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## Pluralized leadership in complex organizations: Exploring the cross network effects between formal and informal leadership relations

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## ABSTRACT

Understanding the connection between leadership and informal social network structures is important in advancing understanding of the enactment of pluralized leadership. In this article we explore how the enactment of pluralized leadership is shaped by leadership influence and informal (advice and support) networks and the interactions between the two. Building on recent developments in Exponential Random Graph Modeling, we empirically model the cross network effects across three leadership networks and explore different forms of cross network effects and under what conditions they occur. Our findings suggest that patterns of pluralized leadership have important endogenous qualities, as shaped through actors' leadership and informal networks, and are important for understanding the required capability for facing increasingly complex organizational situations.

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Rather than the individualized heroic view of leadership, we consider leadership as an emergent network of relations, which is a shared and distributed phenomenon, encompassing several leaders who may be both formally appointed and emerge more informally (Balkundi & Kilduff, 2006; Carson, Tesluk, & Marrone, 2007; Mehra, Smith, Dixon, & Robertson, 2006). Scholars' attempts to theorize the notion that leadership extends beyond the individual have spawned a range of different concepts such as: distributed leadership (Currie, Lockett, & White, 2011; Fitzgerald, Ferlie, McGivern, & Buchanan, 2013; Gronn, 2002; Mehra et al., 2006), collective leadership (Carter & DeChurch, 2012; Contractor, DeChurch, Carson, Carter, & Keegan, 2012; Cullen, Palus, Chrobot-Mason, & Appaneal, 2012; Denis, Lamothe, & Langley, 2001; Friedrich, Vessey, Schuelke, Ruark, & Mumford, 2009; Mumford, Friedrich, Vessey, & Ruark, 2012; Yammarino, Salas, Serban, Shirreffs, & Shuffler, 2012), shared leadership (Carson et al., 2007; Ensley, Hmieleski, & Pearce, 2006), and relational leadership (Uhl-Bien, 2006). In the face of a good deal of inconsistency surrounding conceptual and definitional issues, a number of these scholars have provided prescriptions for a better understanding of these labels (see: Denis, Langley, & Sergi, 2012; Yammarino et al., 2012). In particular, Denis et al. (2012) present the idea of pluralized leadership, within which these other concepts of leadership, extending beyond the individual, are encompassed. In doing so, they present an opportunity to better our understanding of how pluralized leadership arises.

Specifically, Denis et al. (2012) describe pluralized leadership as being characterized by the existence of multiple leaders in organizations, whom exert influence through both formal and informal means, and is "naturally occurring" in complex organizations. As such, leadership is continuously collectively enacted and becomes a consequence of actors' relations; an effect which is a product of their local interactions (Denis et al., 2012, p. 254). In fact, this is a view, shared by many scholars of pluralized leadership (broadly defined) who see leadership as a collective product of actors' interactions that emerges in social relations

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(Balkundi & Kilduff, 2006; Carson et al., 2007; Kilduff & Tsai, 2003; Uhl-Bien, 2006; Yammarino et al., 2012). Here, scholars are persistently pointing to a gap in our knowledge of pluralized leadership surrounding the influence of leadership on the network relations that connect people, and vice versa (Friedrich et al., 2009; Mumford et al., 2012; Yammarino et al., 2012).

In this study we address the research gap above drawing on social network analysis theory and method, and so heed the calls for more scholarly attention to be paid to the micro-dynamics through which pluralized leadership is enacted (Brass, 2001; Carson et al., 2007; Carter & DeChurch, 2012; Contractor et al., 2012; Mehra et al., 2006). In doing so, our research addresses the call for research that “may require new types of leadership operationalizations, methods, interventions, and assessments for understanding and enhancing leadership science and practice” (Yammarino et al., 2012, p. 384).

Consistent with prior research (Carson et al., 2007), we focus on leadership influence networks as constituted in the influence relationships that emerge among actors (Contractor et al., 2012). Unlike most leadership network studies, which rely on a single network, we investigate patterns of pluralized leadership from a multi-network view (i.e. “multiplexity”), focusing on the presence of multiple, and interdependent, types of relationships between the same set of actors (Shipilov, Gulati, Kilduff, Li, & Tsai, 2014).

From a theoretical perspective we explore the multiplexity surrounding pluralized leadership by employing concepts of mutual exchange and entrainment to explain two different forms of interdependency between networks of leadership influence and informal social network relations. Mutual exchange involves a directed tie of one type being reciprocated with a tie of another type between two actors (Hiller, Day, & Vance, 2006; Settoon, Bennett, & Liden, 1996; Sparrowe & Liden, 1997), and is driven by the principle of direct reciprocity (Bearman, 1997; Yamagishi & Cook, 1993). Entrainment is a process through which behavioral cycles related to different informal relations become co-occurring with one another (McGrath, Kelly, & Machatka, 1984; Standifer & Bluedorn, 2006). To theoretically model the conditions under which the informal relations underpinning leadership influence are characterized by mutual exchange or entrainment we focus on nature of the informal ties involved, drawing a distinction between instrumental (i.e. goal oriented) and expressive ties (the tie is an end in itself) (Fombrun, 1982; Ibarra, 1993). In doing so, we are able to offer a unique micro-level perspective of the enactment of pluralized leadership.

From a methods perspective, we draw on recent developments in social network analysis (SNA) methods, specifically Exponential Random Graph Models (ERGMs) (see: Lusher, Koskinen, & Robins, 2012; Pattison & Wasserman, 1999; Robins, Pattison, Kalish, & Lusher, 2007) to examine how multiple relations are interrelated. ERGMs are superior to models that assume independent observations as they take dependencies inherent in network relations into account (Robins et al., 2007). To date there are few studies that have examined leadership using an ERGM approach (Box-Steffensmeier & Christenson, 2014; Mehra, Marineau, Lopes, & Dass, 2009; White, Currie, & Lockett, 2014), and even less that takes a multiplexity view (see: Contractor et al., 2012 for a discussion). ERGM is state of the art, and holds the potential to generate new insights into the structure of leadership relations, as it enables us to specify and test the specific conditions under which informal relations and leadership influence relations may be mutually exchanged and/or entrained.

We contribute to the literature on pluralized leadership by examining the type of complex and contentious organizational situation that Denis et al. (2012) suggest is likely to prove illuminating in considering leadership influence and informal relations within pluralized leadership. Our data is drawn from a complex organization of an inter-professional, inter-organizational network delivering health and social care, specifically the safeguarding of children, an organizational context prone to publicly visible failures of leadership, which may result in child deaths (Laming, 2009).

## Pluralized leadership

Beyond Denis et al. (2012), various commentators have examined pluralized leadership within complex settings (Currie & Lockett, 2011; Gronn, 2002; Huxham & Vangen, 2000; Spillane, Halverson, & Diamond, 2004; White et al., 2014; Yammarino et al., 2012). They agree pluralized leadership is always present in professionalized, complex organizations, but do not provide an adequate theorization of the spread of leadership, which takes account of the interaction of informal relations and leadership influence that underpin pluralized leadership to explain the extent to which it is more or less widespread. Many studies seeking to explain the spread of pluralized leadership tend to highlight the effect of external context (cf. Currie & Lockett, 2011; Currie, Lockett, & Suhomlinova, 2009; White et al., 2014) and argue that some sources of influence carry more weight than others, and are anchored in different sets of resources; i.e. leadership influence derived from managerial accountability or professional status. These studies tend to emphasize that pluralization of leadership is likely to be concentrated in an elite group of actors, rather than widespread. Yet other studies empirically report that pluralized leadership is widespread in a way that cannot be explained by exogenous factors, such as managerial accountability or professional status (Buchanan, Addicott, Fitzgerald, Ferlie, & Baeza, 2007; Huxham & Vangen, 2000). Buchanan et al. (2007) focus upon the fluid, ambiguous, migratory dynamics around social relations in making their claim that ‘nobody’s in charge’, but tend to ignore, or even eschew perceived leadership influence. Meanwhile Huxham and Vangen (2000) take a ‘holistic’ view of leadership through which they consider how collaboration is shaped and enacted. They take a more balanced view of the interaction of perceived leadership influence and social relations, in considering the behavior of participants identified as leaders, but also what happens on the ground because of structures and processes of collaboration. However, Huxham and Vangen (2000) focus upon a wide range of issues, as well as the interaction of perceived leadership influence and social relations within their empirical study, as a consequence of which we still lack sufficient in-depth understanding of the spread of leadership influence at a more micro-level of analysis, involving local level interactions derived from social relations (Denis et al., 2012; Yammarino et al., 2012).

A conceptual perspective within the pluralized leadership literature, synthesized by Denis et al.'s (2012), of particular relevance in addressing the research gap about the interaction of leadership influence with social relations at the micro-level is collective leadership (e.g. Carter & DeChurch, 2012; Contractor et al., 2012; Cullen et al., 2012; Friedrich et al., 2009; Mumford et al., 2012; Yammarino et al., 2012). This most offers a springboard for our theoretical concern in determining how leadership might be more widespread. Friedrich et al. (2009) develop a framework for understanding “collective” leadership, which highlights the utilization of leader and team expertise within networks that aligns with our concern for interaction of multiple relations and leadership influence. Others have followed the direction set out by Friedrich et al. (2009) in researching collective leadership (Kramer & Crespy, 2011). All argue that the sharing of leadership is much less a static condition in which role behaviors are structured, and much more dynamic, engendering collective leadership through multiple network channels. Collective leadership is not isolated to defined leaders, but leaders are embedded within wider team and network structures, with communication central to the collective leadership phenomenon.

Friedrich et al. (2009) set out three core constructs that constitute collective leadership. First, networks are the channels through which communication is enacted. Second, in addition to the leaders' (plural) personal networks, the network among team members is critical to collective leadership. Consequently, third, collective leadership is characterized by exchange behaviors across formal and informal networks. Friedrich et al. (2009: 955) highlight that communication exchanges and relationships across multiple social networks are lacking empirical analysis arguing: “(W)e must ... evaluate the bases of social network connections, how information flows through the social network, and how understanding your social network and the networks of those around you can facilitate collective leadership efforts.” This last statement links to the call for research by Denis et al. (2012), which represents the springboard for our own research concerns regarding our empirical and conceptual focus: How do multiple relations interact in leadership networks and with what effect?

While we draw considerable insight from existing studies of pluralized leadership, it is important to note that a number of these studies are conceptual (e.g. Friedrich et al., 2009), and of those that include empirics, some are more normative than critically analytical (e.g. Carter & DeChurch, 2012; Cullen et al., 2012). Hence, we are left with an inadequate understanding of the empirical basis of pluralized leadership.

Denis et al. (2012) highlight how pluralized leadership research is enacted in daily, often mundane activities inside organizations, and that the direction of leadership is shaped by often subtle and complex dynamics of informal, as well as formal, interactions between organizational members. Although enhancing our understanding of pluralized leadership, Denis et al. (2012) critique the extant literature, which takes a more relational approach, on two main grounds. First, the relational stream does not provide sufficient consideration of power (see Currie & Lockett, 2011, for how this might impact the pluralization of leadership in complex organizations, which are significantly professionalized). Second, and more pertinent to our research concerns, they question how the “mundane activity” that constitutes leadership influence might be distinguished from non-leadership activity, such as decision-making, problem-solving or simply team working: “How can leadership be studied and what counts as leadership in this case?” (Denis et al., 2012, p. 267). Denis et al.'s (2012) critique, therefore, highlights our need to understand the relational mechanisms through which pluralized leadership is enacted and direction of leadership influence derived from these. In order to do so, we argue that it is necessary to complement the existing qualitative approaches, which characterize the relational stream of pluralized leadership research to date, with social network theory and associated quantitative methods.

### Social network theory and pluralized leadership

While there is increasing scholarly attention on the application of network theory and methods to the study of leadership, few explored how this may advance leadership research (Balkundi & Kilduff, 2006; Contractor et al., 2012). A number of scholars have argued that the enactment of pluralized leadership should be viewed as a specific type of social network, comprising multiple forms of relationships, and therefore amenable to investigation using social network theory and methods (see Carson et al., 2007; Dansereau, 1995; Graen & Uhl-Bien, 1995; Mayo, Meindl, & Pastor, 2003). To date, however, scholarship applying social network theory and method to the examination of the enactment of pluralized leadership has largely focused on the networks surrounding individual leaders. For example, scholars have examined network properties and individual influence (Brass, 1984; Brass, Galaskiewicz, Greve, & Tsai, 2004), and dyadic relations, particularly between a formally designated leader and a subordinate (Graen & Scandura, 1987). Consequently, scant attention has been paid to the importance of informal network relationships connecting individual actors, on dimensions such as support and advice (Carson et al., 2007). Indeed, few if any, have examined the potential of (multi) network-level analysis for studying leadership (Yammarino et al., 2012), and even less so from a multiple network view (Contractor et al., 2012). We contend that any examination of the enactment of pluralized leadership needs to embrace how, and under conditions of uncertainty, multiple individuals interact through a variety of different forms of social relationship (Contractor et al., 2012; Yammarino et al., 2012).

Leadership is enacted through different forms of formal and informal interactions and exchanges between individuals (Uhl-Bien, Marion, & McKelvey, 2007). Informal networks can serve to support an organization and provide additional backstage support to formal leadership relations; however, they can also undermine the authority of formal leaders if the two are disconnected. The propensity for relations to co-occur in networks referred to here as multiplexity (Lazega & Pattison, 1999; Shipilov et al., 2014), is a concept that allows us to explore how the structure of relations in one network influences the structure of relations in other networks (Lee & Monge, 2011). Social network researchers view multiplexity as a coincidence of different types of relationships that have multiple contents (Contractor et al., 2012). Such multiplex relationships are expected to be stronger than uniplex relationships because they contain more than one basis for interaction (Skvoretz & Agneessens, 2007). Multiplex relationships reflect not only the simultaneous presence of multiplex

ties, they also contribute to the development of a local network structure that involves multiple types of ties, with interdependence among ties within dyadic and triadic network structures (Koehtly & Pattison, 2005; Lazega & Pattison, 1999). Thus, a central suggestion for this study is that multiplex networks exhibit regularities that are underpinned by specific forms of interdependence among relational ties. These types of interdependencies might be expected to reflect underlying social processes that guide the emergence of pluralized leadership (Contractor et al., 2012). In the next section we examine the multiplexity of perceived leadership influence with informal relationships to facilitate a better understanding of the micro-processes of the pluralized leadership.

#### *Leadership influence and informal social networks*

We focus on leadership influence, rather than formal leadership, because it represents a holistic view of leadership that is not simply based on a formal organizational chart, allowing for more fluid encompassing ties created by “quasi-structures” including committees, task forces, teams etc. (Ibarra, 1993; Schoonhoven & Jelinek, 1990). To understand the enactment of leadership influence, however, it is important to recognize that leadership influence and informal ties are unlikely to occur independently of each other (Monge & Contractor, 2003). What is unclear, however, is what type of interdependencies or cross network effect, where leadership relationships are aligned with informal relations (Krackhardt & Kilduff, 1990; Riordan & Griffeth, 1995), will occur between two (or more) actors. Examining interdependencies or cross network effects is important, in that exploring multiple networks without these effects is equivalent to studying a number of independent single networks. Consequently, the different relational ties in which an actor is embedded should be characterized as cross-network effects (Lazega & Pattison, 1999), as networks cannot be properly understood if such interdependencies are ignored (Rank, Robins, & Pattison, 2010). These effects can be then thought of as the building blocks of the leadership network structure.

Our interest lies in exploring the co-structuration of informal interaction between members of a network, and their orientation toward leadership influence, to provide us with clues as to how pluralized leadership is enacted. In addition, leadership influence itself represents a focused activity that increases mutual awareness, and facilitates the development of informal relationships (Feld, 1981, 1982). According to this view, the presence of informal network ties is not only an antecedent, but also in part an outcome of leadership influence.

In conceptualizing the nature of the leadership influence and informal ties we distinguish between instrumental ties (i.e. goal oriented) and expressive ties that primarily provide friendship and social support (i.e. the tie is considered to be an end in itself) (Fombrun, 1982; Ibarra, 1993). The delineation between instrumental and expressive informal ties is one that has been employed extensively in organizational research (e.g. Fombrun, 1982; Ibarra, 1993; Krackhardt & Hanson, 1993; Torenlvied & Velner, 1998; Umphress, Labianca, Brass, Kass, & Scholten, 2003). We classify leadership influence ties as being instrumental in nature as they are goal oriented, however, informal relations may be instrumental or expressive in nature.

Informal instrumental ties arise in the course of work role performance and involve the exchange of job-related resources including expertise and advice (Fombrun, 1982; Ibarra, 1993; Krackhardt & Hanson, 1993; Lincoln & Miller, 1979). Actors seek out others for advice whom they view as being high status in nature (Blau, 1964; Cook & Whitmeyer, 1992; Thye, 2000) and as having good connections to other parts of the organization (Thye, 2000). For example, Sorrentino and Field (1986) found a positive relation between advice giving and leadership emergence; and Carson et al. (2007) found that advice giving relates to patterns of leadership influence. Informal instrumental networks based on advice enable individuals to identify others with potential resources, and to be able to reach out to these others when seeking such resources (Ibarra, 1992).

Informal expressive ties involve the exchange of friendship and social support, and tend to be less bound to formal structure and work role (Ibarra, 1993). In a complex public services organizational context, however, friendship will be difficult to perceive as ties will not be exclusively personal in nature since they are work-based and span organizational boundaries (Umphress et al., 2003). Consequently, we follow the lead of others to focus on informal expressive relationship ties as represented by those to whom one goes for social support (e.g. Krackhardt & Hanson, 1993; Torenlvied & Velner, 1998). We suggest that the person one might go to for social support may help in shaping one's status in a group in relation to leadership. Here, individuals support one another, and help to create an environment where other members are valued and appreciated. By actively providing support, individuals are more likely to be recognized in relation to leadership status (Seers, Keller, & Wilkerson, 2003).

In the next section, we describe the types of interdependencies or cross network effects that are potentially relevant for the underlying structural regularities of pluralized leadership networks. Drawing on social exchange theory, and the emerging literature on entrainment (e.g. Kelley, Futoran, & McGrath, 1990; McGrath, 1991; Pérez-Nordtvedt, Payne, Short, & Kedia, 2008; Shi & Prescott, 2012), we explain how the similarities and differences in the forms of leadership influence and informal network ties between two actors may lead to different cross network effects in terms of mutual exchange and entrainment. Below, we focus our arguments at the level of the dyad on the basis of parsimony; however, we note that our arguments do not preclude the existence of cross network effects occurring beyond the dyadic level (Balkundi & Kilduff, 2006; Ekeh, 1974; Emerson, 1976; Gillmore, 1987; Jones, Hesterly, & Borgatti, 1997; Sparrowe & Liden, 1997; Takahashi, 2000; Uzzi, 1996).

#### *Cross network effects: mutual exchange and mutual entrainment*

Social exchange theory focuses on the quality of social interactions of actors within their networks, with a focus on the exchange of resources (Molm., 1994, 2001; Settoon et al., 1996), and is based on the calculus of mutual exchange when building and maintaining ties with each other. Applying the principle of mutual exchange to the interrelationships between leadership influence and informal ties, we suggest that mutual exchange occurs where there is a difference in the content of the leadership

influence tie and the informal tie involved; i.e. when one tie is instrumental and the other tie is expressive. For example, where person  $i$  perceives person  $j$  to have leadership influence (instrumental), they are more likely to exchange their willingness to be formally led for informal social support (expressive) from  $j$ . Where mutual exchange occurs there is neither complete overlap, nor complete diversion between networks (Krackhardt, 1987). Rather, there exists a complex pattern of interdependences among relational ties, where exchange occurs in the context of other exchanges (Lazega & Pattison, 1999), and different networks influence and reshape each other. Hence, there is an interlocking of exchanges that go beyond any transfer of a single resource. Based on the above we hypothesize that:

**H1.** Under conditions of uncertainty, actors will seek to balance their relationship with others by entertaining cross network effects characterized by mutual exchange between leadership influence (instrumental) ties and informal social support (expressive).

The second type of structural regularity is the entrainment of leadership influence and informal ties. McGrath et al. (1984) defined social entrainment as the process through which behavioral cycles become co-occurring with one another. The concept of social entrainment has received increased attention in management research (e.g. Kelley et al., 1990; McGrath, 1991; Pérez-Nordtvedt et al., 2008; Shi & Prescott, 2012) because it enables researchers to examine the complex interdependencies between different forms of behavior (Shi & Prescott, 2012). We suggest that a SNA application of social entrainment is particularly relevant to the study of pluralized leadership, and the interactions between different forms of relational ties, for three main reasons. First, actors' activities need to be endogenous for social entrainment to occur, which is consistent with the assumption of structural logic, in that social entrainment is one class of structural regularity that can explain the formation of networks (Lazega & Pattison, 1999). Second, entrainment can facilitate complex and interdependent coordination across a range of human activities (Ancona, Goodman, Lawrence, & Tushman, 2001). Third, scholars have theorized that mutual entrainment may lead to a positive effect on performance through coordination (Lazega & Pattison, 1999).

Entrainment, from a SNA perspective, focuses on the extent to which there is a shared cadence of different forms of ties between actors (Rank et al., 2010). At the dyadic level, mutual entrainment is said to be present between two actors ( $i$  and  $j$ ), where the presence of one type of tie form (e.g.  $i$  to  $j$ ) is interdependent with the presence of another type of tie (e.g. for  $i$  to  $j$ ); i.e. there is the co-occurrence of two different forms of tie between two actors (i.e. both ties are directed from  $i$  to  $j$ ). To date, however, SNA scholars have treated entrainment as an empirical property of two networks (see Lazega & Pattison, 1999; Lomi & Pattison, 2006; Rank et al., 2010; Robins et al., 2007), but have not explained the conditions under which entrainment is likely to occur. Drawing on the logic of social entrainment (McGrath et al., 1984), we suggest that leadership influence and informal ties are more likely to be aligned, and hence mutually entrained, when they are similar in terms of their function. For example, when  $i$  has (instrumental) leadership influence over  $j$ ,  $i$  will be more likely to also provide informal advice (instrumental). Simply stated, advice is likely to be sought out in relation to the enactment of leadership influence (see Lazega & Pattison, 1999). Hence, in contrast to mutual exchange, which is promoted by difference between formal and informal ties (as outlined above), mutual entrainment is promoted by similarity between the function of leadership influence and informal advice network ties. Hence:

**H2.** Under conditions of uncertainty, actors adopt a more social orientation and are more likely to enter cross network effects characterized by mutual entrainment between leadership influence ties (instrumental) and informal advice ties (instrumental).

## Method and data

Our study focuses on a City Local Safeguarding Public Service Network (CLSPSN). CLSPSN, as an organizational entity, represents a mandated public services network, comprised of several legally autonomous organizations that work together to achieve not only their own goals, but also a collective goal; safeguarding children, for example, from domestic or sexual abuse. The CLSPSN is situated within the children's services department of the local level of government (in England, a host local authority), which is ultimately accountable for safeguarding failures. Around half of safeguarding networks are formally led by an independent chair, with the other half led by a senior manager from the host local authority, commonly the Director of Children's Services (France, Munro, Meredith, Manful, & Beckhelling, 2009). At the same time, the children's services department alone does not hold all the resources for service delivery or control, nor do they manage key staff delivering services, so they cannot, alone, ensure high quality delivery of services. Hence, the CLSPSN brings together a multitude of different professionals and organizations (i.e. health, social care, education, careers and youth work, police and voluntary organizations, as well other local level agencies) deemed responsible for strategically overseeing the front-line handling of child abuse and related deaths (DES, Department for Education and Skills, 2007). Unlike non-mandated networks, which develop organically, goal-directed public service networks are established with a specific purpose, either by those who participate in the network or through mandate, and evolve largely through conscious efforts to build co-ordination and encourage informal interaction (Agranoff & McGuire, 2001; Kilduff & Tsai, 2003; Provan & Kenis, 2007). The participants meet regularly at overview meetings, but also work together and interact outside the formal network meetings.

## Data

Similar to many network studies we focus on a whole network, the boundary of which is recognized and defined by the members themselves, and employ a model-based design because we were able to observe all members of the network (Sterba, 2009). Our

approach enables us to explore the social processes and mechanisms in the network more generally (see: Frank, 2009), as the corresponding standard errors provide an indication of how different these estimates might be if the study was repeated. Model-based inference acknowledges that empirical random sampling would not always be feasible, particularly for observational studies in the social sciences, and where it is plausible to consider that the observed network data could also have been different (i.e., the individuals could have been different while the social and institutional context remained the same, or external influences could have been different). The idea is that in such a population of different networks, the systematic patterns as expressed in the parameters of a statistical model would be the same, while the particular outcome observed could be different (Snijders, 2011).

Informal social network data were collected via a questionnaire that was personally administered to all (23) members of the CLSPSN (response rate 100%), which covered participants' perceptions of leadership influence, advice seeking and support, and personal attributes. In parallel to the SNA data collected by the sociometric survey, the program of research at the CLSPSN also involved in-depth qualitative interviews with all members of the board. The qualitative interviews, although not formally utilized in this article, enabled us ensure that we were confident that our SNA data responses were representative of the patterns of advice and support among the individuals concerned. Based on field experience the research team also explored a list of concrete circumstances that would help in rooting leadership influence relations more firmly in the specific safeguarding context and in the understanding that participants have. We avoided selection bias in that we collected network data from all respondents to construct the network measures. Podsakoff, MacKenzie, Lee, and Podsakoff (2003) noted that this is a powerful procedure such that additional statistical remedies are unnecessary. Details of the population of respondents are presented in Table 1. The size of the network is consistent with other studies, as evidenced by Provan, Fish, and Sydow's (2007) review of the literature on whole networks. In addition, as ERGMs are based on dyadic observations, the effective number of (non-independent) observations for each network is  $N \times (N - 1)$ , where  $N$  is the number of nodes in the network. Thus, our total number of observations for all three networks is 506.

### *Perceived leadership influence and informal relations measures*

#### *Perceived leadership influence*

Our definition of a leader is someone who is perceived as such by others, which is reflected through a set of formal and informal ties (Balkundi & Kilduff, 2006; Mehra et al., 2006; Zohar & Tenne-Gazit, 2008). The measure is similar to that used in other studies to capture respondents' personal and explicit theories of leadership (Mehra et al., 2006), and is consistent with classic socio-metrical work on leadership (Calder, 1977). A leadership relationship is said to exist when one member perceives another as exerting leadership influence across multiple individuals. Consistent with the work of Brass and Burkhardt (Brass, 1984; Brass and Burkhardt, 1993; Burkhardt & Brass, 1990), we focus on influence rather than power because of negative connotations associated with the concept of power (Pfeffer, 1981). Furthermore, Brass and Burkhardt (1993) argue that although scholars have made definitional distinctions between influence and power, such distinctions are not common in everyday usage of the words. In addition, the research on leadership perceptions suggests that perception is a good way to assess leadership influence, and is consistent with the attributional nature of power (Dahl, 1957; Wrong, 1968). That is, if actor  $i$  believes that actor  $j$  has leadership influence, actor  $i$  then behaves toward actor  $j$  as if the latter had leadership influence. Consistent with Brass and Burkhardt (1993) and Salk and Brannen (2000), who collected data in this way to assess perceived leadership influence, we employed the roster method (as outlined above) to collect information from each dyad. Specifically, we provided a full list of names of all members of the CLSPSN and asked each individual to identify people on the list whom they perceived to have leadership influence in the CLSPSN, and then rate the degree of leadership influence from 1 being low to 4 being high.

#### *Informal instrumental relations*

Employing Ibarra's (1993) classification, and consistent with Balkundi and Kilduff's (2006) theorization of a social network approach to leadership, we focus on "advice seeking" as our example of informal instrumental ties. Consistent with our approach to measuring leadership influence we employed the roster method and collected information for each dyad, drawing on the measure employed by Lazega, Lemercier, and Mounier (2006). Specifically, each person was asked to identify members of the CLSPSN whom they had regularly asked advice from, or who they have had discussions with, outside of formal deliberations on CLSPSN matters, and then rate the degree of advice from 1 being low to 4 being high. In doing so we were careful to ensure that respondents did not confuse informal advice seeking with formal advice seeking that may constitute a part of a person's formal duties.

**Table 1**  
Network membership.

Organization	Number of participants
Acute health	4
Community health	2
Local authority	7
Mental health	3
Police	1
Probation	1
Voluntary sector	2
Others	3

### *Informal expressive relations*

Following Ibarra (1992), we focus on “social support” as our example of informal expressive ties because it has an important influence on communication processes and the exchange of information (e.g. Brass, 1984, Ibarra, 1993, Ingram & Roberts, 2000). Social support ties are often seen as more readily available than advice, as advice is exchanged at arm’s length (Uzzi, 1996). Furthermore, social support entails a willingness to help in difficult situations by providing different types of resources like emotional support and socialization (Lazega & Pattison, 1999). Consistent with our other measures of leadership influence, we employ the roster method here and collected information for each dyad. Specifically, each person was asked to identify members of the CLSPN whom you go to for support or to be able to talk freely about any personal matters outside of formal deliberations on CLSPN matters, and then rate the degree of advice from 1 being low to 4 being high. Consistent with our measure for informal instrumental network in terms of advice seeking, we ensured that respondents did not confuse informal support seeking with formal duties.

As ERGMs require matrices to be binary, following Krackhardt (1987) we use transformed our three network measures into binary variables. A value of one was given to a person that was nominated as having leadership influence with a rating of greater or equal to three; those who were not nominated, and those nominated but who had low leadership influence ratings of two or less, were given the value 0. In doing so, our aim was to focus on the more significant leadership relations, which is an approach that is consistent with SNA method (see: Wasserman & Faust, 1994). While different cut-off thresholds could have been chosen, our selection of the dichotomization criterion that we adopt follows other studies (e.g. Conaldi & Lomi, 2013). We tested alternative dichotomization rules, as suggested by Wasserman and Faust (1994), and we examined the network statistics including the degree distribution. We found that the dichotomized networks do not appear to be qualitatively different from the corresponding degree distributions of the original valued network, and the results of the analysis that we report were robust to alternative choice of dichotomization rule. It was also a theoretical decision to choose a higher threshold as our interest lies in understanding the process of influence (or the existence of ties) between participants, not the intensity of influence in leadership activities. Finally, we believe that the dichotomization criterion chosen allows us to represent the leadership process with a limited loss of information.

### **Controls for actor attributes**

In considering multi-relational ties, it is important that we control for actor attributes, which may shape participants' inclinations to give advice to each other because of their status or experience. Alternatively, two participants who provide each other with support may be more likely to collaborate on an informal basis. Data relating to actor attributes enabled us to explore the influence of context on the formation of network ties (Robins, Pattison, & Elliott, 2001). Actor attributes are individual-level measures on the nodes of the network, and were measured in terms of a participant’s professional status, seniority and whether or not they had a coordination role in the network.

*Professional status* is measured employing a binary variable, distinguishing between high status professions (one if a doctor or social worker) and low status professions (zero if other profession). We classified the status of actors, drawing on the sociology of professions literature that indicates that doctors and social workers enjoy high status relative to nurses and others, within health and social care networks (Nancarrow & Borthwick, 2005). Professional status matters in safeguarding networks as it may influence whether a participant is perceived as exerting leadership influence (Currie, Grubnic, & Hodges, 2011).

*Seniority (formal leadership)* is measured employing a binary variable indicating whether the participants have a formal managerial role on the safeguarding board (yes = 1) or not (no = 0). Researchers have highlighted the importance of managerially accountable roles in public service networks (Denis et al., 2001; Ferlie, Ashburner, Fitzgerald, & Pettigrew, 1996; Harrison, Hunter, Marnoch, & Pollitt, 1992). This is consistent with Morgeson, DeRue, and Karam (2009) who used the term “formal leaders” to refer to individuals, such as managers or formal team leaders with legitimate authority over other organizational members. We take the view that if an participant has a managerial role, then more participants will perceive them as exerting leadership influence.

*Coordination role* is measured employing a binary variable, which takes the value of one when a participant has a formal coordination role and zero otherwise. We include coordination role as an actor attribute because we expect this role to influence an individual’s embeddedness in the leadership and advice networks (Lazega & Pattison, 1999). Within CLSPSN, there is dedicated administrative cadre of staff to coordinate the work of professionals.

### *Exponential Random Graph Models*

Scholars are increasingly recognizing the importance of the statistical modeling of social networks in organizations, including endogenous network parameters (Robins et al., 2007). Endogenous network parameters represent specific network dependencies and important social processes through which network structures are built (Monge & Contractor, 2003). Accounting for the endogenous tendencies of social networks to self-organize into a variety of local configurations can allow us to account for specific ways in which network ties may generate other network ties. Accordingly, we can employ such models to explicitly state that leadership relations can be characterized by endogenous components, whose effects on tie formation co-exist with the effects of other networks and individual attributes.

To model how leadership networks have their own internal organizing principles, and also the extent to which formal and informal networks are exchanged and/or entrained, we employ ERGMs. ERGMs began with Frank and Strauss (1986), who advanced research into stochastic social networks by proposing the notion of dependency between network ties, and has been extended in a series of

articles exploring how best to identify specific models for certain forms of network data (e.g. Handcock, Hunter, Butts, Goodreau, & Morris, 2004; Pattison & Robins, 2002; Pattison & Wasserman, 1999; Robins, Pattison, & Wasserman, 1999; Snijders, Pattison, Robins, & Handcock, 2006; Wasserman & Pattison, 1996). To model the dependence between network ties, Frank and Strauss (1986) proposed using the Markov dependence assumption and the adoption of Markov Random Graph Models (MRGMs) (Pattison & Wasserman, 1999; Robins et al., 1999; Snijders et al., 2006; Wasserman & Pattison, 1996).

The Markov dependence assumption infers that two tie-variables are dependent if they share a node (i.e. any relational ties involving the same actors (say  $i$  and  $j$ ) can be defined in which a possible tie from  $i$  to  $j$  is assumed conditionally dependent only on other possible ties involving  $i$  and/or  $j$ ). Any proposed assumptions about potential conditional dependencies among network tie variables can be inferred from the Hammersley–Clifford theorem (Besag, 1974), which informs us that MRGMs can be completely characterized by the numbers of edges, stars and triangles (Pattison & Wasserman, 1999; Robins et al., 1999; Snijders et al., 2006; Wasserman & Pattison, 1996). It is important to note that MRGM allows us to understand the intricate arrangement of social processes by which network ties are formed. Network ties can organize themselves into patterns because the presence of some ties encourage others to come into existence, which is an endogenous process in that the network patterns arise solely from the internal processes of the system of network ties. The system of ties can be represented by a number of different configurations. By incorporating a number of configurations (e.g., edges, stars and triangles) simultaneously, MRGMs can test which processes contribute to the formation of a network structure (Monge & Contractor, 2003).

The conditions outlined above are endogenous or structural effects. MRGMs or the more general ERGMs enable us to include a series of different types of network parameters, which provide important insights into the enactment of pluralized leadership in the network (see Fig. 1). The general pluralized leadership properties of a network are represented by the density (edge) and centralization (k-in-star) parameters, which are degree-based effects that can give rise to self-organization. Density (edge) configuration is a baseline propensity for tie formation and corresponds to the amount of leadership interaction in a network, in terms of the proportion of direct ties in a network relative to the total number possible. Centralization (K-in-star) network configurations are equivalent to modeling the in-degree distribution (Snijders et al., 2006); and we found that modeling with a Markov 2-in-star (simple activity) was sufficient for convergence. High positive values of these parameters indicate network centralization. For instance, a significant large positive parameter indicates that in-degrees are centralized on a few key actors; whereas a small or even negative parameter indicates a relatively equal spread (de-centralization) of influence across actors (Robins, Pattison, & Wang, 2009).

Dyadic effects through the reciprocity parameter represent restricted exchange. Reciprocity is defined at the level of the dyad, and refers to the overall tendency of actors to reciprocate leadership influence with similar others. Typically ERGMs provide an estimate of reciprocity for all pairs of actors across the network and we consider the estimate as an average effect across the network.

Generalized forms of exchange are represented by the transitivity and cycle parameters, which we operationalize at the level of the triad. Triadic effects reflect the human propensity to operate in a group structure. We adopt two main triadic configurations. Cycle denotes the tendency for a relationship to be in the form of generalized reciprocity (i.e. if there is a tie from  $i$  to  $j$ , and also from  $j$  to  $h$ , there is also a tie from  $h$  to  $i$ ). Transitivity denotes that if actor  $i$  perceives actor  $j$  as a leader, and actor  $j$  perceives actor  $h$  as a leader, then actor  $i$  will also perceive actor  $h$  as a leader. The inclusion of transitivity and cycle parameters are strengths of ERGMs, which address the paucity of network models that incorporate these effects (Newman, 2003).

In modeling the three networks we ask questions about how different types of networks interact with each other, and how these interactions affect the structure of each network. The model specification can be divided into two parts: within network effects (as described above), and cross-network effects, which involve ties from all networks. For cross-network effects, we focus on mutual exchange and mutual entrainment. Significant cross-network effects imply that there is an association between the different networks. For directed networks there are two dyadic configurations. The mutual exchange parameter represents the extent to which the dyad exchanges ties of different types, whereas the mutual entrainment parameter represents the extent to which the different network ties align within the dyad (i.e. both ties are directed from  $i$  to  $j$ ). This specific configuration is perhaps the most commonly encountered mechanism in studies of inter-organizational networks (Uzzi, 1996). These are basic configurations for network association and should always be considered in a multivariate model. The advantage of the ERGM approach is that it allows us to investigate these cross network effects for multiple networks at the same time as taking into account any relevant dependencies of each network that are present.

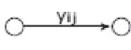
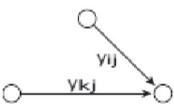
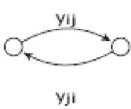
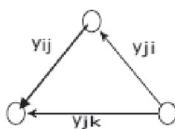
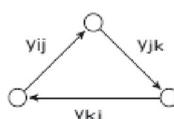
Finally, we include parameters to control for the influence of exogenous context using actor attributes. These are important in that individual participants bring their own qualities, capabilities and predispositions to a network. These can be very important to the formation of ties (Kilduff & Tsai, 2003). Actor covariate effects can be entered into an ERGM taking several forms including sender effects, receiver effects, and homophily effects (Lusher et al., 2012). Homophily effects capture the increase in the likelihood of a tie forming between two participants given that both participants share or are similar on a given attribute. Sender effects indicate whether an individual with a particular trait is more or less likely to seek out a tie. Receiver effects capture whether individuals with certain attributes are more or less likely to be recipients of ties. We model our actor attributes as influencing the presence of ties through homophily effects and we also added a receiver effect for our seniority measure (i.e. formal leadership), in that we expect that members from *higher* levels of organizational hierarchy to be relied on for leadership.

#### Model specification

Following Wasserman and Pattison (1996), ERGMs can be viewed in a standard form in which the response variable is the log-odds of the probability that a relational tie is present. In modeling the network we consider each potential network tie

### Configuration of relationships between nodes

#### Network statistics applied to all models

	Parameter	Network statistic	Pattern
	Density	$\sum y_{ij}$	
<b>General plural leadership</b>	Two in-star	$\sum y_{ji}y_{ki}$	
<b>Restricted Exchange</b>	Reciprocity	$\sum y_{ij}y_{ji}$	
<b>Generalized Exchange</b>	Transitive	$\sum y_{ij}y_{ik}y_{kj}$	
	Cycle	$\sum y_{ik}y_{kj}y_{ji}$	

#### Networks statistics for cross network effects

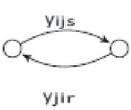
	Parameter	Network statistic	Pattern
<b>Entrainment</b>	Mutual entrainment	$\sum y_{ijs}y_{ijr}$	
<b>Exchange</b>	Mutual exchange	$\sum y_{ijs}y_{jir}$	

Fig. 1. Configuration of relationships between nodes.

between the participants as a random variable. For each pair of individuals  $i$  and  $j$ , we define a random variable  $Y_{ij}$  so that  $Y_{ij} = 1$  if a given relation exists between  $i$  and  $j$ , and  $Y_{ij} = 0$  otherwise. As relations of leadership influence give rise to directed ties,  $Y_{ij}$  may be different (in general) from  $Y_{ji}$ . The observed value is specified as  $y_{ij}$  and  $Y$  is the matrix of all such variables, with  $y$  the matrix of observed ties. In addition, we employ the assumption of homogeneity; i.e. parameters do not depend on the identities of the nodes in the configurations to which they correspond. Following [Pattison and Wasserman \(1999\)](#) for ERGM the basic model has the following form:

$$P(Y = y) = \kappa^{-1} \exp\left(\sum_A \lambda_A Z_A(y)\right) \quad (1)$$

where: (i)  $Y$  is the  $n \times n$  array of network tie variables, with realizations  $y$ ; (ii)  $Z_A(y)$  is the network statistic of all configurations  $A$  (hypothesized to affect the probability of this network forming) in the model (configurations might include edges, stars, transitive triads and so on); (iii)  $\lambda_A$  is the corresponding parameter estimate (equal to one if a particular configuration is observed or zero otherwise); and (iv) the value  $\kappa$  is the normalizing constant, included to ensure that Eq. (1) is a proper probability distribution.

The summation in the model includes all network effects within the given model. Eq. (1) describes a probability distribution of graphs on  $n$  nodes. The probability of observing any particular graph  $y$  is dependent both, on the statistics  $Z_A(y)$ , and on the corresponding parameter  $\lambda_A$ , for all effects in the model.

We perform a multiple network ERGM including cross-network effects. In order to extend the univariate ERGM to multivariate relations, we adopt an assumption that simply allows us to state that the status of, say, a dyadic network tie in one network (e.g. leadership influence) may be conditionally dependent on the status of ties in another type of network (e.g. informal advice seeking). Invoking the Hammersley–Clifford theorem ([Besag, 1974; Pattison & Wasserman, 1999](#)), we constructed a probability model for a multivariate random network. Eq. (1) describes a general probability distribution of graphs and is used to determine the particular probability of observing a graph (or network). The specific probability of observing any graph  $P(Y=y)$  depends on both networks statistics  $Z_A(y)$  and the non-zero parameters  $\lambda_A$  for all configurations  $A$  in the model.

For the multivariate case,  $Z_A(y)$  is a multigraph as presented in Eq. (2); where  $A_k$  is a collection of configurations  $A$  of tie-variables.

$$Z_A(y) = \sum_{A \in A_k} \prod_{(i,j,s) \in A} y_{ijs} \quad (2)$$

For the social relation  $s$  we define a binary variable  $Y_{ijs}$ , which equals 1 if there is a relational tie of type  $s$  between actor  $i$  and actor  $j$ , and is 0 if no such tie is present. Each of the  $s$  social relationships is intended to express a distinctive relational content. As we are exploring cross-network effects, we are particularly interested in whether or not there may be a tendency for leadership ties to be entrained and/or exchanged with our informal networks. For example, and taking the simple case of looking at our leadership influence network and the advice network, on the basis that those perceived as influential are more likely to be sought out as sources of advice than non-influential participants, we would expect to observe  $Y_{ija} = Y_{iji} = 1$  more frequently than expected from the baseline frequencies of  $Y_{ija} = 1$  and  $Y_{iji} = 1$ . There may also be mutual exchange or reciprocation effects in directed networks, such that we may observe more frequently than expected situations where  $Y_{ija} = Y_{ji} = 1$  (a person  $j$  chosen by  $i$  for advice tends to perceive  $i$  as influential – advice is “exchanged” for influence) and where  $Y_{iji} = Y_{ji} = 1$  (perceptions of influence tend to be reciprocated).

### Model estimation

Estimation parameters for ERGM are complex, and only recently have statistical methods become available (see: [Robins et al., 2007](#)). More recently, Monte Carlo Markov Chain Maximum Likelihood Estimation (MCMCMLE) methods have been developed to obtain estimates of parameters and standard errors for Exponential Random Graph Models (see: [Hunter & Handcock, 2006](#)). Software for the modeling and estimation of networks using ERGMs is widely available for a single network, and two networks (see: [Robins et al., 2007](#)), but none exists presently for three or more networks.

Without the use of MCMCMLE, the estimation of the parameters in Eq. (2) (the multivariate case) is more complex. To estimate such a model with complex dependency assumptions using maximum likelihood methods may not be viable, and therefore, indirect methods need to be used to estimate model parameters. Pseudolikelihood techniques are an indirect method for estimating the ERGM parameters which are good for estimating univariate models since the estimation of  $\kappa$ , the normalizing constant, can be done directly for simple models. For our univariate case we used pseudolikelihood techniques for parameter estimates the results as a starting point for building a univariate model amenable to estimation using MCMCMLE as suggested by [Robins et al. \(2007\)](#). Pseudolikelihood techniques are also easily implemented to the case of multiple networks, and they have proven useful in estimating model parameters ([Lazega & Pattison, 1999; Rank et al., 2010](#)). Hence, we employed pseudolikelihood estimation for our multivariate ERGM ([Pattison & Wasserman, 1999; Strauss & Ikeda, 1990](#)). In order to do this, following [Koechly and Pattison \(2005\)](#), we use the fact that the random variables  $Y_{ijs}$  is dichotomous in nature to re-specify Eq. (2) into a generalized autologistic model. Maximization of the pseudolikelihood function is achieved by fitting a logistic regression model, which builds on the logit form of the Exponential Random Graph Model ([Strauss & Ikeda, 1990](#)). Based on the empirical network data, a vector of measurements of the response variable and a matrix of measurements on the explanatory variables are created.

The statistical importance of a particular variable is assessed by fitting two models, one with the variable and the other without it, with the difference in the pseudolikelihood ratio statistics the indicator of variable importance.

Pseudolikelihood estimation techniques, however, are only approximate, and so assessment of the model is based on heuristics that compare the observed values with the fitted values. As such, the approximate standard errors that accompany the pseudolikelihood estimates are given only for guidance as to likely order of magnitude. All comparisons among models are based on two indices of model fit, namely  $-2$  times the log of the maximized pseudolikelihood, and the mean absolute residual (MAR) for each possible network (Pattison & Wasserman, 1999). The MAR is the mean of the absolute value of the difference between the observed values  $y_{ijs}$  and the fitted values,  $\hat{y}_{ijs}$ . It is an index of model fit (Koechly & Pattison, 2005).

## Empirical findings

Network descriptive statistics are presented in Table 2, and indicate that the leadership influence and informal networks have a similar density, with just over 16% of all ties realized in all the cases. The centralization statistics are scaled to percentages, with 0% indicating that no participant in the network plays a more central role than any other participant, and 100% indicating that all ties are through only one star participant. In the leadership influence network, relatively few leaders are recipients of incoming ties (at a little over 73%), which stands in sharp contrast with the informal networks, in which the interaction is much more distributed (at a little over 36%). Further insights can be gained by examining the co-occurrence of the relational ties in the networks, which we achieved by providing the associations between the networks using QAP correlation (Krackhardt, 1988). The results suggest that the informal (instrumental) leadership and informal (instrumental) advice networks are significantly correlated, whereas, the informal (instrumental) leadership and informal (expressive) support networks are not correlated. The QAP results give some indication of entrainment but not exchange, and that QAP is insufficient to look at the effects simultaneously. We can, however, explore several effects simultaneously with ERGM.

We now present more details of the leadership influence and informal (advice seeking and support) networks, before progressing to the multivariate ERGM, encompassing informal networks and informal leadership influence network. In presenting the results, some clearly non-significant effects were dropped from the model. Several non-significant effects were retained in the results presented below because they were of primary interest (cross-network effects). Dropping further non-significant effects did not lead to important changes in the remaining results.

The results for the univariate ERGMs are presented in Table 3. Evidence of the enactment of pluralized leadership is represented by density and centralization parameters. For each of our univariate networks we find strongly negative parameters for the density effect (single directed ties) from some actor  $i$  to another actor  $j$ . The negative parameters indicate that ties occurring at random are rare, suggesting that ties are more likely to appear in regular combinations with other ties. We suggest that because building and maintaining relational ties are costly, exchange relationships in the form of one-sided alignment to arbitrary others are unlikely, unless there are additional desirable properties to the ties. These properties constitute the basis for tie interdependence, which we explore below. In terms of a centralization parameter (2 in star), the results (which were positive and significant) suggest a tendency for some level of centralization of incoming ties for the all three networks. We also find significant and negative values for the 3-in-star parameters for both informal networks (advice and support), which reveal that informal ties are exhibiting more de-centralization than the leadership influence network. In practical terms, there are a number of participants sought for informal advice and support by many of their colleagues, as compared to the informal leadership influence, which is more concentrated.

Our findings suggest that both leadership influence and informal advice relations are likely to be directly exchanged, as reflected in positive values of the reciprocity parameters. However, we did not find a significant parameter estimate for informal support. In terms of generalized exchange, we found no significant parameter estimates on cycle triads for our leadership influence network. We did, however, find a significant parameter estimate on 3 cycle for our informal support network (an indication that support tie formation responds to a logic of generalized exchange), and a significant parameter estimate on transitivity for our informal advice network.

Our findings for the leadership influence network, however, suggest that the emergent structuring of ties beyond dyads occurs through means other than leadership influence. In contrast, the informal networks (advice and support) show structural regularities that are of considerable importance in the context of pluralized leadership, both at the dyadic level as well as at the triadic level. In our

**Table 2**

Descriptive statistics and correlations for univariate networks.

	Formal leadership		Informal leadership	
	Influence		Advice	Support
No. of participants	23		23	23
Density (proportion of actual connections/maximum number of connections)	0.1621		0.1602	0.1640
In-degree centralization (network concentration or distribution)	73.347%		35.744%	36.655%
Mean no. of arcs per node (Std Dev)	3.565 (5.531)		3.522 (3.657)	3.391 (4.080)
QAP correlation coefficient				
Influence	–		0.551*	0.105
Advice			–	0.305*
Support				–

\*  $p \leq 0.05$ .

**Table 3**  
Univariate ERGMs.

Network properties	Parameters	Influence estimate (approx S.E.)	Advice estimate (approx S.E.)	Support estimate (approx S.E.)
Structural effects	Density	−3.461* (0.537)	−3.944* (0.824)	−4.729* (0.857)
	In-2 star (centralization)	0.458* (0.091)	0.529* (0.153)	3.529* (1.152)
	In 3 star	0.027 (0.016)	−0.535* (0.146)	−2.539* (1.146)
Restricted exchange	Reciprocity	0.533* (0.101)	1.571* (0.544)	1.904 (1.190)
Generalized exchange	Transitivity	0.045 (0.087)	0.611* (0.111)	1.154 (0.995)
	3 cycle	0.101 (0.236)	−1.889 (1.049)	1.889* (0.488)
Actor attributes	Professional status-homophily	0.572* (0.277)	1.706* (0.804)	1.016 (0.901)
	Professional status-receiver	0.228 (0.418)	0.147 (0.588)	0.123 (0.513)
	Seniority-homophily	1.832* (0.537)	0.802 (0.797)	−1.078 (1.090)
	Seniority-receiver	−0.101 (0.271)	0.036 (0.571)	0.589 (0.807)
	Coordination-homophily	1.628* (0.503)	0.554 (0.608)	2.930 (1.579)
	Coordination-receiver	0.161 (0.244)	−0.231 (0.694)	0.316 (0.553)

\*  $p \leq 0.05$ .

support network, the ties may be typically based on shared interests among participants. If so, it may be that support can contribute to influence in the network rather than influence being only an outcome of ongoing formal relationships.

Finally, in terms of exogenous controls, we found significant actor attribute parameters (seniority, professional status and being in a coordination role) for the leadership influence network, suggesting that they are driving the concentration of ties in the network. Actor attributes were modeled as homophily effects, and we find that similarity in status in our leadership influence network provides a strong signal of hierarchy and may be an important mechanism in reducing uncertainty in the selection of leadership partners. The lack of structuring leadership influence of the formal organization is particularly interesting because the pluralized leadership literature tends to promote the view that formal leadership structures matter for pluralization, requiring intensive cooperation among the participants in terms of shared responsibilities and tasks (Gronn, 2002). In contrast, only one of our actor attribute parameters was found to be significant for our advice network (professional status) and none for the support network. The findings suggest that actor attributes in terms of similarity of status matter little for the formation of informal network ties. In terms of the receiver effects for our actor covariates, there is no indication of a receiver effect in our univariate models. This suggests that members with higher status are not any more likely to be sought out for influence or informal ties.

#### Multivariate ERGM

We now explore cross-network effects. We focus our discussion mainly on the multivariate model and refer to the univariate models only to highlight interesting changes. The multivariate ERGM presented in Table 4 indicates that, in terms of structural effects, the density influence, density advice and density support parameters are all negative and significant. The findings suggest that there is significant interaction between the participants. Our 2 star measure was also significant, which suggests that our multivariate network exhibits centralization. In terms of restricted exchange, the parameter estimates for reciprocity influence and reciprocity advice are positive and significant, indicating that each network interaction is through direct reciprocity and rarely occurs in isolation. In both cases this indicates that the participants tend to reciprocate leadership nominations as well as advice. None of the parameters capturing generalized exchange (3-cycle and transitivity) were significant. Additionally, it should be noted that actor attributes effects that are present in the univariate models drop out when considering the multivariate level, suggesting that actor attributes do not matter in our multivariate model. The inclusion of these effects did not lead to an improvement of the pseudolikelihood ratio statistics, and were thus eliminated from the model.

#### Exchange

In terms of the cross-network effects of mutual exchange, we argue that the exchange of ties is more likely to occur where there is a difference in the content of the ties involved; i.e. when one tie is instrumental and the other tie is expressive. From Table 4 it can be seen that the only significant parameter was that for informal instrumental leadership ties and informal expressive (support) ties being characterized by mutual exchange, which supports hypothesis 1. The finding can be interpreted as indicating the following: those that receive support tend to nominate the supporter as having leadership influence. Informal

**Table 4**  
Multivariate ERGM.

Network properties	Parameters	Estimate <sup>a</sup> (approx. S.E.)
Structural effects	Density influence	−2.113* (0.375)
	Density advice	−1.014* (0.310)
	Density support	−2.146* (0.446)
	In-2 star (centralization)	0.295* (0.031)
Restricted exchange	Reciprocity influence	1.092* (0.501)
	Reciprocity advice	2.274* (1.068)
	Reciprocity support	−0.292 (0.880)
Generalized exchange	3 cycle-influence	0.101 (0.029)
	3 cycle-advice	−0.130 (0.099)
	3 cycle-support	0.102* (0.046)
	Advice–support–influence	1.216* (0.503)
	Influence–advice	0.642 (0.927)
	Influence–support	0.080* (0.040)
Cross-network effects: mutual exchange	Advice–support	−0.249 (0.737)
	Mutual entrainment Influence–advice	0.110* (0.045)
	Influence–support	−0.282 (0.910)
Cross-network effects: mutual entrainment	Professional status	Dropped
	Seniority	Dropped
	Status	Dropped

<sup>a</sup> The final  $-2\log$  pseudolikelihood ( $-2LPL$ ) = 643.49 and the MAR = 0.11. The parameters are pseudolikelihood estimations and the approximate standard errors are given in brackets. Substantial effects are where the parameter estimate equals at least twice its standard error.

\*  $p \leq 0.05$ .

(expressive) support, therefore, seems to be important in the context of reciprocity, as conferring informal support on another participant may encourage reciprocation in the form of leadership influence.

#### Entrainment

Drawing on the logic of social entrainment [McGrath et al. \(1984\)](#), we suggest that two ties are more likely to be entrained when they are similar in terms of their function. Regarding mutual (dyadic) entrainment, the parameter estimates were positive and significant for informal instrumental leadership and informal instrumental (advice) networks, indicating that if an informal instrumental leadership tie connects two participants, they are more likely to be also linked by an informal instrumental advice tie. The finding is also re-enforced through the QAP correlation results in [Table 2](#), which indicated a strong association between informal leadership influence and informal instrumental (advice) networks. Hence we find support for hypothesis 2. In contrast we found no evidence for the mutual entrainment between informal leadership influence and informal expressive (support) networks, which were more likely to be mutually exchanged as outline above.

#### Discussion

Our study addresses calls for more scholarly attention to be paid to the micro-dynamics through which pluralized leadership is enacted ([Brass, 2001](#); [Carson et al., 2007](#); [Carter & DeChurch, 2012](#); [Contractor et al., 2012](#); [Mehra et al., 2006](#)). In particular we extend understanding of the spread of leadership influence at a more micro-level of analysis, involving local level interactions derived from social relations ([Denis et al., 2012](#); [Friedrich et al., 2009](#); [Yammarino et al., 2012](#)). We built on the insights of [Sparrowe and Liden \(1997\)](#) and [Balkundi and Kilduff \(2006\)](#), to examine how the enactment of pluralized leadership is shaped by local interactions derived from social relations. Drawing on recent developments in the area of SNA, employing ERGMs (see: [Pattison & Wasserman, 1999](#); [Robins et al., 2007](#)), we have been able to show a complex pattern of interdependencies between informal leadership influence and informal networks, where patterns of interaction occur in the context of other interactions ([Lazega & Pattison, 1999](#)). We contribute to the existing literature in the following ways.

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First, we contribute to the emerging stream of research that emphasizes the need for an understanding of how leadership influence interacts with local interactions derived from social relations (Friedrich et al., 2009). The findings from our univariate ERGMs reveal that extra-dyadic regularities tend to be found in informal leadership ties, whereby transitive relations tend to appear with advice ties and cyclical relations with informal support, but appear absent in relation to formal leadership ties. Then, building on the work of Lazega and Pattison (1999) and Rank et al. (2010), we examined the patterns of interactions across multiple forms of leadership ties using multivariate ERGMs, focusing on the interactions between informal instrumental leadership networks and informal instrumental (advice) and expressive (support) networks. Our findings suggest that pluralized leadership is not limited to singular types of network tie, but as suggested by Sparrowe and Liden (1997), may encompass several different forms of network ties simultaneously. The cross network effects (via exchange and entrainment) seen in these relationships, however, depend on the types of ties involved as detailed below. Incorporating both leadership influence and informal social relations enables us to explore a more widespread enactment of pluralized leadership than evident in some empirical studies (Buchanan et al., 2007; Huxham & Vangen, 2000).

Second, with regard to the cross-network effects of exchange, we drew on social exchange theory to argue that participants use the calculus of mutual exchange when building and maintaining ties with each other. Based on the principle of direct reciprocity (see: Bearman, 1997; Yamagishi & Cook, 1993) we argue that mutual exchange will be more likely to occur when there is a difference in the content of the ties involved; i.e. when one tie is informal instrumental and the other tie is informal expressive. Our findings support this argument, and offers important insight into the conditions under which mutual exchange is more likely to occur between different ties.

Third, extending the work of Lazega and Pattison (1999) and Rank et al. (2010), we modeled the cross network effects of entrainment across informal networks and informal leadership networks. To develop our understanding of the conditions under which informal networks and informal leadership ties will be entrained we drew on the logic of social entrainment (McGrath et al., 1984). As expected, we found entrainment between instrumental leadership influence and informal instrumental advice network ties. In addition, we also were able to model for, and find, the presence of collective entrainment, which was enacted in a pattern consistent with mutual entrainment.

Fourth, our work attests to the complex patterns of interdependencies that exist between perceived leadership influence and informal social relations, and how leadership resources can flow in the opposite or the same direction. We suggest, therefore, that it is important to be able to examine the different ways in which informal networks may interact, as only focusing on one or two types of relations will provide a limited and partial insight into the extent to which leadership is really pluralized. Furthermore, we highlight that the significance of actor attributes in shaping networks, fall away when we move from our univariate analysis of leadership influence to our multivariate analysis modeling the cross network effects of leadership influence and informal networks. We suggest that such a finding may indicate the importance of modeling multiple informal networks, as they may have a greater effect on the shaping of differences in status and/or network role.

Finally, the vast bulk of extant research has tended to focus on a general conception of leadership, and as a consequence, our knowledge of pluralized leadership remains under-developed (Denis et al., 2012). We suggest that by focusing on the relational mechanisms through which leadership is enacted our study offers insight to how activities that constitute leadership influence might be distinguished from other organizational activities. In particular, we draw on a broader concept of leadership by examining the informal support and advice networks that constitute an important component of pluralized leadership (Friedrich et al., 2009). By focusing on informal support and advice networks, as well as leadership influence, we are able to explore aspects of pluralized leadership that extant research may not recognize as “leadership influence”, but are reflected in the patterns of social exchange and entrainment across the different networks. Hence, our approach enables us to develop a broad concept of leadership, moving beyond a narrow conceptualization of formal leadership influence, yet at the same time differentiating between leadership and non-leadership activities.

## Limitations and future research

In terms of future research, we suggest that it is important that scholars of PL broaden their focus to acknowledge that leadership may be embedded in multiple forms of network relations. The importance of multiplex relationships between two (or more) actors has had a long history in social network research, being viewed as a defining feature relational pluralism (Shipilov et al., 2014). There exists, however, very little research on effects of multiplexity or the effects of heterogeneous relations on leadership (and specifically pluralized leadership). Furthermore, although interest in the mechanisms behind multiple network ties in organization has increased (Tortoriello, Reagans, & McEvily, 2012), the focus has been on dyadic relations, with more collective forms of tie interdependencies remaining an important research gap (Shipilov et al., 2014). Hence, we argue that scholars should build on our work, drawing on recent developments in SNA, to examine and better understand the complexity of cross-network relationships from which more widespread pluralized leadership might derive.

In addressing the point above, we suggest that our work can help in contributing toward the construct validity via providing some insight into a potential “nomological network” of leadership endeavor (Mumford et al., 2012). In modeling the relationships between perceptions of leadership influence, and the cross network effects with informal relations, we have attempted to enhance our understanding of pluralized leadership by considering under what conditions we will find multiplexity. As our study contains multiple variables that are proposed as being differentially related to pluralized leadership, we regard that our work can inform a nomological network approach to the validation of this concept. However, our research is only a first attempt to model the

multiplexity of relations encompassed within pluralized leadership, and much work would be required to refine and validate any such approach.

As with all research our work is not without limitations, some of which provide additional potential avenues for future research. First, our data is drawn from a single case study of an English public services network form of organization. Clearly, any single case study limits the generalizability of findings, therefore, there is a need for others to conduct similar studies across a range of empirical settings.

Second, our data is based on a cross-sectional research design, which only provides a snap-shot of the network structures. We suggest that in the future researchers should try and employ more longitudinal research designs to explore the dynamics and enactment of pluralized leadership over time. Recently, there have been developments around longitudinal versions of ERGMs to investigate network dynamics (e.g. Hanneke, Fu, & Xing, 2010; Krivitsky & Handcock, 2014). Several scholars have reported early work along these lines, including the evolution of multiple networks (e.g. Cranmer, Desmarais, & Kirkland, 2012; Snijders, Van de Bunt, & Steglich, 2010). However, multiple network variants of existing models for longitudinal networks are still under-developed. Over the next few years, attention to dynamics will be at the cutting edge of social network research, both empirically and methodologically.

Third, a final limitation concerns the validity of our network measures. Our data collection method may have inflated the observed correlations among our variables, via common method bias, so obscuring their true relationship (Avolio, Yammarino, & Bass, 1991). In socio-metric research, other researchers have routinely acknowledged this problem (see: Podolny & Baron, 1997). In this study, the informal social networks measures were constructed differently to the influence construct, and the (QAP) correlations were below the threshold suggested by Podsakoff et al. (2003). Thus, common methods bias can neither be completely ruled out nor does it clearly present as a problem; however, the evidence seems to suggest that it is unlikely to have been a serious problem in our work.

## Conclusion

In this article we have addressed the gap in our knowledge of pluralized leadership surrounding the interplay between the leadership influence and the informal network of relations that connect people, and vice versa (see Friedrich et al., 2009; Mumford et al., 2012; Yammarino et al., 2012). In theoretical terms, we explored the conditions under which leadership influence relations may exhibit cross-network effects with informal social relations and how, focusing on mutual exchange and mutual entrainment. We did so through utilizing recent advances in SNA methods, through which we were able to demonstrate the value of the ERGM approach for understanding how the micro-level enactment of pluralized leadership is shaped by local interactions derived from social relations. We hope that our work will serve to focus future research on understanding the complex social processes that underpin the enactment of pluralized leadership, and how they are shaped over time.

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