Such junctions as those outlined above are often fruitful.

In what follows, we describe how our focal, socio-semantic, duality, as well as other related dualities (1) evolved and shaped socio-semantic network analysis into its present form, (2) constitute the landscape of socio-semantic network analysis today, as highlighted, in particular, by the papers included in this Special Issue, and (3) may lead to potential future perspectives for socio-semantic network analysis as a research field.

2. The roots of socio-semantic duality

Throughout time, bridging dualities have been the main source of theoretical and methodological innovations, gradually bringing social and semantic network analyses together. In *social network analysis* the main focus has traditionally been on actors' social positions and the ensembles of connections among them. The latter served to explain actors' behavior and characteristics based on structural opportunities and constraints, while other types of relations and entities were largely bracketed (Barnes, 1954; Borgatti & Foster, 2003; Moreno, 1934; Wasserman & Faust, 1994; Wellman & Berkowitz, 1988; White, Boorman, & Breiger, 1976).

A principal turn in social network analysis occurred when the researchers initially focusing on social ties between social actors in small groups (dually) connected the intra-group level to the inter-group level – in order to account for positions of network actors in larger social structure, such as organizations, clubs or social movements. This 'two-mode' approach accentuated dual constitution of individuals and the groups they belong to (Borgatti & Halgin, 2011; Breiger, 1974; Fararo & Doreian, 1984). Drawing on the two-mode approach, social network analysis came to consider types of nodes other than social actors (e.g., technology items), and multiple types of ties (e.g., friendship and collaboration), as well as multiple types of node attributes (Contractor, Monge, & Leonardi, 2011). In particular, generalization of the two-mode approach (Fararo & Doreian, 1984) allowed for developing multi-mode approaches using affiliation matrices that connect social actors to other entities. This further evolved into multidimensional network approaches that combine multiple types of nodes and relations within and across node types known as multi-layer/-level networks, or different types of relations among the same nodes, known as multiplex networks (Lazega & Pattison, 1999; Lazega & Snijders, 2015; Padgett & Powell, 2012; Snijders, 2011; Wang, 2013; Wang, Robins, Pattison, & Lazega, 2013). These developments have turned out to be crucial to the formation of socio-semantic network analysis, as they allow for combining social actors and relations among them with cultural elements – meanings, words, discourses – as well as with relations of cultural similarity among social actors.

Meanwhile, *semantic network analysis*, rooted in psycholinguistics (Quillian, 1968; Raphael, 1968; Johnson-Laird, Herrmann, & Chaffin, 1984) and structural linguistics (Harris, 1963; de Saussure, 1959), focused on relations between such elements as words and *their* positions with respect to each other. This perspective argued that words co-define each other and, therefore, meaning can be found in networks of associations between words rather than in the words *per se*. With the idea that the content of words resides in the structure of relations between them, the duality of structure and content was put forward.

In parallel, sociolinguistic perspectives (Labov, 1972; Wittgenstein, 1953) have shown that meaning depends on social contexts rather than being imposed entirely by language rules such as grammar, and hence, that there is no meaning outside of social context. This led to the idea that meaningful relations between linguistic elements are inseparable from particular social relations and practices. Further reinforced by the evidence on idiomatic expressions in corpus linguistics, such as in the work of Sinclair (1991), the idea of semantic networks as associated with particular social settings became persistent.

Similarly, Callon and Latour (1981), Callon, Courtial, Turner and Bauin (1983), and Latour (1996) proposed an approach emphasizing word associations within science and technology studies, in particular, within actor-network theory, that aims to account for interactions between human and non-human actors. One technique in this line of research was the mapping of co-occurring words in scientific texts (Callon, Courtial, Turner, & Bauin, 1983; Leydesdroff, 1989). Importantly, actor-network theorists accentuated mixed approaches based on co-constitution of ethnographic and textual data and formalized structural representation of these data as networks. Leydesdorff (e.g., 1997), further, focused on the relation between social actors in communication and discourse, and on meanings as continuously re-created at different levels by social actors, and has further developed the ideas underlying actor network theory so as to apply to large-scale data sets, shifting the focus from qualitative case studies to a quantitative system level approach (e.g., Leydesdorff, 2001). In this line of research, automated tools for mapping word co-occurrences in the context of science communication (e.g., Leydesdorff & Hellsten, 2005) and for mapping implicit frames in communication (Hellsten, Dawson, & Leydesdorff, 2010) have been developed.

However, subsequent decades witnessed a departure from the analytical perspective reviewed above, owing to the rapid growth of online communication and, hence, the amount of accessible yet largely decontextualized cultural data. This led to a burgeoning of semantic network analyses in communication science (Corman, Kuhn, McPhee, & Dooley, 2002; van Atteveldt, 2008; Nerghes, Hellsten, & Groenewegen, 2015; Nerghes, Lee, Groenewegen, & Hellsten, 2015), which already had the tradition of associating semantic networks with particular social groups (Danowski, 1982; Doerfel & Barnett, 1999; Doerfel, 1998; Monge & Eisenberg, 1987; Rice & Danowski, 1993). Simultaneously, rapid progress was made in the adjacent fields of cognitive science (Borge-Holthoefer & Arenas, 2010; Teixeira et al., 2010, linguistics (Steyvers & Tenenbaum, 2005), and computational social sciences (Lerique & Roth, 2018; Taramasco, Cointet, & Roth, 2010). Researchers derived relations between words from various types of textual data and proposed natural language processing extensions, such as syntax-based approaches to enhancing word associations with information about parts of speech, grammatical relations between words, and ontologies (Corman et al., 2002; van Atteveldt, 2008; Sudhahar, Veltri, & Cristianini, 2015; Evans & Aceves, 2016; Nivre et al., 2016). Dealing mainly with online 'Big' data, researchers developed a

range of techniques for automated mapping of, for instance, co-occurring hashtags and addressed usernames in social media data (Hellsten and Leydesdorff, 2020), and further to mapping 3-mode networks of stakeholders authoring social media postings and addressing other stakeholders (@usernames) while tagging their postings to specific topics (hashtags) (Hellsten, Jacobs, & Wonneberger, 2019).

Progressing in automated data mining and computational analyses while focusing on online data, this stream of studies often abstracts from social contexts. The junction of the duality of computational automated analyses of large-scale data and of in-depth contextual analyses utilizing ethnographic data was achieved in sociology. There, the interest in semantic networks in the 1990s brought together the perspectives and techniques of communication science, cognitive science and sociolinguistics in a movement known as *formal analysis of culture*. Led by John Mohr (1994, 1998, 2000) (see also Kirchner & Mohr, 2010; Mohr & Bogdanov, 2013; Ferguson, Groenewegen, Moser, Borgatti, & Mohr, 2017; Edelmann & Mohr, 2018), this movement is largely responsible for the growing popularity of semantic network analysis in sociology today (Hoffman, Cointet, Brandt, Key, & Bearman, 2018; Kozlowski, Taddy, & Evans, 2019). Formal analysts approach culture as "relations rather individual elements and the patterns arising in these" (Edelmann & Mohr, 2018: 3) and aim at theorizing cultural mechanisms and applying formal methods to cultural data in search of the corresponding cultural patterns. One of the major contributions to this movement, apart from John Mohr's own works, is to be found in the 'quantitative narrative analysis' of Roberto Franzosi (1999, 2004, 2010), whose methodological project created a profound basis for enhancement of word collocation semantic network analysis with syntax-based techniques. Alternative, yet also essentially mixed-methods-based network analyses of culture in sociology have been developed by Paul McLean (1998; 2007), as well as by the team of Peter Bearman (Bearman & Stovel, 2000; Hoffman et al., 2018) and by John Padgett (2018). A recent step in taking advantage of the duality of state-of-the-art computer techniques and qualitative interpretation in formal analysis of culture is the proposal for a 'computational hermeneutics', combining automated 'distant reading' of texts with 'close reading' that allows for a deeper understanding of meanings in their social contexts (Breiger, Wagner-Pacifici, & Mohr, 2018; Mohr, Wagner-Pacifici, Breiger, & Bogdanov, 2013; Mohr, Wagner-Pacifici, & Breiger, 2015).

Notwithstanding these developments, the point of convergence of the focal duality of social and semantic networks lies at the junction of formal analysis of meanings and social network analysis. This, however, did not come about in a straightforward way. Traditionally, social network research has purposively bracketed culture for the sake of focusing on the structures of relations among social actors (Barnes, 1954; Wellman & Berkowitz, 1988; Wellman, 1988; White et al., 1976). Gradually, nonetheless, culture began to be 'smuggled' (Emirbayer & Goodwin, 1994) into network analysis by a range of *network and culture studies* (for overviews, see Pachucki & Breiger, 2010; Fuhse, 2015). These studies empirically tested theories related to specific network mechanisms affecting culture, such as transmission (Erickson, 1982; Krackhardt & Kilduff, 1990; Mark, 1998; Krackhardt & Kilduff, 2002), proximity (Meyer, 1994; Rice & Aydin, 1991; Rice, 1993), or socialization (Kandel, 1978). Such theories argue that social ties enable exchange with cultural elements—pieces of knowledge, preferences, attitudes, choices, or attributions—which condition similarities in individuals' cognitive systems, perspectives, tastes, and individual knowledge consisting of these elements (DiMaggio, 1987; Erickson, 1988; Kilduff, 1990; Mark, 1998), mainly focusing on dyadic exchanges between social actors (Kilduff, 1990; Krackhardt & Kilduff, 1990; Rice & Aydin, 1991) (however, see Krackhardt & Kilduff, 2002).

Kathleen Carley was, perhaps, the one who changed the treatment of culture in social network analysis. She supplemented analysis of social networks with a semantic network analysis of culture, thus treating not only the social but also the cultural order structurally – in line with the formal perspective on culture. Similarly to other formal analysts of culture, Carley did that drawing on the duality of automated computational analysis and ethnographic data – by applying computer techniques to study culture formation in interpersonal interactions in dyads and small groups (Carley, 1989, 1994, 1997). Yet, in contrast to others, Carley and her team explicitly combined social network structures and semantic structures (1986), experimented with applying social network measures to semantic networks (Carley & Kaufer, 1993), proposed intersecting semantic networks to represent group culture (Carley, 1997), and derived social networks from semantic networks based on manual and semi-automated labeling of words into categories, such as agents (actors mentioned in the texts), knowledge (claims in the texts), resources (mentioned in the texts), and tasks (Carley, Diesner, Reminga, & Tsvetovat, 2007; Diesner, 2013). Furthermore, she and colleagues also developed and popularized software for (semi-)automated mapping and analysis of semantic networks, 'AutoMap' and 'ORA' (Diesner & Carley, 2011; Pfeffer & Carley, 2013). At the conceptual level, Carley proposed a 'constructural theory' that highlighted the interplay between networks and culture (1991) and later inspired a number of prominent scholars in networks and culture (including Lizardo, 2006; Pachucki & Breiger, 2010). In parallel, the classical methods of social network analysis, such as blockmodelling (White et al., 1976), were applied to co-occurrences of semantic categories (Mohr, 1994; Tilly, 1997) and later the concepts from social network analysis became increasingly applied to culture, leading to the emergence of hybrid notions, like 'cultural holes' or 'weak cultural ties' (Pachucki & Breiger, 2010; Schultz & Breiger, 2010; Lizardo, 2014).

Still, the earlier studies on networks and culture mostly considered culture asymmetrically, as an outcome rather than a cause, reducing it to elements that diffuse through the conduits of social network ties or attributes of actors. Such a perspective on culture has been a subject of sympathetic yet severe and continuous criticisms (e.g., Brint, 1992; Emirbayer & Goodwin, 1994; Vaisey & Lizardo, 2010). A growing body of more recent studies started showing also an inverse dependency: cultural meanings affecting social network ties, rather than the other way around (Bottero & Crossley, 2011; Bottero, 2009; Lewis & Kaufman, 2018; Lizardo, 2006; Mark, 1998; Vaisey & Lizardo, 2010). For instance, Lizardo (2006) showed that those who opt for popular culture tend to establish friendships with one another, while tastes towards 'highbrow' culture have little to do with weak social network ties.

The broad turn towards de-marginalizing culture in social network analysis overall was initiated by Harrison White – one of the founding fathers of social network analysis as it is currently known. Along with the cultural turn in social sciences overall (Alexander & Smith, 1993; Alexander, 2006; Friedland & Mohr, 2004), White's *relational sociology* argued that culture and social network ties are

intertwined in dynamic processes where social actors and cultural meanings co-evolve (Emirbayer, 1997; Fuhse, 2015; Kirchner & Mohr, 2010; Mische, 2011; White, 1992). Even dyadic pairs of social actors have been shown capable of developing relationship cultures of their own (Becker & Useem, 1942; Fuhse & Mützel, 2011; Fuhse, 2009), not to speak of larger social groupings, such as social welfare systems (Mohr & Duquenne, 1997) or urban communes (Yeung, 2005). In relational sociology "social networks are seen not merely as locations for, or conduits of, cultural formations, but rather as composed of culturally constituted processes of communicative interaction" (Mische, 2003: pp. 258). The main focus is on social interactions and creation of meaning as co-constitutive processes that occur in specific cultural contexts. Calls have been sounded for closer connections between research on network relations and the underlying cultural processes embedded in networks (Fuhse & Mützel, 2011; Mische & White, 1998). Perhaps, the quintessence of White's perspective is the notion of a netdom (White, 1992) – a cultural domain and a social network dually corresponding to it.

As Carley's work introduced the idea of approaching not only the social but also the cultural order structurally, and White's theorizing about netdoms brought these two orders together, social network analysts well familiar with Breiger's seminal two-mode approach were then quick to arrive at the idea of *cultural and social duality* (Breiger, 2000, 2010; Martin, 2000; Mohr, 2000; Pachucki & Breiger, 2010; Basov & Brennecke, 2017; Lee & Martin, 2018). This thinking aligned with one of the main fundamental dualities known in sociology (Berger & Luckmann, 1966; Bourdieu, 1984; Foucault, 2013; Mead, 1934). This perspective treats culture as an emergent system of relations between elements, 'meaning structures', distinct and self-consistent "continuously interacting populations of forms of discourse" (White & Godart, 2007: 11), which comprise a system in its own right, embedded in social network structure but having an 'equal weight' to it, rather than merely transmitted through it (Mohr, 2000). Thus, researchers started "folding together [...] cultural meanings and social structures as primary elements within the same research design" (Mohr, 1998: 348). As part of the cultural and social duality endeavor, scholars also drew on another crucial sociological duality and empirically showed that institutions, for example universities (Mohr & Lee, 2000) or city administrations (Meyer, Jancsary, Höllerer, & Barberio, 2012), classify individuals, bringing them together, ascribing subsets of them with similar identities, and imbuing them with corresponding meanings. In this perspective, the way that macro-level meanings are imposed at the micro level is that distinct meanings are institutionally attached to individuals or groups that occupy particular social positions. This implies a duality of social positions and meanings.

Drawing on the idea of dual relationships between networks and culture, Camille Roth for the first time explicitly proposed a full-fledged *socio-semantic network analysis* (Roth & Bourgine, 2003), combining joint analysis of the social relations among scientists and the semantic relations among the concepts they put forward. Roth and Bourgine connected social actors to words with bipartite links, akin to Breiger's two-mode perspective. Modeling joint evolution of semantic communication networks in scientific communities and in social media, Roth and coauthors revealed a number of stable principles of this co-evolution, such as clustering, centralization, integrity and transitivity (see Roth, 2007; Roth & Cointet, 2010; Roth, 2013).

3. Socio-semantic duality today

In the decade following the introduction of socio-semantic network analysis, the movement of scholars jointly considering social and semantic networks has been rapidly expanding, reinforced by a series of workshops, meetings, and conference sessions that brought together academics from around the world who shared the passion in socio-semantic networks. These meetings were organized by an international team including Nikita Basov, Iina Hellsten, Johanne Saint-Charles, Camille Roth, Adina Nerghes, John Mohr and Jana Diesner. Since 2016, a continuous series of sessions on 'Socio-semantic networks' has been organized at 'Sunbelt', the Social Networks Conference of the International Network for Social Network Analysis (INSNA), as well as in 2017 at the European conference on social networks (EUSN), supplemented with open roundtable discussions and a workshop entitled 'Dialog on the use of quantitative and qualitative methods for studying online social and socio-semantic relationships' that took place in 2019 in Montreal. In 2017, a three-day seminar on 'Socio-Semantic Patterns' took place in Paris to discuss the micro-principles of how social and semantic/meaning/cultural structures interplay. Finally, the biannual 'Networks in the Global World' (NetGloW) conference in St. Petersburg first hosted the seminar 'Basic notions and measures of social network analysis in semantic networks' in 2016, and then, in 2018, a session on 'Socio-semantic Networks'. A session on 'Semantic and Socio-Semantic Networks' will be held at NetGloW in St Petersburg, in July 2020.

Several strands of socio-semantic network analysis currently co-exist and enrich each other both methodologically and substantively, while developing their own styles of research, specific approaches, and combinations of analytical techniques. One strand uses social media data for (semi-) automated reconstruction of social and semantic networks (Hellsten et al., 2019; Himelboim, Smith, Rainie, Shneiderman, & Espina, 2017; Holmberg & Hellsten, 2016; Roth, 2013; Hellsten and Leydesdorff, 2020). Researchers examine the co-evolution of semantic and structural configurations mainly using 'Big' data and computational methods. An important direction within this strand of studies is exploration of the meaningful ways in which social network measures can be applied to semantic networks. For instance, in order to improve semantic co-word analysis, Nerghes, Hellsten et al. (2015) proposed the so-called structural space of concepts in semantic networks. This approach combines two social network centrality measures: betweenness centrality as a measure of concept connectivity, and degree centrality as an indication of concept popularity. Rule, Cointet, and Bearman (2015)), in turn, applied community detection to word co-occurrence semantic networks in order to identify categories that span across centuries. Furthermore, Deichmann et al. (2020) examined how socio-semantic connectivity of ideas and research teams facilitates diffusion of ideas in academic conference publications.

Another strand, dually, focuses on small group interactions and draws on the growing mixed method movement in the analysis of culture and networks (Fuhse & Mützel, 2011; Ibrahim & Crossley, 2016). Researchers quantify ethnographic data in order to map

social and semantic networks, and the relations between the two (Christopoulos & Vogl, 2015). For instance, these studies found a non-trivial relation between semantic similarity to other group members and social network centrality, positive only up to a threshold point after which the relation inverts (Saint-Charles & Mongeau, 2018; see Basov et al. (2017) for related findings). Another example is the recently published study by Basov, de Nooy and Nenko (2019; first published as Basov, de Nooy, & Nenko, 2018), inspired by the junction of social field theories and social network analysis (see Bourdieu, 1990; de Nooy, 2003; Bottero & Crossley, 2011). This work connects socio-semantic micro structures of small groups to the socio-cultural macro structure of social fields. The main finding is that field-imposed meaning structures are instantiated in small groups, leading to the production of idiocultures (Fine, 1979) of their own. The analysis of the Frankfurt philosophical school by Monica Lee (2017) utilizes archival data on letter exchanges between the philosophers. Lee applies computational semantic network analysis to the relations revealed in their textual works. On the quantitative side, she shows that cultural structures of ideas positively correlate with social network structures throughout three decades of the school's development. Yet, in-depth interpretation allows her to explain the exceptions, i.e. when ideational similarity diverges from social network patterning. For example, Lee discusses the career of Leo Löwenthal, who aimed to affiliate with the core ideas of the Frankfurt group but whose work was considered superficial by some key members and who was finally expelled. Recently, the social and cultural duality reasoning reached its culmination with the introduction of the 'full' duality framework (Lee & Martin, 2018), very resonant with Roth's two-layer socio-semantic network framework (Roth & Bourgine, 2003), where meaning structures that connect cultural elements are also embedded in social networks as interacting individuals use cultural elements. This achievement linked the sociological 'networks and culture' duality perspective and socio-semantic network analysis in communication and computational science by hinting at the representation of a socio-cultural system as a network graph – in order to study the duality of the social and the cultural orders as an integral sociocultural space.

Corresponding multidimensional extensions, based on recent developments in social network analysis, such as statistical modeling of multiplex and multilevel networks (Hollway & Koskinen, 2016; Wang et al., 2013; Wang, Robins, Pattison, & Koskinen, 2014), and combining social networks with networks of cultural elements, were proposed by Basov, Lee, and Antoniuk (2017), enabling tests for interdependencies between social and semantic networks in ways that are compatible with the networks and culture duality perspective. Particularly attractive is identifying the fundamental principles and mechanisms (Edelmann & Mohr, 2018; Hedström & Ylikoski, 2010; Martin, 2002) of co-evolution of social and cultural structures as interplaying and affecting each other. Further progress in this direction rests on conceptualization of the concrete patterns corresponding to these principles and mechanisms (see, e.g., Basov & Brennecke, 2017; Lewis & Kaufman, 2018).

The present Special Issue (SI) expands these lines of inquiry in two principal ways. The SI authors propose new theoretical and methodological approaches to relating semantic and social networks by drawing on unique emergent datasets. At the same time, the authors propose a number of analytical methods, both in-depth and computationally advanced. Signaling growth of the field, 31 papers were submitted in response to the open call for papers for this Special Issue. In our evaluation, many of the papers submitted report significant advances. The papers finally comprising the SI present several of the main highlights of numerous efforts in socio-semantic network analysis made by these and many more authors and projects.

Importantly, while revolving around the main, socio-semantic, duality, this Issue draws on a number of other dualities (structure and content; computational and qualitative analyses; macro and micro levels; small groups and social media data; present and historical cases) that have been pivotal for the emergence and development of the socio-semantic movement. Whereas the ten papers in this Issue draw on the multitude of dualities that have been stimulating socio-semantic network research, together they comprise a mosaic whole that itself is a bridge – between these dualities, disciplines, and scholarly communities.

Our journey begins in the distant past: 14th century Florence. In the first two papers, ***John Padgett, Katalin Prajda, Benjamin Rohr, and Jonathan Schoots (2020)*** and ***Jonathan Schoots, Benjamin Rohr, Katalin Prajda, and John F. Padgett (2020)*** examine an interplay of political expressions and social relations between the speakers in Florence's Consulte e Pratiche – an advisory body to the city council that made all important policy decisions during the War of Eight Saints, and further, up to the famous Ciompi Revolt. The dilogical structure of this work corresponds to the main – socio-semantic – duality of this Special Issue. To understand how foreign-policy conflict became a domestic revolution in the Florentine republic, the authors bring together the social and the semantic gradually. The first paper introduces semantic network analysis of associations between words in politicians' speeches, and then the second paper adds analysis of social relations among these actors. Combining social and semantic analysis allows the authors to bring forward the relation between words and actions. Paradoxically, they reveal a negative relation: Against the background of a deep social-class conflict, similarities in speeches made in the Council provoked, not social peace, but exactly the opposite – the revolt and the failure of the whole republic (akin to Saint-Charles & Mongeau (2018), who find a treshold beyond which the positive relationship between semantic similarity and social centrality becomes inverted). This analysis draws on the duality of the qualitative and the quantitative. In the expanding tradition of narrative network analysis (Bearman & Stovel, 2000; Padgett, 2018) and that of purely text-based historical socio-semantic analysis (Lee, 2017), the authors draw on a manual formalization of dynamic relations comprised of associations among words about focal topics found in a 'thick' dataset of detailed archival transcripts of one of the oldest policy discussions recorded. However, they move farther and apply a mixture of – mutually constitutive – statistical and qualitative analyses of social actors' similarities in speeches (see also Christopoulos & Vogl, 2015; Basov, de Nooy, & Nenko, 2019), thus using textual content to infer co-evolution of multiple – social and semantic – structures.

The paper by ***Jan Fuhse, Oscar Stuhler, Jan Riebling, and John Levi Martin (2020)*** also draws on archival records of parliamentary debates and utilizes textual data (transcripts of speeches) to reconstruct both social and semantic relations, but of a less distant past: The authors analyze proceedings of the Weimar Republic in Germany (1919–1933). In contrast to the papers by Padgett et al., and Schoots et al., this work puts social and semantic orders alongside each other. As do many others in this Issue, the authors take advantage of one of the cornerstones of socio-semantic network analysis, Breiger's two-mode approach and its recent 'full'

extension (Lee & Martin, 2018). Yet, the authors still argue that relations between social actors, between cultural elements, and between the two should be treated differently. Correspondingly, they propose three distinct but complementary approaches: dually linking words to texts, terms – to actors through symbolic practices, and symbols – to social relationships. The first-listed linkage is based on co-occurrences of words in expressions shared among key word communities which correspond to distinct perspectives. The second compares usages of terms by political parties. The third examines the use of symbols in interactions between actors. For each approach, different analytical techniques are recommended and illustrated. For the first approach, co-occurrences of symbols are mapped using multi-dimensional scaling, as in the influential approach of Carley (Carley & Kaufer, 1993; Carley, 1994). For the second approach, the authors follow Breiger (2000) and put social actors (parties) and symbols (political terms) into a two-dimensional space using principal components analysis. For the third approach, the authors examine reactions of parties to each other in speeches and combine principal components analysis with multi-dimensional scaling. While using textual data to map not only semantic links but also social relations, the results of Fuhse et al. confirm those of socio-semantic network studies that use sociometric surveys about association between social connections and symbolic similarity (Saint-Charles & Mongeau, 2018).

Continuing the section of this Special Issue devoted to political history research, ***Daniel Karell and Michael Freedman (2020)*** study sociopolitical conflict in Afghanistan during the late 20th century. Similarly to Fuhse et al. and most of the other authors in this Issue, the authors build on the two-mode approach. However, they move farther and put social and semantic orders into a single analytical framework. They also connect to other articles in this Issue by continuing along the avenue of multidimensional statistical modeling (Lazega & Snijders, 2015; Wang et al., 2013) of socio-semantic networks, applied to ethnographic and textual socio-semantic data (Basov & Brennecke, 2017). Yet, they go beyond their predecessors here as well and draw on the duality of computational text analysis and social network analysis, introducing a socio-semantic approach that combines stochastic actor-oriented models with topic modelling. Being longitudinal, this advanced approach responds to the recent calls to formally study socio-cultural dynamics (Edelmann & Mohr, 2018: 6). The approach is applied to study militants operating in Afghanistan between 1979 and 2001, thus expanding socio-semantic network analysis applications into sociopolitical conflict studies. Rather than explaining conflict dynamics by characteristics of individuals, as is usual in sociopolitical conflict studies, the authors employ the relational approach of Mische and White (1998), who argue that 'narratives of affinity' result from interpersonal ties. Hence, the drivers of peaceful conflict resolution may be sought in interactions and individuals' interpretations based on these interactions (Bearman, 1993). As Karell and Freedman write, their analysis indeed suggests that "shared associations with cultural elements can, under certain conditions, lead to comradeship among militants, which, in turn, promote ties to cultural elements [in a way that] points towards a key insight into conflict resolution." (p. 5). Importantly, the authors map semantic networks using mixed data combining online texts (to model and connect topics) and interview data on social relations between the combatants, thus drawing on yet another duality associated with the pivotal, socio-semantic, duality.

The paper by ***Nikita Basov (2020)*** is another example of two-layer statistical modeling of socio-semantic networks, here applied to collectives of artists and making use of multilevel exponential random graph models. Basov's modeling, on the one hand, provides an account of the social field positions of individuals and, on the other hand, in continuity with socio-semantic research, draws on '**thick**' small group data (Saint-Charles & Mongeau, 2018). The research combines qualitative data (ethnographic materials, interviews, visual observations, textual data) and quantitative sociometric survey data on collectives of artists in which participants represent different social field positions. This approach, making use of a variety of data types as well as mixed-methods analysis, allows the author to introduce an account of the duality of social macro structure and social micro structure into socio-semantic network analysis. In particular, Basov examines the working of cultural homophily – a concrete micro-principle of socio-semantic structuring that is hypothesized to mediate the interplay of social fields and local group practice with respect to their effects on individuals' meaning structures, as socio-semantic network research previously highlighted (Basov et al., 2019). The principal finding is that cultural homophily both reproduces social fields and contextualizes them as driven by local group idioculture, which links to the duality of macro structure and micro structure. In addition, this paper draws attention to the importance of taking into account relations between cultural elements with regard to different types of social ties between individuals who jointly engage with culture, in line with the premise of socio-semantic network analysis. Finally, Basov illustrates the benefits of combining the two sides of another duality by showing that mixed statistical and qualitative analyses inform each other and enable insights impossible for either of these separately.

In their paper, ***Iina Hellsten, Tobias Opthof, and Loet Leydesdorff (2020)*** propose a novel attribute matrix for combining many types of nodes into a single network analysis, an n-mode network approach, drawing upon actor-network theory, and the tradition of Breiger's two-mode approach. This allows them to overcome the tendency of scientometric research to separately map different types of relations, e.g., social, epistemic, and semantic networks, while addressing calls for hybrid methods in science and technology studies, such as in Actor Network Theory (Callon et al., 1983; Latour, 1996). The authors propose an n-mode network analysis, capable of linking a potentially unlimited number of node types, such as ideas, texts, and agents, thus integrating social, epistemic, and semantic networks. Putting within- and across-mode relations into the same space enables direct comparisons between them. Their application lies in the field of cutting-edge contemporary science: the medical field constructed around a rare lethal cardiac disease, the Brugada Syndrome. Applying computational methods for automated reconstruction of social and semantic networks (Hellsten & Leydesdorff, 2020 [first published as Hellsten & Leydesdorff, 2017]; Himelboim et al., 2017; Haunschild, Leydesdorff, Bornmann, Hellsten, & Marx, 2019), they examine complex visualizations of 3-mode networks of different combinations of institutional affiliations, subject headings, and journals based on an extensive online set of almost 3000 publications. The authors search for the type of node that drives field dynamics. Further tests, time-series extensions, and applications to other fields are likely to be motivated by this paper.

The work by ***Linzhuo Li, Lingfei Wu, and James Evans (2020)*** is similar to that by Hellsten et al. in their usage of state-of-the-art

computational methods for automated reconstruction of both social and semantic networks. Motivated by the growing convergence of global culture and inspired by the idea of duality of social structure and culture (Breiger, 2010; Mohr, 2000; Pachucki & Breiger, 2010), the authors examine how social network centralization induces semantic homogeneity in global science. In order to do so, they map collaboration networks and word co-occurrences as represented in 359,395 papers in 21st century physics on two-dimensional hyperbolic spaces, which allows representation of both hierarchy and diversity, and hence directly relates social centralization and semantic diversity. Moreover, the authors show that these findings generalize to all contemporary science by applying more conventional techniques of computational scientometrics to a 'Big' data set on 13 million articles in about 10,000 journals representing over 200 subfields.

This Special Issue concludes with essays by ***Robin Wagner-Pacifici, Ronald Breiger***, ***Paul DiMaggio***, ***Camille Roth, and Nikita Basov (2020)*** dedicated to John W. Mohr, a guest co-editor of this Special Issue, a major founder of and contributor to social and cultural duality studies, and a beloved friend to many of us. On August 24, 2019, after a long and serious illness, John passed away, retaining until the end his keen, astute, gentle, generous, and humorous mind – a bottomless loss for the whole field of cultural sociology. In his role as editor of a number of highly influential Special Issues of *Poetics*, John had a major impact on making the journal what it is today, even as he provided firm inspirational and analytic foundations for the measurement of meaning and the formal analysis of culture. His work also played a crucial role in forming socio-semantic analysis, both as a thematic area and as a diverse community of scholars. Importantly, in the recent years John and his co-authors have been arguing for approaches that combine analyses of imposed culture with emergent culture using mixtures of hermeneutic and computational techniques. To give due to all this, the essays feature both a 'phenomenological', heart-felt part and a computational-analysis-based map formalizing the socio-semantic space John was so astonishingly pulling together. The latter is also dual itself, as it is based on a combination of online publication data and self-nominations by John's collaborators, colleagues, co-authors and co-editors, students and teachers, mentors and mentees, and others from all over the world, who have kindly sent dozens of responses to our, rather short, call. The composition of the authors of this triad of essays is itself symbolic, joining the fields of social and computational sciences, American and Eurasian academic fields, and senior and emerging researchers. Looks like John's kind of crowd.

4. The future of socio-semantic duality

While offering a significant step forward, the works reviewed in this essay also set up a range of tasks for future investigations drawing on the multitude of dualities that revolve around the pivot of the socio-semantic. The cornerstone challenges are posed by the duality of the social and the semantic itself. One is that most of the measures developed within social network analysis focus on the relations between social actors and are not necessarily suitable as measures of semantic networks of cultural elements, and proper justifications and reconsiderations are yet to be made. For example, while degree centrality signals the importance of a social actor in a network, in semantic networks the words with trivial meaning often have the highest degree centrality. Complexity grows when the social and the semantic form joint heterogeneous networks, such as the n-mode networks put forward by the computational scientometric analysis of Hellsten, Opthof, and Leydesdorff (2020). Graph measures and operations over matrices that are conventional in social network analysis need to be carefully rethought conceptually before applying them to semantic and socio-semantic networks. This relates to the question of whether our framework has so tightly combined analyses of the social and the semantic that it may now be desirable to disentangle them to some extent. Such a disentangling might be necessary to account for differences in the principles structuring the social and the cultural orders, and the relation between the two, as Fuhse, Stuhler, Riebling, and Martin (2020) propose in this Issue. Supplementing computational measures with qualitative techniques to examine these measures in context might be one of the possible sources of insight, as well as assisting the analysis of online interactions and 'Big' data with analysis of in-presence interactions drawing on **'thick**' data.

Another crucial task, which in this Issue is highlighted by the works of Basov (2020) and Karell and Freedman (2020), consists in identifying the fundamental principles that underlie socio-cultural evolution and in specifying concrete socio-semantic patterns that correspond to these principles. Another avenue for further research brought about by these two papers is linking the micro-dynamics of socio-semantic networks to the macro structures of society – such as social fields, classes, and strata. A nontrivial task is relating socio-semantic structuring processes at macro and micro levels, including not only layering, but also nesting of smaller-scale socio-semantic patterns within larger-scale ones, e.g., individuals and words in organizations and themes.

Generalizability, given the contextual nature of the association between culture and networks, is another challenge for socio-semantic network analysis. As, in particular, the dilogy by Padgett, Prajda, Rohr, and Schoots (2020) and Schoots, Rohr, Prajda & Padgett (2020) reveals, different social formations, political systems, cities, and, groups, such as the Florentine Republic in the 1300s, may exhibit different, even inverse, relationships between the social and the semantic. Mixed methods of narrative network analysis are crucial for understanding the sources of such discrepancies. Cross-case comparisons are also necessary. And yet, to understand in which direction this multiplicity of socio-semantic clusters is evolving as a whole, full pictures of socio-semantic landscapes are needed, such as the one enabled by 'Big' data and computational methods of network science (Li, Wu, & Evans, 2020). A related issue is that in-depth socio-semantic data about in-presence interaction, taking context into account, is to be more extensively collected and used – to pillar the rapidly growing 'Big' online socio-cultural data. Such socio-semantic datasets require much effort to gather, and hence, are still scarce.

Having mentioned these specific challenges, perhaps, an overarching substantive theoretical and methodological issue brought about by socio-semantic network analysis involves thinking about the boundaries of the notion of cultural meaning, central for all social and cultural duality studies. As our overview of the roots of socio-semantic analysis has shown, semantic network analysis and formal analysis of culture reveal that associations between words are crucial in order to shed light on meaning. Subsequent research

showed that social contexts condition meaning and that links between social and semantic orders are also to be accounted for, as the duality perspective suggests. Furthermore, relational sociologists highlighted that social ties matter, because meaning is something inscribed and articulated in relationships. Moreover, they have also shown that the absence of interpersonal ties is important – as switching between relational contexts is, itself, a source of meaning. Finally, broader socio-semantic contexts going beyond focal relationships and groups, while focusing on peripheral relations and actors, are, probably, significant for a range of issues, from predicting future scientific success to understanding the nature of marginal and oppositional social formations. So do physical, economic, political contexts. What socio-semantic duality teaches its scholars, perhaps, most crucially, is constant awareness of this multidimensional universe of other, potentially equally (or should we say, dually?) important matters to consider.

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