

**COLLABORATIVE GOVERNANCE AND THE CHALLENGES OF NETWORK-  
BASED RESEARCH**

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## **ABSTRACT**

We review the literature examining collaborative governance processes from a network perspective, and evaluate the extent to which it tackles important conceptual and methodological challenges. In particular, we assess whether scholars clearly identify the boundaries of the network, define nodes and the nature of ties, and examine how they deal with missing data, account for tie strength, take tie multiplexity into account, and study networks over time. We discuss the implications of our findings for the collaborative governance literature and ways to address the shortcomings in existing research.

**KEYWORDS:** Collaborative governance, network analysis, nodes, ties, network boundaries.

# **COLLABORATIVE GOVERNANCE AND THE CHALLENGES OF NETWORK- BASED RESEARCH**

## **Introduction**

Research on collaborative governance in public policy, administration, and management has experienced a sustained growth in recent years, as scholars have sought to disentangle the complex array of relationships among myriad variables that affect the propensity of policy actors to engage in collaborative behavior, as well as the outputs and outcomes of collaborative governance (Ansell & Gash, 2008; Emerson, Nabatchi, & Balogh, 2012). One of the common traits of the foundational work in this area is repeated reference to the importance of networks in promoting and sustaining collaboration among actors who do not always have the same goals or interests when participating in public arenas (Amsler, 2016; Lecy, Mergel, & Schmitz, 2014; Vangen, Hayes, & Cornforth, 2015). In general, the literature has espoused the idea that collaborative governance involves structures of interactions among actors (i.e. networks) that span sectoral, hierarchical, and geographic boundaries (Tyler A. Scott & Thomas, 2017).

Yet despite the seemingly natural coupling between insights on collaborative governance and network-related research, we remain relatively ignorant about how exactly scholars examine networks when they study collaborative governance processes. Against this background, reviewing the literature on collaborative governance that explicitly references (or focuses on) networks can enrich discussions on the strengths and pitfalls of research undertaken to explain how patterns of interactions among policy actors shape collaborative governance outcomes. Such an exercise can help us highlight ways in which the field of collaborative

governance studies may move forward (Isett, Mergel, LeRoux, Mischen, & Rethemeyer, 2011; Lecy et al., 2014).

In this article, we aim to accomplish two goals. The first one is to examine the extent to which studies on collaborative governance conceptualize networks as a set of interrelated nodes and ties, rather than as a metaphor for the existence of some set of more or less structured interactions among actors (Dowding, 1995). Shedding light on this topic is important for discussions of comparability and transferability of more general network theories to the field of collaborative governance. The second goal, which is closely tied to the first one, is to document how collaborative governance scholars who indeed examine networks in a formal way (i.e. observe and measure one or more properties of the network) approach conceptual and methodological decisions that have important implications in network-based research. To accomplish the second goal, we seek answers to the following three questions:

- 1) How do researchers define who participates in collaborative governance systems? In network terms, this includes defining the boundaries of networks as well as the nodes of the networks, and addressing the common problem of missing data in network studies.
- 2) How do researchers measure interactions in collaborative governance systems? In network terms, what are the ties that connect network nodes, and to what extent do studies account for tie strength and multiplexity (i.e., multiple types of relationships)?
- 3) How do collaborative governance systems evolve over time? In network terms, are networks examined longitudinally?

Guided by these research questions, we take stock of the literature on collaborative governance that formally examines networks and provide a straightforward assessment of how collaborative governance scholarship tackles challenges unique to research on networks. Our review is designed to encourage researchers to think carefully about how to improve research design in collaborative governance studies that invoke the importance of networks as a conduit for collaborative behavior.

The next three sections explain in more detail why these three questions are central to network-related research, and why asking and answering them is important for the study of collaborative governance. We then describe the methods we use for our review and present and discuss our results. We conclude with a summary of key findings and highlight important directions for future research on collaborative governance and networks.

### **Who Participates in a Collaborative Governance Process?**

In order to understand collaborative governance processes, a first critical task for researchers is to clearly identify the set of relevant actors. From the perspective of networks, researchers need to precisely define the so-called network boundaries (Wasserman & Faust, 1994). Failing to clearly establish these boundaries can have noxious effects on findings. For example, if important actors who are part of the network are left out of the analysis, the internal validity of findings that purportedly assess how the whole network operates will undoubtedly be threatened. The external validity of findings will also be hampered if network boundaries are not clearly defined, as generalizations of findings to other cases will be necessarily off-target.

Of course, defining the boundaries of the network is not easy. In some cases, the set of actors that form the network is a relatively bounded population, as when scholars are able to rely on publicly available exhaustive roster of participants of collaborative governance systems (Emerson & Nabatchi 2015; Scott & Thomas 2017) or policy forums (Fischer, Angst, & Maag, 2017; Fischer & Leifeld, 2015). But in many cases such simplicity can be elusive, and researchers will need to spend time carefully considering how network boundaries are defined, which may depend on both theoretical and case-related criteria.

Often, defining who exactly is part of a network is an empirical challenge that can be addressed in different ways. Laumann, Marsden, & Prensky (1989) describe two possible approaches. The first one is the *realist* approach (see Wasserman and Faust 1994 for more discussion on this approach), which simply consists of extracting the information about the network boundaries from some subset of study subjects who can volunteer that information for the researcher. For example, a researcher interested in the study of collaborative governance on transportation policy in a metropolitan area could initially identify a number of actors that unequivocally belong to the network (the head of the local transportation department, representatives of the local public transit provider, etc.). Then, using a ‘snowball’ technique, the researcher could inquire about other actors that need to be accounted for, until a more or less exhaustive list of network participants could be obtained. Importantly, this approach requires that study subjects collectively consider themselves to be members of a “social entity” (Laumann, Marsden, & Prensky 1989, 65), which defines the boundaries of the network of interest to the researcher.

A second approach is the so-called *nominalist* approach, in which nodes are identified as part of the network given the analytical purposes of the researcher. For instance, continuing

with the previous example of collaborative governance in local transportation, the researcher could decide to define the boundaries of the network by incorporating to the study only the actors that are mentioned in a specific local transportation plan or document. Regardless of what approach is used, determining the boundaries of the network should be a basic first step for researchers studying networks in the context of collaborative governance.

A closely related issue is the precise definition of what type of entity qualifies as an actor in a collaborative governance system, or a node in the network. Actors can be individuals, organizations, parts of an organization, or a mix of all these types of entities (Huxham, Vangen, Huxham, & Eden, 2000). Defining the participants in a collaborative governance system is a pre-condition for understanding collaboration among actors (Emerson et al. 2012, 11). From a network perspective, clearly defining nodes enables assessment of the structural properties of the network, which in turn affects the scope of insight on how collaborative behavior unfolds (author 2008).

Finally, related to the substantive issue of network boundary definition is the topic of missing data and its potentially negative effects on the analysis of collaborative governance systems. As we explained above, lack of attention to network boundaries can invalidate findings. But even when network boundaries are properly defined, the absence of data on non-trivial numbers of actors and ties can bias results (Kossinets, 2006; Smith & Moody, 2013). Particularly when researchers use surveys to collect data to gauge how interactions occur, missing data can be a rather critical issue, since high enough levels of non-response can lead to very unreliable estimates of network-level statistics (Burt, 1983, 1987). For example, centrality measures can be valuable to determine activity and power levels in networks, as well as

influence and control over flows of information—depending on the type of centrality measure that the researcher uses. However, network centrality measures can be very unstable in the presence of missing data (Costenbader & Valente, 2003). Thus, scholars interested in the study of collaborative governance systems from a network perspective must make extra efforts to minimize the amount of missing data and/or mitigate its effects through specialized analytical techniques.

### **What are Interactions in a Collaborative Governance Process?**

Collaboration is not a unidimensional concept, and can be indicated by different types of interactions. Examples abound. Bardach's (1998) classic description of collaboration among governmental agencies, for instance, includes seven different types of collaborative behavior that could be analyzed as distinct ties in a network (exchange of information, joint litigation efforts, etc.). Similarly, Ansell & Gash (2008, 558) define five steps of the collaborative process (dialogue, trust, commitment, shared understanding, outcomes), each of which can by itself indicate the presence of collaborative behavior. Others observe that actors in a network may be connected by different types of ties that may indicate collaboration, including the joint participation in policy venues or forums (author 2016; Shrestha, Berardo, & Feiock, 2014). A final example is Emerson et al. (2012, 6), for whom collaboration involves principled engagement, shared motivation, and capacity for joint action (additionally, all three have sub-categories). Each of these three dimensions can require different types of interactions, all of which can be thought of as indicators of collaboration. For instance, principled engagement requires face-to-face deliberation to jointly define problems, and scholars have attempted to carefully measure it (e.g. Ulibarri & Scott, 2016). Yet such deliberations are rarely simple or



represented by single types of network interactions. Social interactions can exist on a variety of planes, and each realization of a social interaction aggregates to form a discrete relationship. Furthermore, some of these multiplex ties influence each other, as when venue co-participation leads to more intense exchanges of information (Fischer & Sciarini, 2016; Leifeld & Schneider, 2012).

To complicate matters further, relations can have different intensities or strengths. Information exchange, collaboration, and cooperation are sometimes distinguished as representing different degrees of collaboration intensity (Margerum, 2008). Furthermore, Ansell and Gash (2008, 546) mention that collaboration requires strong communication or multilateral deliberation, thus emphasizing the importance of strong connections among actors. When possible, scholars need to understand how these complex relationships unfold and coevolve, since they are collectively important to better understand the inner working of collaborative governance processes.

It is also important to note that multiplexity can depend on how nodes in a network are defined, as discussed in the previous section. For example, two individuals might share a relation of friendship, and, additionally, their respective organizations may be linked by ties of project collaboration. While a multi-mode network (i.e., with multiple types of nodes representing individuals and organizations) would not be by definition a multiplex network, aggregating individuals within organizations as unique entities (a common practice among collaborative governance network scholars) would result in a network featuring multiplexity (i.e., with one inter-organizational tie defined by friendship and another by project collaboration). Again, mutual dependencies and influence between these two types of relations

are likely to exist (for a more elaborate discussion of interpersonal vs. institutional/structural ties, see Marsh, 1998).

### **How do Collaborative Governance Processes Evolve Over Time?**

Emerson et al. (2012) claim that collaborative governance processes and actions therein are nested within a general ‘system context that produces opportunities and constraints and influences the dynamics of the collaboration at the outset and over time’ (Emerson et al. 2012, 5). They argue that some of the opportunities and constraints from political, legal, socioeconomic or environmental influences are the emergence of leadership, incentives for individual actors, and uncertainty, which can affect the way the collaborative governance regime performs in the long run, particularly as new possibilities and challenges arise (Emerson et al. 2012, 9). Other scholarship also highlights the fact that networks evolve as exogenous forces operate on them. For example, transitions of the legal framework from a monopoly to a liberalized economic sector (Fischer, Ingold, Sciarini, & Varone, 2012), an external environmental shock (Fischer, 2015), or the fact that an issue gains traction on the political agenda (Ingold, Fischer, & Cairney, 2017) can all affect how networks evolve.

Networks also evolve over time due to actors’ strategic behavior, independently of the evolving context. Actors cultivate relationships in order to increase the likelihood of achieving their goals, constrained by formal authority and existing relations, costs and uncertainties, as well as limitations imposed by cognitive capacities (Scholz, Berardo, & Kile, 2008; Snijders, Van de Bunt, & Steglich, 2010). They tend to connect to others that are already powerful and central in the network (Stokman & Zeggelink, 1996), or they reciprocate ties, close structural holes, or create transitive ties based on the types of risks they face (author 2010).

In addition, the importance and the purpose of collaboration in networks might change as the collaborative process itself unfolds (Huxham et al., 2000, 345). For example, Johnston, Hicks, Nan, & Auer (2011, 704) claim that collaboration early in the process is what matters for understanding outputs that are produced later. Early collaboration fosters trust and reciprocity, upon which further collaboration can be built in a sort of positive feedback process that increases the likelihood that actors find negotiated solutions to joint problems (author 2010). In sum, analyzing a collaborative governance system over time is important given that actors' interactions are not stable over time, and that these dynamic changes might be crucial to assess outputs of collaborative governance, as well as reactions of the collaborative governance process to changing context conditions.

### **Review Method**

To identify articles focusing on collaborative governance and networks, and analyze their content to answer our set of three research questions, we conducted a search in Scopus based on the following key terms in English: 'Collaborative Governance' or 'Collaboration' and 'Governance', plus 'Network' or 'Networks'. These terms had to appear in the title, abstract, or keywords accompanying the articles. We identified all articles published between January of 2000 and May of 2019 in journals listed in the 'Social Sciences & Humanities' category.<sup>1</sup> The search produced a total of 472 articles, of which we discarded 133 as they either were clearly unconnected to the topic of collaborative governance or were not empirical studies (i.e., we excluded reviews, conceptual papers, and perspectives). Consequently, the universe of articles we analyzed is formed by the remaining 339 articles.

It is interesting to note that not all of these articles are strictly about collaborative governance. In fact, a majority of them (199) are what we consider to be ‘loosely’ about collaborative governance, while a minority (140) are ‘strictly’ about collaborative governance.

**[Figure 1 here]**

Articles that are ‘strictly’ about collaborative governance explicitly mention the term ‘collaborative governance’ somewhere in the text and tend to adopt conceptual perspectives on governance consistent with Ansell and Gash (2008). Articles that are ‘loosely’ about collaborative governance do not use the term explicitly, yet they are concerned with collaboration and governance and pay attention to the role of networks to analyze the former.<sup>2</sup> Still, we perform the review on all 339 articles.<sup>3</sup>

## **Results**

Before analyzing how articles assess the network related variables of interest, we plot the number of articles on collaborative governance and networks published since the year 2000 in figures 2 and 3. The first finding worth mentioning is that for the first eight years of the panel (2000-2007) the number of published articles was very low, with less than ten per year. This starts changing in 2008, when an upward trend becomes clear, peaking in 2015 with 50 articles. While the number of articles declined two years in a row (2016-2017), the overall trend indicates an increasing volume of research over time.<sup>4</sup>

**[Figure 2 about here]**

Figure 3 disaggregates the results of figure 2 to distinguish between articles that are strictly about collaborative governance versus those that are loosely about collaborative governance.

**[Figure 3 about here]**

We observe two noteworthy findings. First, in general, there have been more articles that are loosely about collaborative governance than those that are strictly about collaborative governance. Of the 19 years plotted in figure 3, only in three do articles that are strictly about collaborative governance exceed those that are only loosely about it. Second, despite the general dominance of articles loosely about collaborative governance, there have been more articles published that are strictly about collaborative governance in the last several years (2017-2018, as well as the first five months of 2019, which is not plotted). It is not possible with such few data points to argue that this is a sustainable tendency, but at least this finding hints at the fact that scholars who study collaboration, governance and networks may be increasingly more likely to explicitly embrace the collaborative governance terminology as they do so. We believe this bodes well for this field of study, as a profusion of new scholarship will undoubtedly result in both theoretical and methodological advancements in the study of collaborative governance from a network perspective.

In addition to investigating the rate at which articles on collaborative governance and networks have been published in peer-reviewed journals we are also interested (see our first goal) in assessing the degree to which authors use the network concept in a metaphorical way or whether an actual network is empirically examined.. We coded articles based on whether they measure a network (i.e. they observe nodes and their interactions) or not (i.e. authors simply refer to the role of networks as conduits for collaboration, but don't engage in data collection to formally analyze the network). Out of the 339 articles we examined, only 73 measure a network explicitly, and not all of them were strictly about collaborative governance, as shown in figure 4.

**[Figure 4 here]**

Overall, of the articles that explicitly measure networks (i.e. using the term in a non-metaphorical way), we identified 44 as being strictly about collaborative governance and 29 as being loosely about collaborative governance. Seventy eight percent of all the articles we analyzed (266 out of 339) use the term network metaphorically, without measuring networks explicitly. It is important to stress that we do not believe that this is, by itself, a problem. In fact, many of the theoretical advances in our understanding of collaborative governance processes and the roles of networks have been produced by research that engages in careful thought about the importance of networks without ever explicitly measuring them. Nevertheless, we believe that moving forward, collaborative governance studies need to collectively engage in a more comprehensive effort to produce a solid *corpus* of empirical evidence of the relationship between network characteristics and collaborative behavior, with the goal of properly testing (and extending) the theoretical work that has already been produced in the last two decades.

The next step in our analysis was to code the 73 articles that treated networks in a ‘non-metaphorical’ way to answer the three research questions we included in the introduction of this paper.<sup>5</sup> First, we determined whether the network boundaries and the nodes of the network were clearly defined, and whether the authors discussed missing data and tried to remediate the problems associated with it (e.g. by performing missing data imputation, running simulations to check for robustness of results, etc.). With respect to the definition of network boundaries, we gauged whether the article clearly explained and justified the criteria for membership in the network studied. With respect to the definition of nodes, we assessed whether the article clearly defined the type of entity that counted as a node in the network. Articles that correctly identified

nodes contained statements such as ‘the nodes in the network are organizations/individuals who are active in the topic of...’ or ‘members of these network are the individuals who are interested in...’

Next, to address our second research question, we evaluated whether the articles a) clearly defined the ties in the network, b) accounted for tie strength if appropriate, and c) analyzed multiplex relationships. With respect to tie definition, we coded whether the article defined relationships among actors (for example, the transference of information, money, expertise, etc.). With respect to tie strength, we coded articles to gauge whether the ties analyzed were dichotomous (i.e., present/absent) or valued (i.e., of varying intensity) in nature. Among those articles that examined networks with valued ties, we then observed whether the authors took the strength of tie into account for the analysis or elected to dichotomize ties in order to simplify the analyses. Regarding multiplexity, we coded whether the article explicitly examined more than one type of relationship or not.

Finally, to assess whether an article examined the evolution of the network, we simply coded whether the authors observed and analyzed the network at more than one point in time.

### **Defining network boundaries, nodes, and dealing with missing data**

Figure 5 presents results describing whether articles clearly define the boundaries of the networks they study, and the nodes within the networks.

**[Figure 5 about here]**

First, we notice that most studies (>70% in both articles that are loosely and strictly about collaborative governance) indeed define the boundaries of the network by clearly

describing the criteria for membership. These articles include Bodin & Nohrstedt (2016), who study the network of individuals engaged in the disaster response organization during the acute phase of a Swedish wildfire, Fischer et al.'s (2012) analysis of networks of actors in Swiss telecommunication policy, and (Faul, 2016), who identifies the actors that participate in a network of global education policy. Whether values exceeding 70% are high or low is, to a large extent, a matter of opinion. The optimistic reader would claim that these are high scores, since more than seven out of ten articles on collaborative governance that deal with networks in a non-metaphorical way are successfully dealing with the challenge of properly defining the boundaries of the network. On the other hand, the pessimist would probably think that these are low scores, since properly defining the boundaries of the network is critical to lend internal and external validity to studies that engage in formal network analytic techniques (Wasserman and Faust 1994).

Regarding the definition of nodes, a very large majority of the articles carefully define the nodes that are part of the network under analysis. Most studies defined nodes as organizations (Kapucu & Garayev, 2013; T. Scott, 2016; Villaseñor, Bolland, & Fernández, 2018), although others defined them as individuals operating as members of organizations (e.g. author 2013; Song, Temby, Kim, Cisneros, & Hickey (2019), or individuals without organizational affiliation (e.g. Matti & Sandström, 2011; Person et al., 2017). Of the subset of 44 articles that are strictly about collaborative governance, only two did not provide enough information for us to understand what exactly qualified as a node in the examined networks.

Figure 6 contains our findings about how articles deal with missing data.

**[Figure 6 about here]**



Within the broader group of articles we reviewed, 15 did not have missing data problems, or they were negligible to the point of not posing significant threats to the internal or external validity of the studies. Thus, for the two variables reported in Figure 6 we analyzed the 58 articles that have a larger, and potentially more threatening, percentage of missing data. We found that in about 59% of the articles the authors either mentioned that there is missing data in their studies or explicitly acknowledged that missing data could pose problems in their research design and potentially affect their findings. Interestingly, the difference between articles that acknowledge these issues and those that do not is more pronounced among authors of papers that are strictly about collaborative governance. Thus, it should come as no surprise that the percentage of studies that implement fixes to missing data problems is also greater among studies that are strictly about collaborative governance. While about 40% of articles that are strictly about collaborative governance implement measures to address missing data problems (e.g., by limiting analysis to the network of actors that responded to a survey; Bodin, Sandström, & Crona, 2017), only about 16% of articles that are loosely about collaborative governance do so.

### **Defining ties and accounting for tie strength and multiplexity**

Figure 7 presents our findings on whether researchers properly define the ties that connect the nodes in the networks, account for tie strength, and study multiplex relationships that are often present in collaborative networks.

**[Figure 7 about here]**

As it was the case with the definition of nodes, panel A in the figure shows that a large percentage of articles (~93%) did a good job at precisely describing ties (i.e. they provided enough information about what ‘flows’ through the ties in the network). Five articles did not include enough information, and all of them were strictly about collaborative governance. Ties included information exchange and provision (Horning, Bauer, & Cohen, 2016; Provan, Beagles, & Leischow, 2011), dyadic collaboration (Bergsten et al., 2019; Fischer et al., 2012), and project support (Gallemore & Jespersen, 2016), to name a few.

While almost all studies do a good job at defining the ties, a minority of the articles we reviewed (approximately 30%) properly accounted for tie strength, as seen in panel B of the figure. Most studies, in fact, performed analyses that depended on dichotomizing ties, turning naturally valued ties into binary ones. For example, inter-firm collaboration (Della Corte & Aria, 2014), collaboration between municipalities (Kininmonth, Bergsten, & Bodin, 2015) or collaboration between organizations (Fischer et al., 2012), which, per definition, can be of various intensity, were measured and analyzed as dichotomous ties. This approach was all the more prevalent in studies that are strictly about collaborative governance, a finding we will discuss in more detail later. Dichotomizing ties in social network analysis (e.g. applying a threshold to a continuous variable to transform it into values of 0 and 1 is a common strategy in part because more readily accessible analytical tools have been developed to analyze non-valued, or binary, matrices.

Finally, panel C in Figure 7 shows that almost half of the articles that measured networks analyzed multiplex relationships that took place among the members of the network. Collecting data on multiplex relationships is generally more difficult to do, especially in studies that use surveys or interviews, which can tax the attention of respondents when they are asked to provide

detailed information about different types of social interactions. Yet the careful examination of multiplex relationships can be critical in assessing the potential for collaborative governance; after all, collaborative relationships can be cemented on informal interactions to exchange valuable resources (Lee, Lee, & Feiock, 2012; Weare, Lichterman, & Esparza, 2014) but also formal exchanges that take place in multiple forums where conflict can be managed (author, 2016; Fischer & Leifeld, 2015). Among the studies included in this review, researchers examined multiplex relationships in a variety of ways, including the observation of formal and informal partnership ties (Faul, 2016), relationships of competition and cooperation (Lee et al., 2012; Weible, 2011), different intensities of information exchange or collaboration (e.g., Meek, 2013), binary measures of information exchange, coordination, and collaboration (Calliari, Michetti, Farnia, & Ramieri, 2019), multiple forms of trust (Song et al. 2019), collaboration revealed by nominations in a survey, hyperlinks and Twitter mentions (Hayes & Scott, 2018), and the co-occurrence of venue co-participation and water exchange among water agencies (Hughes & Pincetl, 2014).

### **Evolution of networks**

Figure 8 shows that there is a small number of studies that examine the evolution of collaborative governance processes by analyzing dynamic changes in networks (~ 15% of the 73 articles that measured networks).

**[Figure 8 about here]**

The study of collaborative governance processes is enriched when researchers can understand how collaboration evolves over time. For example, (Kanwar, Koliba, Greenhalgh, & Bowden, 2016) analyzed how the governance network around the Kaipara harbor in New

Zealand became larger and more integrated because of ecological challenges, cultural integration efforts, and the change of legislation. Fischer et al. (2012) assessed the evolution of collaboration ties in Swiss telecommunication policy across two phases of decision-making. Author (2013) studied perceptions of procedural fairness and the establishment of relationships among organizations in policy networks in five U.S. estuaries. Finally, Hughes & Pincetl, (2014) studied networks of actor co-participation in venues before and after the introduction of Integrated Water Resource Management plans in California.

### **A Multiple Correspondence Analysis of articles measuring networks**

To explore whether studies tend to cluster based on the types of network challenges they tackle, we perform a multiple correspondence analysis (MCA), which is a version of factor analysis designed for categorical variables (Greenacre & Blasius, 2006; Le Roux & Rouanet, 2010). MCA allows us to detect patterns of differences and similarities between articles in a statistically inductive manner, identifying variables that best describe the dimensions defining the similarities between the articles (see Lieberherr, Fischer, & Tschannen, 2019; Trein, Meyer, & Maggetti, 2019 for recent applications of this method to literature review articles). MCA relies on a symmetric matrix of all two-way cross tabulations between the categorical variables included in the analysis. From this matrix MCA then identifies variable categories that cluster together into a dimension (Trein, Meyer & Maggetti 2019). We use the FactoMiner and factorextra packages in R to perform the analysis.<sup>6</sup>

The first two dimensions of the MCA cover almost 40% of the overall variance (24.5% and 14.7%, respectively<sup>7</sup>). Figure 9 shows the seven variables included in the MCA and how they align with the two dimensions (see Figures in the Appendix for the contributions of the

single variables categories to each dimension). We did not include the variable capturing whether articles properly defined nodes because 71 out of the 73 cases did a good job in defining nodes. We also report results for all articles, not disaggregated by whether they are strictly or loosely about collaborative governance.<sup>8</sup>

**[Figure 9 about here]**

The first dimension (horizontal axis) identified by the MCA is strongly related to whether the article correctly defines network boundaries, identifies and addresses missing data problems, and analyzes multiplex relationships. The first three of those variables (definition of boundaries and identification and fixing of missing data problems) hint that this dimension is defined by what we could call a concern with methodological “quality” about collaborative governance and networks. Furthermore, on the top right corner of the figure, the variable “ties defined” also appears to contribute to this first dimension (although this variable also contributes strongly to the second dimension). Properly defining ties, properly defining and discussing network boundaries, and discussing and addressing missing data issues are issues that every collaborative governance paper on networks should deal with. The second dimension identified by the MCA is structured by variables that seem to indicate a “trade-off” between different aspects of networks. The two variables most strongly associated with this dimension are those that define whether the article includes a longitudinal analysis, and whether tie strength was accounted for, and how. Both are not issues directly related to the quality of the article, in the sense that a network might be rightly defined by simple dichotomous ties and a static analysis. This dimension indicates a trade-off in the sense that longitudinal analyses might require a dichotomization of ties, and an analysis of longitudinal networks might complicate the correct analysis of weighted ties (variable categories “longitudinal analysis\_1” (yes) and “tie

strength analysis\_3” (dichotomization of valued ties) do indeed lie at opposing ends of this dimension (see Appendix, Figure A2).

## **Discussion**

Most of the studies we reviewed that treated networks in a non-metaphorical way properly defined network boundaries, and clearly identified nodes and ties that connect them. We see this as a very positive result considering that, for example, not defining the boundaries of networks may have the most negative impact on the internal and external validity of results. Yet our results show that despite the fact that a majority of studies do a good job at defining boundaries, nodes, and ties, there is still room for improvement.

Perhaps the simplest, most cost-effective way for researchers to achieve more precision in these tasks is to seek support from non-academic sources that can provide complementary information to the sources the researcher has already identified. For instance, it may be the case that a researcher using a ‘realist’ approach to network boundary identification (Laumann et al. (1989) may fail to identify the proper contours of the network if the network is fragmented, with multiple components that are disconnected from each other. In such cases, for example, a snowball technique used in a survey to identify actors who are members of the network but were not identified at the outset of the study may result in missing actors who are indeed part of the network, but are not located in the components populated by the initial respondents to the survey. In these types of situations, a researcher may benefit immensely from putting together a study advisory committee formed by a handful of individuals who are highly knowledgeable about the study area, the problem of interest for the researcher, and the group of actors and/or stakeholders that may be active in addressing the problem. Such a group of knowledgeable

people can help the researcher be more exhaustive in identifying nodes that may have otherwise been overlooked. Regardless of what approach a researcher uses to better approximate the boundaries of the network, we believe that resources spent at the beginning of the research process to address this issue is likely to be cost effective simply because the failure to account for all relevant network members affects all subsequent stages of the research process may ultimately diminish the validity of results.

Our results also show other areas in which collaborative governance research dealing with networks can improve considerably. For instance, missing data is a common problem that is not often faced head-on. Sure enough, acknowledging missing data problems is by itself valuable, but researchers should, when possible, take a more militant approach to reduce the effect of missing data on the validity of findings. This is by no means easy to do. Given that most studies on collaborative governance rely on survey data, the underlying problem that a certain (and probably not random) percentage of survey participants simply decide not to participate is hard to fix. There are, however, different types of strategies to deal with this issue, some of which were in fact used in studies included in our review. These include the re-consideration of network boundaries (Bodin et al., 2017; Kronenberg, Pietrzyk-Kaszyńska, Zbieg, & Żak, 2016), the transformation of directed network data to undirected network data (Balsiger & Ingold, 2016), or the application of extrapolation methods to infer patterns of missing data (Claro, Hagelaar, Kemp, & Omta, 2003).

In addition to these approaches, others have recently explored the interchangeability of non-intrusive methods to reduce missing data problems. Specifically, Yi & Scholz (2016) collect data on network interactions based on media reports, hyperlinks available on individual policy actors' websites, and on public policy partnership documentation, and find that all three

methods produce similar results in terms of descriptive network level statistics and dominant local structures in exponential random graph models. Thus they conclude that these different strapped for resources that can be quickly depleted in survey-based research.

It is also important to keep in mind that in the last few years there have been rapid methodological developments in the areas of text analysis that hold promise to circumvent the problems of missing data that are pervasive in survey-based research. For instance, recent scholarship has leveraged the benefits of mining textual sources to gather information about level of agreement and interactions among stakeholders in collaborative partnerships (author et al. 2014; (Tyler A. Scott, Ulibarri, & Scott, 2018) as well as the effect that collective action problems have on the design of formal institutional arrangements that force actors into formal relationships of collaboration with each other (Olivier, 2019). Collaborative governance scholarship will benefit from aggressively pursuing these new approaches to data collection, particularly given the trove of invaluable data that is available online to examine collaborative processes.

Our results also show that a large percentage of studies using networks in a non-metaphorical way simplify their modeling strategies by dichotomizing ties that are valued in nature. There are potential problems with this type of choice, since dichotomizing ties might distort the latent structure of the network (Aicher, Jacobs, & Clauset, 2014; Thomas & Blitzstein, 2011), which in turn will likely lead to biased results. Historically, these choices made sense as methodological tools to describe and model behavior in valued networks were not readily available for a majority of scholars. Fortunately, new methodological advances in the last few years allow researchers to examine valued ties without resorting to the practice of dichotomization. These advances include the design of statistical models for valued networks



(Krivitsky, 2012) that can be used to explore collaborative behavior in organizational networks (Scott, 2016) and new approaches to network partitioning for valued data that overcome some of the limitations of older techniques (Nordlund, 2016). Of course, dichotomization can be a defensible research strategy under certain conditions, as when different positive values indicating tie strength are heavily skewed to the right. But at the very least, the dichotomization of ties should be accompanied by a sound theoretical justification for the choice of dichotomization thresholds and (when possible) robustness tests with other potentially meaningful thresholds.

Regarding the study of multiplex ties, which we argued should be a distinctive feature of collaborative governance studies, we found that approximately 50% of the articles indeed explored the multiplex nature of connections in networks. We see this as a positive development, as it demonstrates that collaborative governance studies are increasingly adding empirical evidence to the long-held claim that collaborative network relationships are multidimensional in nature (Allen, James, & Gamlen, 2007; Håkansson & Johanson, 1988; Shrestha et al., 2014). As was the case for the missing data problem, new methodologies have been developed that can facilitate the measurement of multiplex networks. For example, Hayes & Scott (2018) study a policy network composed by 221 organizational nodes, and collect information on ties using multiple approaches (surveys, Twitter interactions, and hyperlinks). They find that, while correlated, the objective measures (online-based behavior) produce a different pattern of interactions than the subjective, memory-based survey approach. Their approach can be easily (and, as importantly, cheaply) imitated to produce more nuanced explanations of how different types of ties may affect the collaborative practices of actors.

Finally, we found a minority of studies in collaborative governance that assess how networks evolved over time. Contrary to cross-sectional studies, longitudinal network studies can analyze not only the evolution of network structures, but also their coevolution with collaborative practices (author 2010). If it is true that system context matters in the study of collaborative processes, and that multiple variables help explain how a collaborative governance regime unfolds (Emerson et al. 2012), then a more significant portion of collaborative governance scholarship will need to devote considerable resources in the future to measuring and analyzing the evolution of networks.

Clearly, there are justifiable reasons why researchers rarely study networks over time. Chief among them is the time and resource-intensive task of gathering multiple waves of data. Fortunately, there are ways of addressing this challenge. One simple approach that survey-based studies can adopt, for instance, is to ask actors about their current as well as their past relations (Ingold & Fischer, 2014). While convenient, this approach suffers from the obvious shortcoming of depending on the memory of respondents to identify past ties, which may be affected by their current set of interactions (i.e. a collaborative tie in the present may bias respondents to name a collaborative tie in the past when none existed). But some of the approaches we highlighted above when discussing missing data and the multiplexity of networks can be tailored to the longitudinal study of networks. For example, the media reports used by Yi & Scholz (2016), and the online exchanges examined by Hayes & Scott (2018) could be mined to easily reconstruct different snapshots of collaborative networks. In any event, the advent of new techniques to uncover networks from textual sources may aid researchers in further studying collaborative governance as the dynamic process that it is.

## Conclusion

The fundamental aim of this paper is to encourage researchers to think carefully about how to improve research design in studies that invoke the importance of networks for a better understanding of collaborative governance. Actual research on collaborative governance often – implicitly or explicitly – deals with networks of actors that operate dynamically across sectoral, hierarchical, and geographic boundaries.

A first goal of our review was to evaluate the extent to which collaborative governance research used networks as metaphors for the existence of some set of more or less structured interactions involving multiple actors, or whether network relations are formally measured and analyzed in one way or another (Dowding, 1995). The majority of the literature we reviewed that explicitly points to the importance of networks as vehicles to facilitate or accelerate collaborative governance processes tends to treat networks in a metaphorical way. The metaphorical use of the network concept has spurred the development of new theoretical ideas in this vein of literature and will continue to do so. But applying formal network analytical techniques and precisely observing and analyzing structural features of networks also provides unique advantages. For instance, formal network analysis can help create a body of literature that facilitates comparison across different collaborative governance processes, in different countries, and over time. Furthermore, this approach facilitates the application of theoretical ideas from other domains of network studies to the analysis of collaborative governance systems.

The second goal was to assess how collaborative governance scholars who examine networks in a formal way address some of the basic conceptual and methodological challenges that arise in network-based research. Most studies in this group properly defined network

boundaries, and clearly identified nodes and the ties that connect them. However, we also found considerable potential for scholarship on networks to better address missing data, properly account for tie strength in relationships, evaluate multiplexity of network ties, and study the evolution of networks over time. These findings somewhat parallel results from Lecy et al.'s (2014) review of network research in public administration scholarship that identifies a need for greater conceptual clarity and broader usage of methods capable of capturing specific network activities.

Researchers obviously need to simplify some aspects of their research designs, particularly when collecting data on complex social interactions becomes an expensive, time-intensive task. Within a given research project, it will thus always be a major challenge to address the different considerations we have discussed. The second dimensions of our MCA illustrates such a trade-off between longitudinal analysis and the correct specification of tie strength. However, in order for network research to realize its potential and make a strong contribution to the study of collaborative governance, it is important that researchers carefully consider the implications of simplifications, especially those that relate to the bounding of networks and the measurement of interactions. We hope that our propositions on how to address and overcome the different challenges will spur innovative ideas on how to perform research on networks in collaborative governance.

We would like to close by noting optimistically that very rigorous work in collaborative governance and networks does, in fact, exist. A non-trivial number of the articles we reviewed were extremely nuanced from both a theoretical and methodological standpoint. For each of the challenges, we highlight potential solutions that have already been implemented in recently published work. More than a good share of this work was clear in describing simplifying

assumptions and the inner work of some of the sophisticated social network analysis techniques used in the analyses. If future research continues on the path that some of this recent scholarship has embarked on, the study of collaborative governance through a network perspective will continue to strengthen, attracting a new crop of social scientists striving to answer theoretically interesting questions through the use of sound methodological practices.

Collaborative governance: Integrating management, politics, and law.

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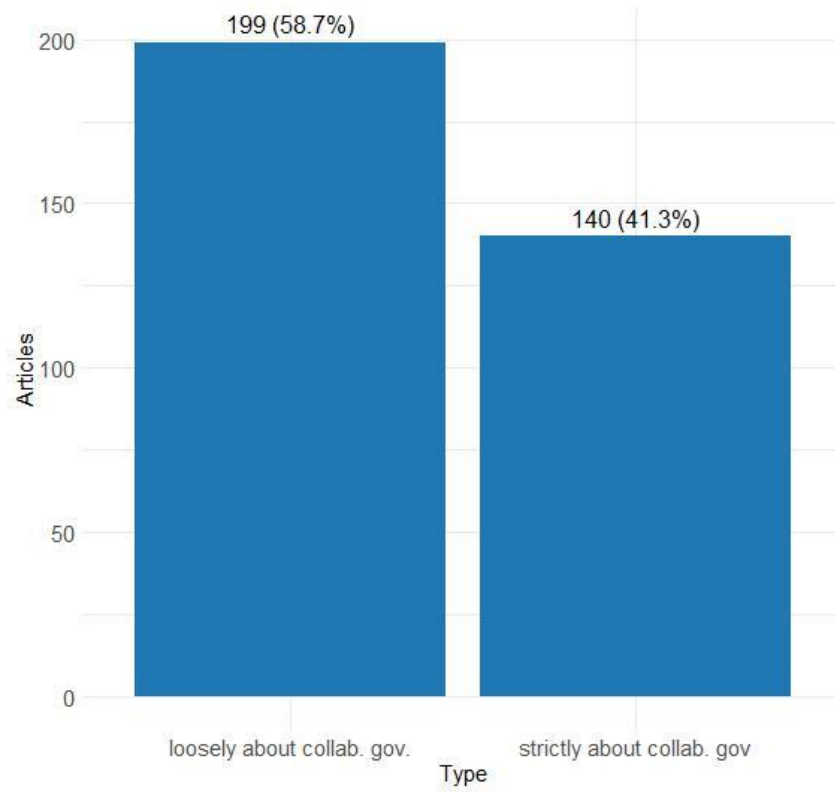
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## Footnotes

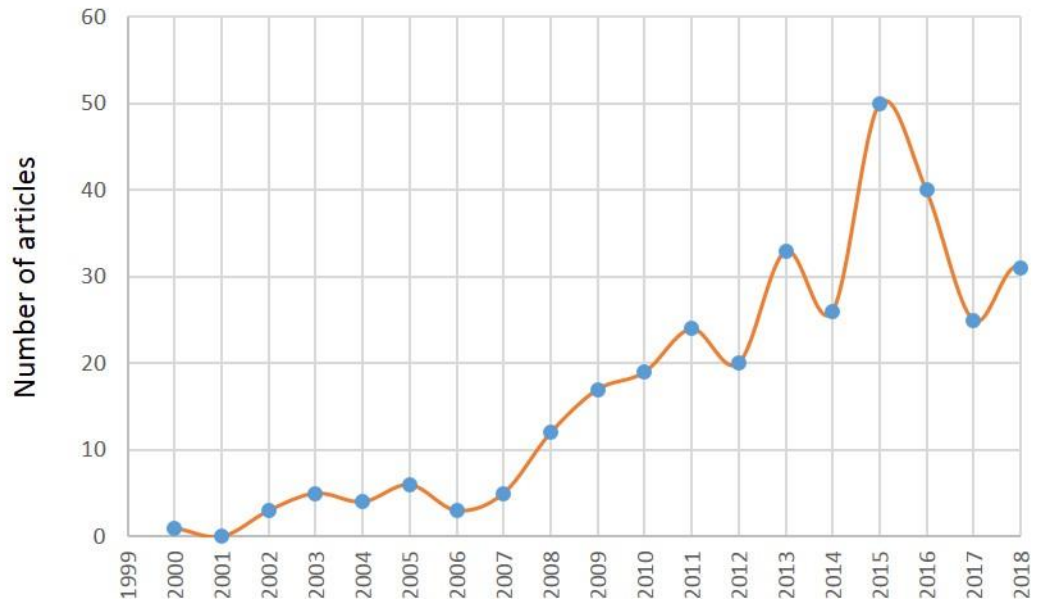
1. The specific syntax we used in Scopus is '( TITLE-ABS-KEY ( collaborative AND governance ) OR TITLE-ABS-KEY ( collaboration AND governance ) AND TITLE-ABS-KEY ( networks ) OR TITLE-ABS-KEY ( network ) ) AND DOCTYPE ( ar ) AND PUBYEAR > 1999 AND PUBYEAR < 2017 AND ( LIMIT-TO ( SUBJAREA , 'SOCI ' ) OR LIMIT-TO ( SUBJAREA , 'ARTS ' ) ) ).
2. An example should help us clarify this distinction. Gallemore and Jespersen (2016) is an article that we have catalogued as being 'loosely' about collaborative governance. The article is about matching markets involving donors and sustainable development projects in multiple countries, which the authors see as being typically present in transnational polycentric governance initiatives. Even though the authors do not explicitly use the 'collaborative governance' moniker, they are interested in the study of collaborative behavior among multiple actors in complex governance systems and ask how transnational brokers or familiar partners in projects lead donors to pick some projects and not others. Their findings do indeed inform our knowledge about the role of networks in the creation of collaborative behavior that takes place through the projects, and thus we consider this an article that is 'loosely' about collaborative governance and include it in our analysis.
3. We followed a simple procedure to code the articles. First, each of the authors separately coded the first forty articles. Next, we met to discuss inconsistencies in the coding and agree on refinement of coding rules, when necessary. In a third step, each author coded a subset of the remaining articles.

4. We are not including 2019 in the graph simply because we conducted our search including only the five first months of the year.
5. While the large majority of the 73 articles that examined networks in a non-metaphorical way explicitly measured and analyzed activity for a whole network (or in some cases, multiple networks), approximately 15% of the articles analyzed network processes, such as tendencies for collaboration or the distribution of power among network participants, but made no effort collect or analyze data on entire networks. Because papers that model network processes but not whole networks can just as well yield insight into how network properties shape collaborative governance, we included these papers in our analysis.
6. MCA needs a fully specified dataset, we therefore imputed missing data with the missMDA package in R. However, the procedure does not affect the dimensions of the MCA, results are based on the non-imputed data only.
7. Subsequent dimensions cover 13.8%, 13.3%, 11.2%, respectively.
8. We did run separate analyses across the two subsets of articles, and results are similar to what we report here. The two dimensions identified in the MCA are even clearer for the articles that are strictly about collaborative governance.

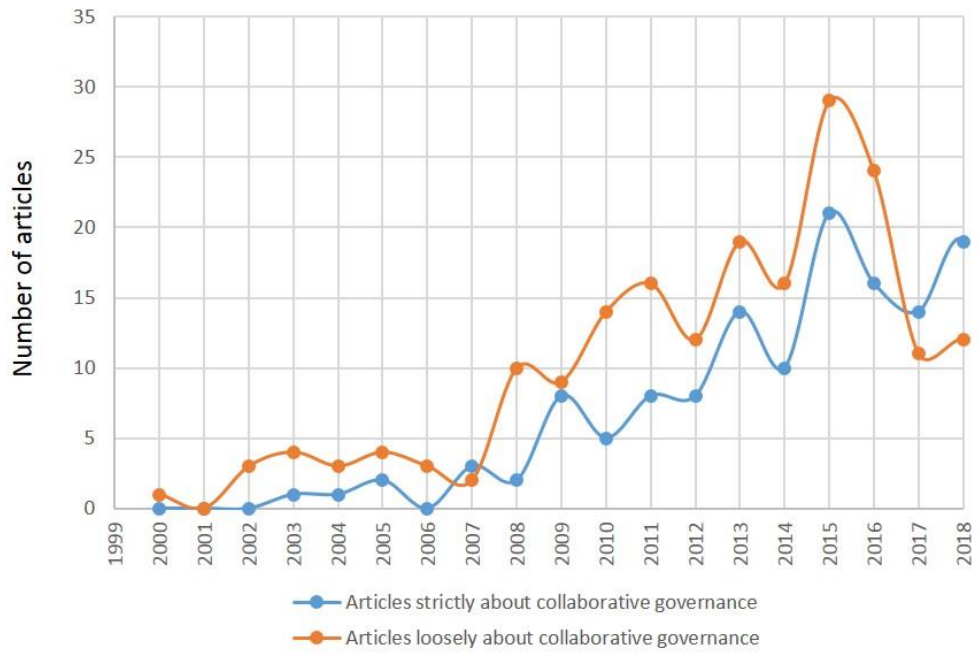




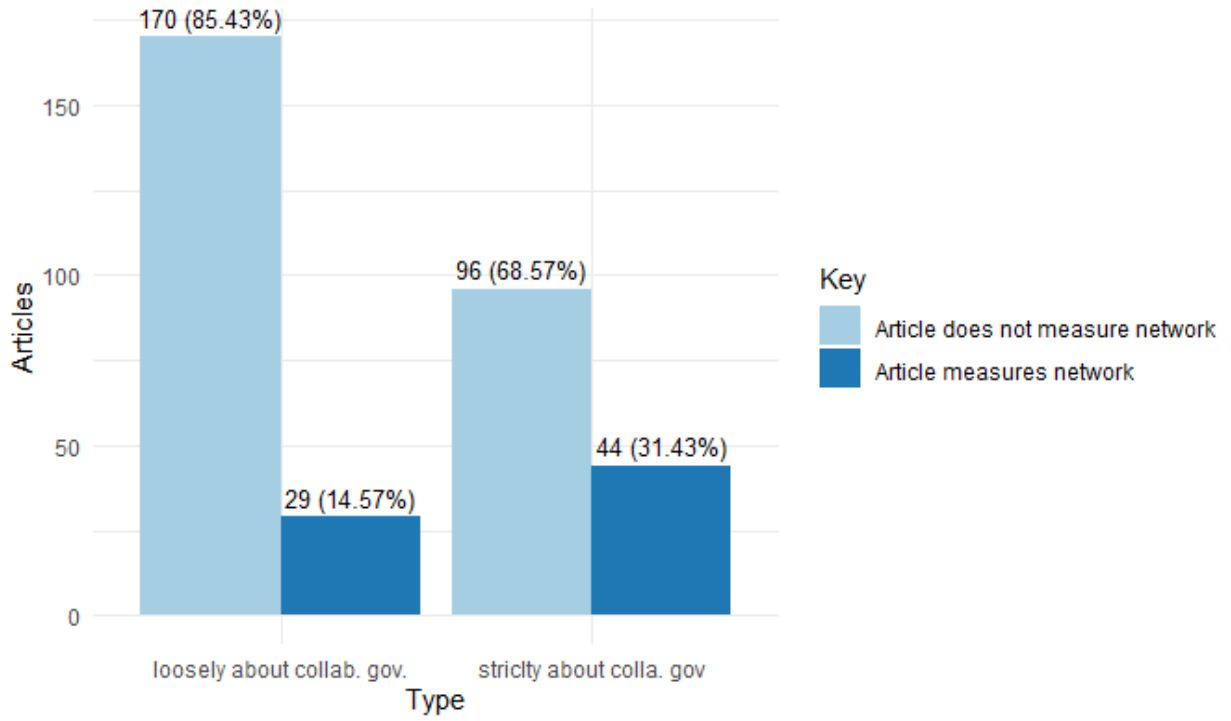
**Figure 1. Types of Articles Analyzed**



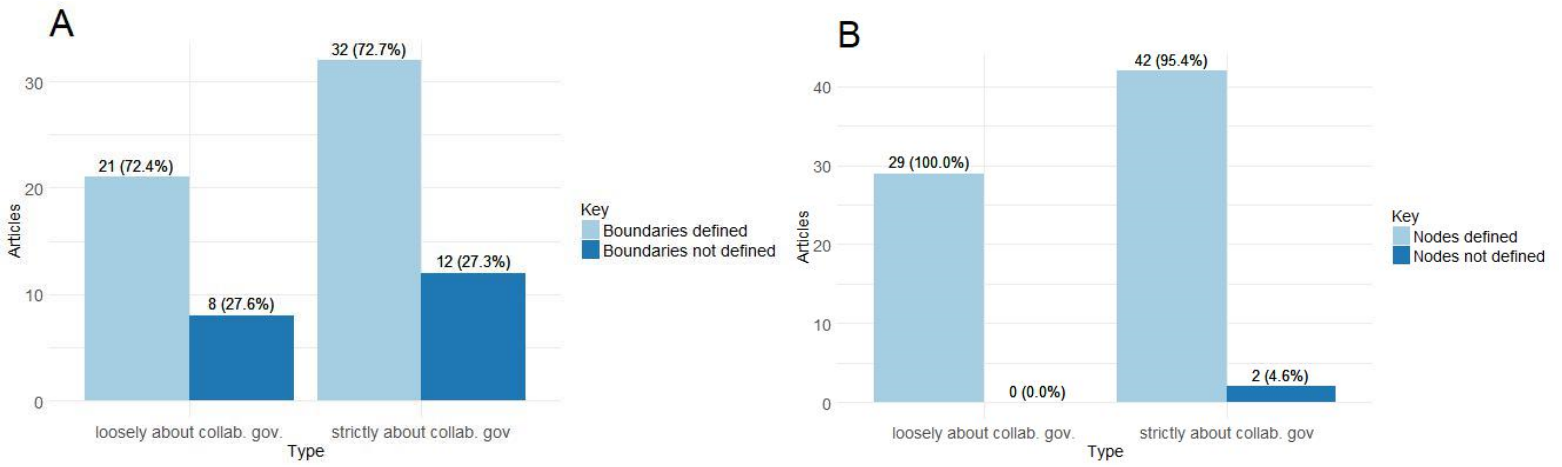
**Figure 2. Number of articles published yearly since 2000**



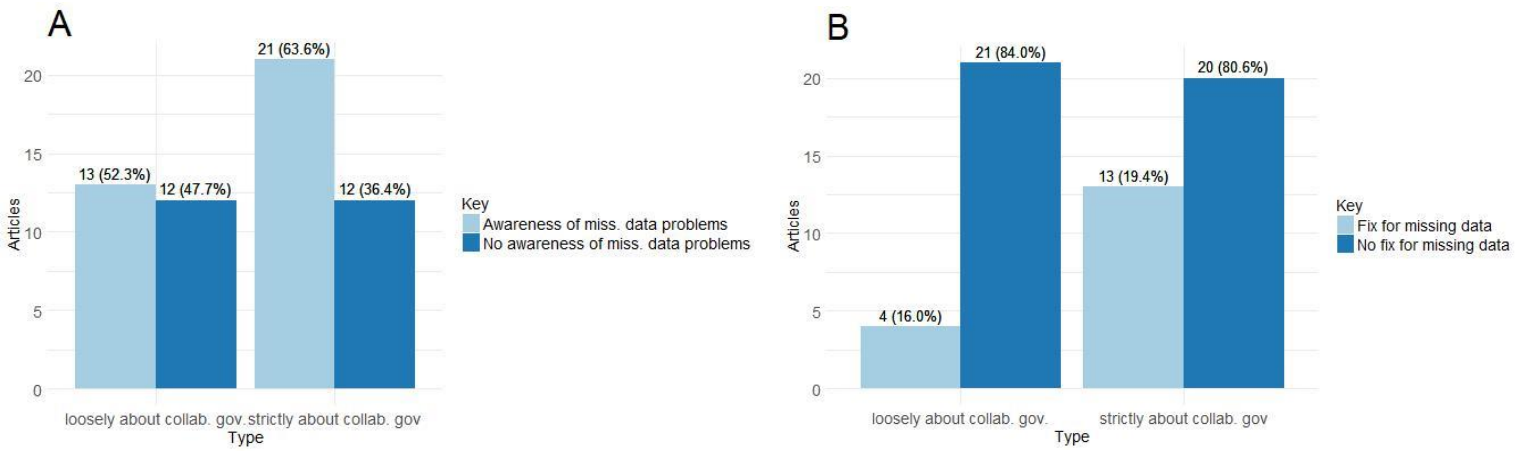
**Figure 3. Number of articles published yearly since 2000 (disaggregated by type of article)**



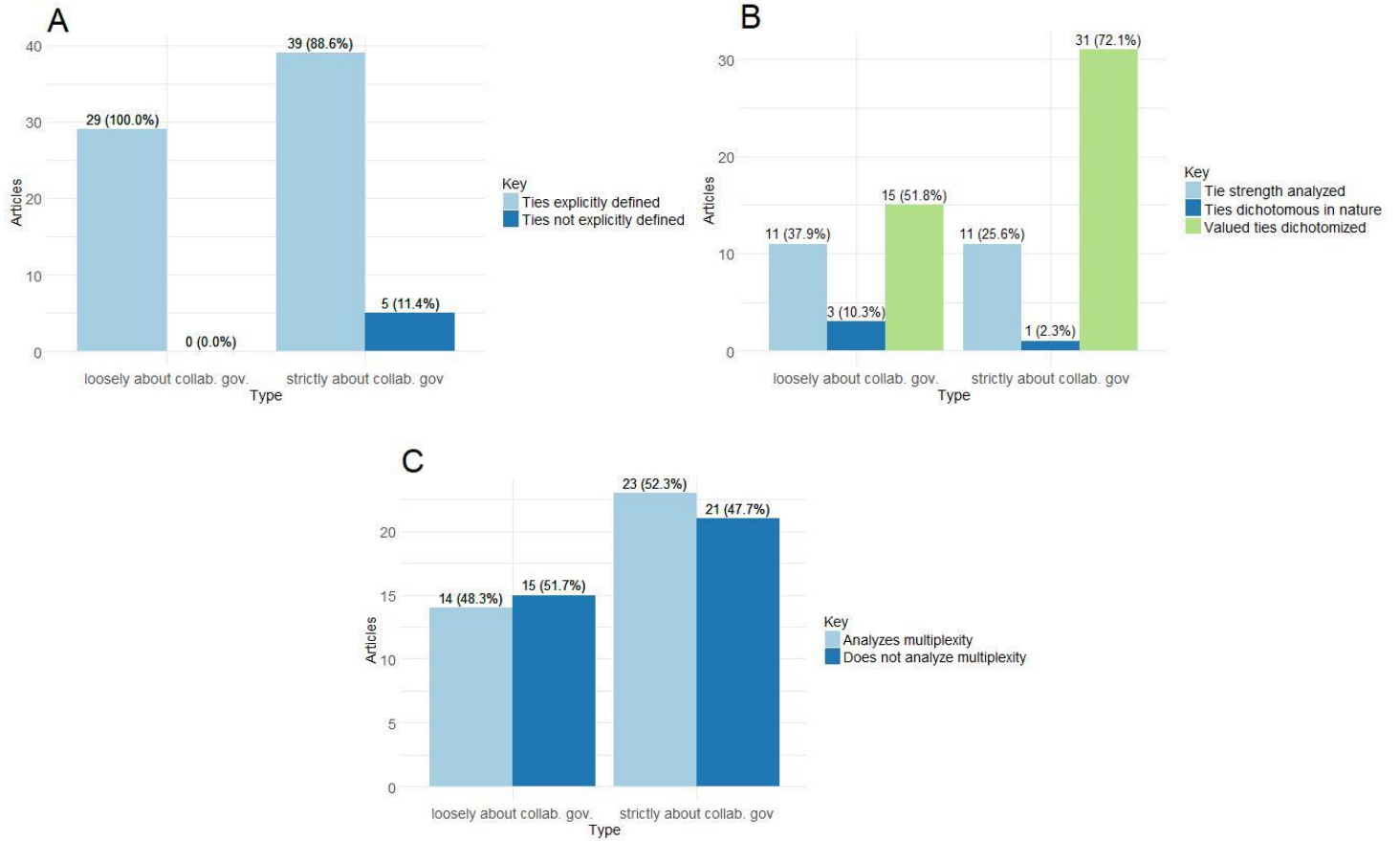
**Figure 4. Distribution of articles based on whether they measure networks or not (disaggregated by type of article)**



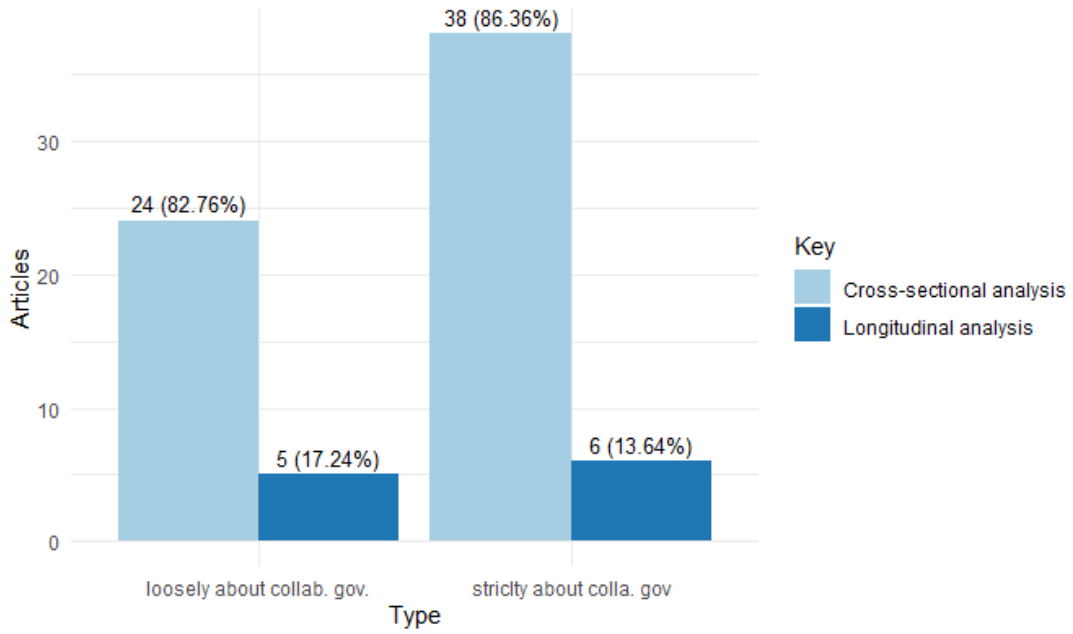
**Figure 5. Distribution of articles based on whether they define network boundaries and nodes or not (disaggregated by type of article)**



**Figure 6. Distribution of articles based on whether they identify missing data problems and implement fixes (disaggregated by type of article)**

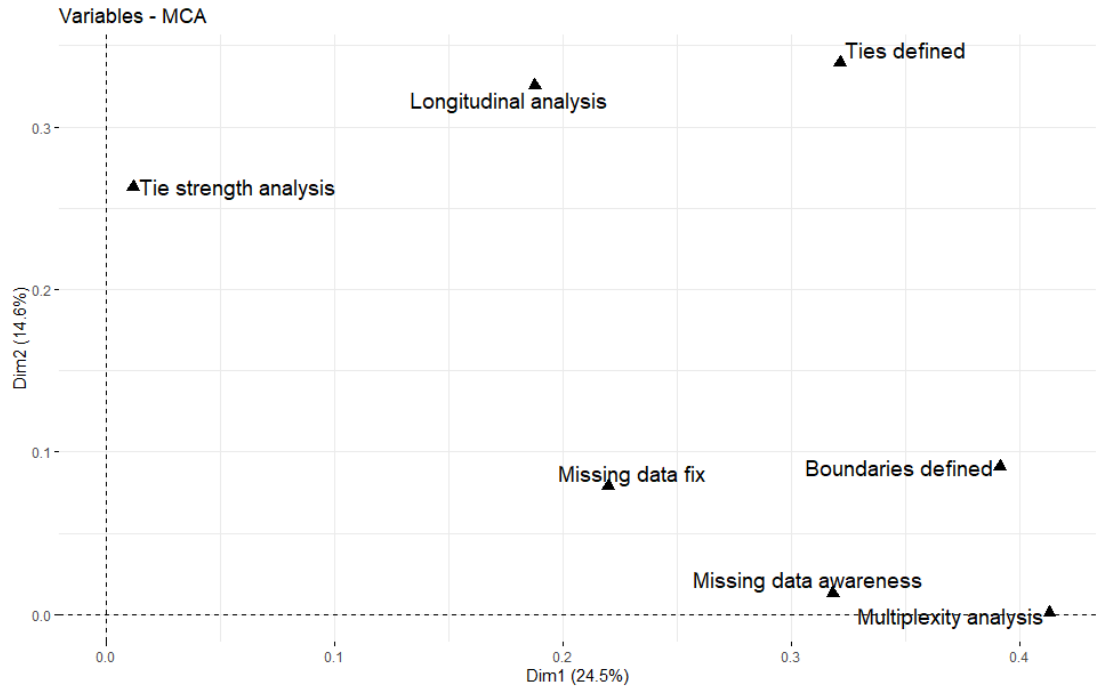


**Figure 7. Distribution of articles based on whether they define ties, account for tie strength, and analyze multiplex relationships (disaggregated by type of article)**



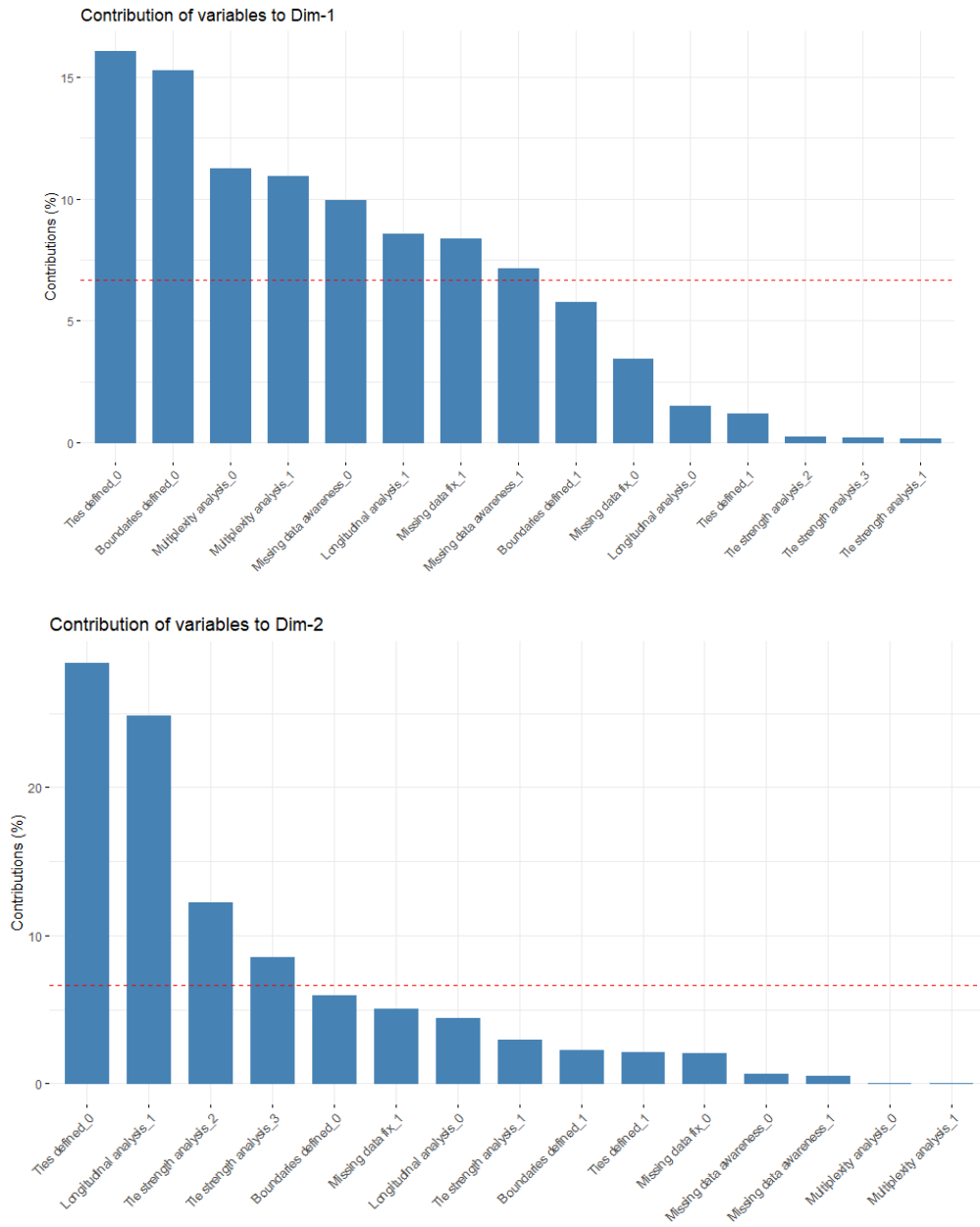
**Figure 8. Distribution of articles based on whether they analyzed networks longitudinally or not (disaggregated by type of article)**



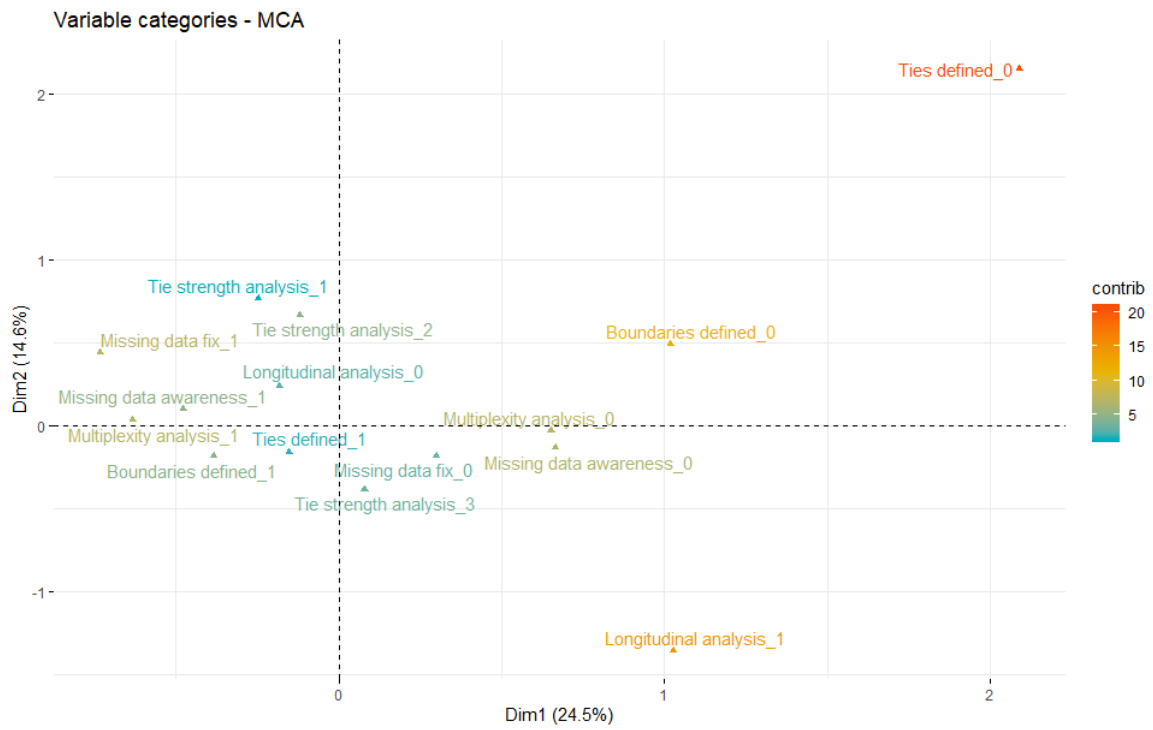


**Figure 9. Contribution of individual variables to the main two dimensions of the Multiple Component Analysis (MCA) performed in articles that measure networks**

## Appendix



**Figure A.1. Contributions of individual variable categories to dimensions 1 and 2**



**Figure A.2. Distribution of variable categories in the two-dimensional space**

## **Authors' Biographies**

Ramiro Berardo is Associate Professor of Environmental and Natural Resources Policy at the School of Environment and Natural Resources at The Ohio State University. He holds a Ph.D. in Political Science. His research focuses on examining collaborative processes in polycentric governance systems

Manuel Fischer is a research group leader in Policy Analysis and Environmental Governance at the Swiss Federal Institute of Aquatic Science and Technology. He holds a Ph.D. in Political Science. His research examines governance arrangements, decision-making processes and political networks, with a focus on environmental issues.

Matthew Hamilton is an Assistant Professor at the School of Environment and Natural Resources at The Ohio State University. He holds a Ph.D. in Ecology. His research aims at improving understanding of human-environment interactions in complex institutional settings, in which networked interactions influence the performance of environmental institutions.