ACADEMY OF Management Journal

Dissonant Ties in Intraorganizational Networks: Why Individuals Seek Problem-Solving Assistance from Difficult Colleagues

Journal:	*Academy of Management Journal*
Manuscript ID	AMJ-2017-0399.R3
Manuscript Type:	Revision
Keywords:	Network analysis < Analysis < Research Methods, Social networks < Group/team processes < Organizational Behavior < Topic Areas, Organization and management theory (General) < Organization and Management Theory < Topic Areas, Attitudes, cognitions, and affect (General) < Attitudes, Cognitions, and Affect < Organizational Behavior < Topic Areas

Abstract:	This paper investigates employees seeking problem-solving assistance from colleagues with whom they find it difficult to work. In so doing, the paper introduces the construct of dissonant ties: network ties to colleagues that are simultaneously positive and negative. The study builds on the assumption that individuals in knowledge-intensive workplaces employ dissonant ties to access distinct work-related benefits, and establishes a link between dissonant ties and performance. Subsequently, it provides an in-depth analysis of employees' willingness to rely on this potentially unpleasant but instrumental networking behavior, and suggests that formal hierarchical rank, tenure, and unit membership as critical elements of the organizational architecture drive dissonant tie formation. In the empirical analysis, the study utilizes survey and interview data collected from engineers in a large manufacturing firm. The findings confirm that seeking problem-solving assistance from difficult colleagues entails performance benefits. Moreover, the embeddedness of individuals in the organizational architecture shapes the employment of dissonant ties. Dissonant ties are, hence, context driven. By simultaneously addressing the consequences and the drivers of employees' networking behavior, the study presents a comprehensive theory of dissonant ties that challenges and refines previous research on the interplay between positive and negative networks.

Dissonant Ties in Intraorganizational Networks: Why Individuals Seek Problem-Solving Assistance from Difficult Colleagues

Julia Brennecke
University of Liverpool
Chatham Street, Liverpool, L69 7ZH
United Kingdom
julia.brennecke@liverpool.ac.uk

Acknowledgements: The author thanks Jill Perry-Smith and the anonymous reviewers as well as Tom Elfring and colleagues at the University of Liverpool Management School, Alexandra Gerbasi, Dean Lusher, Andrew Parker, Garry Robins, Peng Wang, and participants of the 2016 EGOS colloquium and the 2017 Academy of Management meeting for their very helpful comments and advice.

DISSONANT TIES IN INTRAORGANIZATIONAL NETWORKS: WHY INDIVIDUALS SEEK PROBLEM-SOLVING ASSISTANCE FROM DIFFICULT COLLEAGUES

ABSTRACT

This paper investigates employees seeking problem-solving assistance from colleagues with whom they find it difficult to work. In so doing, the paper introduces the construct of dissonant ties: network ties to colleagues that are simultaneously positive and negative. The study builds on the assumption that individuals in knowledge-intensive workplaces employ dissonant ties to access distinct work-related benefits, and establishes a link between dissonant ties and performance. Subsequently, it provides an in-depth analysis of employees' willingness to rely on this potentially unpleasant but instrumental networking behavior, and suggests that formal hierarchical rank, tenure, and unit membership as critical elements of the organizational architecture drive dissonant tie formation. In the empirical analysis, the study utilizes survey and interview data collected from engineers in a large manufacturing firm. The findings confirm that seeking problem-solving assistance from difficult colleagues entails performance benefits. Moreover, the embeddedness of individuals in the organizational architecture shapes the employment of dissonant ties. Dissonant ties are, hence, context driven. By simultaneously addressing the consequences and the drivers of employees' networking behavior, the study presents a comprehensive theory of dissonant ties that challenges and refines previous research on the interplay between positive and negative networks.

> *Some older chaps like [name] and I, we're reputed to be difficult people. But really only because it's our attitude to it all. We're combative… That's almost aggressiveness in modern engineering… You have to take a sort of pseudo-aggressive mode and not just give them the answer to a problem. That's not the game that we play. We challenge them to reflect on their decisions and assumptions… And so we're difficult to get along with because we just won't tell them what to do.*
>
> *Interview with long tenured engineer*

> *Most of the people that are difficult to work with tend to be people that work very hard…They are very bright and think quicker than the rest of us. They can see the issue and they don't understand why you don't see the issue… So, if you can channel the awkwardness but get the output from them, they can actually make you look good. I've got a guy I work with… and he's an incredibly hard worker, but he's very self-opinionated, which a lot of people find very difficult to deal with. I just swear at him and tell him where to go, but I get a huge amount of work out of him. It makes me look really good. So I'm prepared to put up with that.*
>
> *Interview with engineer*

According to social ledger theory (Labianca & Brass, 2006), networks of positive ties and networks of negative ties co-exist in the workplace. Comparable to the two sides of the financial ledger, employees derive benefits from networks of positive professional or personal ties, such as advice seeking, knowledge transfer, or friendship, (e.g., Cross & Cummings, 2004; Sparrowe, Liden, Wayne, & Kraimer, 2001). Conversely, negative tie networks, which may include dislike, avoidance, or difficult working relationships, result in liabilities and have negative implications for those involved (e.g., Baldwin, Bedell, & Johnson, 1997; Schulte, Cohen, & Klein, 2012). Based on this duality, social ledger theory emphasizes the importance of jointly investigating positive and negative networks and, thereby, comprehensively capture organizational reality (Labianca & Brass, 2006). However, social ledger theory implicitly assumes that an employee's positive and negative network ties are mutually exclusive and not directed at the same individuals. Accordingly, many studies that jointly examine positive and negative ties in the workplace regard them as two ends of a continuum: friends versus foes (e.g., Sherf & Venkataramani, 2015), supportive versus antagonistic (Chiaburu & Harrison, 2008), or energizing versus de-energizing (e.g., Parker, Gerbasi, & Porath, 2013).

In this study, I demonstrate that this assumption is short-sighted, as two employees may simultaneously be connected by positive and negative network ties. Indeed, recent research on workplace relationships proposes that individuals may be friends with their competitors (Ingram & Roberts, 2000), "frenemies" connected by ambivalent relationships (Melwani & Rothman, 2015; Methot, Melwani, & Rothman, 2017), or colleagues who seek advice from each other even if their relationship is conflictual (Marineau, Hood, & Labianca, 2018). This overlap of positive and negative ties can be seen as a specific form of network multiplexity—the co-existence of multiple types of network ties between two individuals (Kilduff & Brass, 2010).

In line with the opening quotes, this study conceptualizes the multiplexity of positive and negative ties in terms of individuals seeking problem-solving assistance from colleagues with whom they find it difficult to work. Problem-solving networks consist of professional network ties, which serve as conduits of task-relevant knowledge and support (Casciaro, Gino, & Kouchaki, 2014; Shah, Cross, & Levin, 2018). They are particularly important for knowledge-intensive work (Hargadon & Bechky, 2006). The decision to turn to someone for problem-solving assistance reflects a cognition-based positive evaluation of that person (Nebus, 2006). In contrast, difficult working relationships are negative network ties (e.g., Merluzzi, 2017; Schulte et al., 2012). They signal a cognition-based negative evaluation of colleagues based on their perceived quality as co-workers (Labianca & Brass, 2006); as exemplified in the opening quotes, working with those colleagues can be seen as challenging or awkward, for instance, because they appear belligerent or arrogant. Problem-solving and difficult ties can overlap, as individuals may turn to others with whom they have difficult working relationships for problem-solving assistance. Borrowing from cognitive dissonance theory (Festinger, 1957), I introduce the term "dissonant tie" to describe this positive-negative multiplexity characterized by an individual's conflicting cognitions of another person.

I argue that individuals engaged in knowledge-intensive work employ dissonant ties as an instrumental networking behavior in anticipation of distinct work-related benefits. To show that this anticipation is justified and to establish dissonant ties as a construct with significant theoretical and practical implications, I first demonstrate that seeking problem-solving assistance from difficult colleagues benefits the performance of the assistance seeker. The paper's main goal is to subsequently uncover the conditions under which individuals rely on this potentially unpleasant but instrumental form of social networking. To this end, I integrate cost-benefit theorizing (Borgatti & Cross, 2003; Nebus, 2006) with research on the importance of the organizational context for network tie formation (e.g., Blau, 1955; Lincoln & Miller, 1979; McEvily, Soda, & Tortoriello, 2014). In particular, elements of the organizational architecture have repeatedly been shown to influence positive and negative tie networks (e.g., Kleinbaum, Stuart, & Tushman, 2013; Merluzzi, 2017; Oh, Labianca, & Chung, 2006; Soda & Zaheer, 2012). I suggest that formal hierarchical rank, tenure, and unit membership as critical architectural elements determine the benefits and costs individuals anticipate when seeking problem-solving assistance from difficult colleagues. Thereby, these elements drive dissonant tie formation in the workplace.

The study contributes to the literature on intraorganizational networks by developing and testing a comprehensive theory of dissonant ties in knowledge-intensive workplaces. Following a call by Ahuja, Soda, and Zaheer (2012), it moves beyond examinations of how the structural characteristics of networks predict outcomes to investigate how individuals proactively employ social networks to succeed at work. Focusing simultaneously on the consequences and drivers of employees' purposeful networking behavior allows me to reveal ways in which individuals secure resources that help them achieve task-related goals. As such, this study sheds light on the agentic nature of individual behavior, and adds to the nascent stream of research on instrumental networking employed in anticipation of task and professional benefits (e.g., Casciaro et al., 2014; Marineau et al., 2018; Soda, Tortoriello, & Iorio, 2018).

By merging assumptions of social ledger theory with a network multiplexity perspective, the study extends current knowledge on the interplay of positive and negative networks. First, positive network ties have generally been linked to positive performance implications and negative networks have been shown to entail negative consequences (e.g., Baldwin et al., 1997; Labianca & Brass, 2006; Sparrowe et al., 2001; for notable exceptions, see Marineau, Labianca, & Kane, 2016; Venkataramani, Labianca, & Grosser, 2013). However, the ways in which the multiplexity of positive and negative ties (i.e., dissonant ties) influence outcomes have yet to be established. Social ledger theory suggests that the consequences of positive and negative ties counterbalance each other. Shifting the accounting logic inherent in social ledger theory towards a synergistic understanding, I propose that this is not the case when the two types of ties overlap. Instead, multiplex positive-negative ties exert a unique influence on performance. Second, by examining elements of the organizational architecture as drivers of dissonant tie formation, I am able to clarify conflicting findings in previous organizational network research. Casciaro and Lobo (2008) illustrate that individuals avoid seeking assistance from colleagues they dislike. In contrast, Ingram and Roberts (2000) and Marineau et al. (2018) provide evidence that positive and negative ties can overlap. In highlighting the conditions under which individuals are willing to seek problem-solving assistance from difficult colleagues, this study demonstrates that the interplay of positive and negative intraorganizational networks and their convergence into multiplexity are context driven.

In the empirical analysis, I use a mixed-method approach, which is considered most suitable when introducing a new construct and linking it to established research (Edmondson & McManus, 2007). I rely on quantitative survey data collected from the engineering department of a large manufacturing firm, and apply regression analyses to uncover the performance consequences of dissonant ties. I then utilize exponential random graph modeling (ERGM, e.g., Lusher, Koskinen, & Robins, 2013) to investigate the factors that drive individuals to seek problem-solving assistance from difficult colleagues. EGRM allows estimating the likelihood of observing problem-solving and difficult ties—separately and overlapping as dissonant ties—and translates my theoretical arguments on the interplay of positive and negative tie formation into an appropriate statistical representation. At the same time, I build on a series of qualitative interviews with survey participants to substantiate the theoretical mechanisms behind the consequences and drivers of dissonant ties.

THEORY AND HYPOTHESES

Dissonant Ties in Intraorganizational Networks

The positive component of dissonant ties, the problem-solving tie, can be characterized as a professional network tie (Casciaro et al., 2014). Professional ties allow colleagues to exchange work-related resources and support, and to engage in joint action. They are task-oriented and cognition-based, but typically lack affect (Umphress, Labianca, Brass, Kass, & Scholten, 2003; Varella, Javidan, & Waldman, 2012). In contrast, personal network ties, such as friendship, are affect-based (Casciaro et al., 2014; Ibarra, 1993; Lincoln & Miller, 1979). Professional ties are positive as they reflect a favorable evaluation of another's potential to help with work-related problems or opportunities (Cross & Borgatti, 2004). From a value-added perspective, they are created "as a result of cognitively coalescing previous experiences, social cues, observations, and perceptions of the potential contact into an overall judgment" (Nebus, 2006: 628).

Problem-solving ties combine the knowledge and ideas of different individuals, and add instrumental value for individuals and organizations (Rodan & Galunic, 2004; Shah et al., 2018). As a form of instrumental networking (Casciaro et al., 2014), seeking problem-solving assistance is not necessarily bound to the assistance seeker's or the provider's technical expertise, nor is it part of their formal role requirements (Cross & Sproull, 2004). Hence, problem-solving ties can be characterized as informal network ties (Venkataramani & Dalal, 2007) that are deliberately created in anticipation of task and professional benefits (Casciaro et al., 2014). Unlike other forms of task-related help-seeking, such as requesting advice or feedback (e.g., Hofmann, Grant, & Lei, 2009; Mueller & Kamdar, 2011), problem-solving ties concern non-routine aspects of work (Casciaro & Lobo, 2008). They usually involve intense dialogue and high levels of cognitive engagement (Cross & Sproull, 2004), which enables learning and mutual development (Shah et al., 2018). As seeking problem-solving assistance allows employees to deal with complex tasks, it is an inherent part of knowledge-intensive work (Hargadon & Bechky, 2006).

The second component of dissonant ties—difficult working relationships—is a specific type of negative network tie. Negative ties have been defined as interpersonal attitudes that "represent an enduring, recurring set of negative judgments, feelings, and behavioral intentions toward another person—a negative person schema" (Labianca & Brass, 2006: 597; italicized in the original). They often involve conflict, jealousy, or rejection (Methot et al., 2017), and have detrimental work-related consequences (e.g., Baldwin et al., 1997; Sparrowe et al., 2001; Venkataramani et al., 2013). Similar to positive network ties, there are different types of negative ties. As highlighted by Labianca and Brass (2006) and Labianca (2014), they may be affective (e.g., dislike; Casciaro & Lobo, 2008); behavioral (e.g., avoidance; Venkataramani et al., 2013); or cognitive (e.g., finding colleagues difficult to work with; Klein, Lim, Saltz, & Mayer, 2004; Merluzzi, 2017; Schulte et al., 2012).

In line with this study's focus on problem-solving ties founded on cognition-based positive person evaluations, I examine difficult working relationships as cognition-based negative ties (Labianca, 2014). Difficult ties reflect a cognition-based rather than affective interpersonal attitude because the difficulty assessment concerns others' perceived quality as co-workers. Akin to positive, professional ties, they result from the cognitive coalescence of experiences, cues, and observations of another individual into an overall judgement. In this case, the judgement is negative because the perception of that individual's work-related qualities is unfavorable. Highlighted by the opening quotes, difficulty may refer to a range of qualities, such as being challenging and playing devil's advocate, coming across as aggressive, arrogant, and self-opinionated, or being otherwise awkward to deal with. Different priorities, interpersonal differences, and being perceived as hindering may also contribute to the emergence of difficult ties (e.g., Hardavella, Saad, & Bjerg, 2015; Klein et al., 2004; Schulte et al., 2012; Sparrowe et al., 2001).

Problem-solving and difficult network ties share common ground, as both evoke certain cognitive schemas regarding other persons' work-related qualities (Fiske & Taylor, 2008), thereby influencing individuals' behaviors toward them (e.g., Sherf & Venkataramani, 2015; Venkataramani & Dalal, 2007). At the same time, the evoked cognitions conflict: favorable evaluations of another person's problem-solving capacity draw individuals towards that person while finding someone difficult keeps individuals away from that person. Nevertheless, the two types of ties may overlap. Borrowing from cognitive dissonance theory (Festinger, 1957), I use the term "dissonant tie" to describe multiplexity of problem-solving and difficult ties. I define dissonant ties as the overlap of network ties characterized by an individual's conflicting cognitions of another person. Hence, dissonant ties comprise associative and dissociative forces. In line with cognitive dissonance theory, their formation can be seen as counter-attitudinal behavior, which occurs when individuals act in conflict with their cognitive attitudes (Hinojosa, Gardner, Walker, Cogliser, & Gullifor, 2017). Dissonant tie formation involves agency. Building on a recent conceptualization of instrumental networking (Casciaro et al., 2014), it reflects individuals' conscious and purposeful engagement in counter-attitudinal behavior in anticipation of task and professional benefits.

Just like their positive and negative components, dissonant ties are based on cognition. More specifically, they are characterized by tie-inherent cognitive inconsistency. Like all cognition-based ties, they may be intertwined with affect (Casciaro & Lobo, 2015; Lawler, 2001) and, for instance, give rise to feelings of discomfort (Hinojosa et al., 2017). However, attitudinal judgements and their behavioral consequences can also operate on a purely cognitive basis (Eagly & Chaiken, 1998). Accordingly, the employment of cognition-based positive-negative ties as a form of instrumental networking behavior, rather than their affective effects, will be the main focus of this research. Moreover, dissonant ties are conceptually related to but distinct from relational ambivalence, which has recently attracted the attention of management scholars (Rothman, Pratt, Rees, & Vogus, 2017). Defined as "the simultaneous experience of positive and negative emotional or cognitive orientations toward a person, situation, object, task, goal, or idea" (Rothman et al., 2017: 33), ambivalence has been argued to be void of any behavioral component (Ashforth, Rogers, Pratt, & Pradies, 2014)—such as the formation of network ties. In other words, the assumption that individuals consciously seek ambivalence is inconsistent with existing views, while the literature on dissonance explicitly allows for individuals' engagement in counter-attitudinal behavior to achieve desired outcomes (Hinojosa et al., 2017).

Given the inherent tension between positive and negative cognitions in dissonant ties, under which conditions are individuals willing to adopt this counter-attitudinal behavior by seeking problem-solving assistance from difficult colleagues? To answer this question, I first argue that dissonant ties positively affect the performance of assistance seekers. Thereby, I show that individuals' anticipation of benefits from dissonant ties is actually justified. In proposing that dissonant ties are antecedents of performance, I follow the vast majority of theoretical (e.g., Labianca & Brass, 2006) and empirical (e.g., Balkundi & Harrison, 2006) research on the network-performance relationship in organizational settings. The underlying assumption is that network ties, in this case dissonant ties, serve as conduits for benefits or liabilities that influence employees' abilities to get things done (Ibarra, 1993). Second, I undertake an in-depth analysis of the employment patterns of dissonant ties, investigating the drivers of cognition-based positive-negative tie formation as a form of instrumental networking behavior. In line with the cognitive conceptualization of dissonant ties, I argue that their formation follows a cost-benefit evaluation (Borgatti & Cross, 2003; Nebus, 2006), which is driven by elements of the organizational architecture. The conceptual framework, which integrates the consequences and drivers of dissonant ties, is summarized in Figure 1.

--- Insert Figure 1 about here ---

Performance Consequences of Dissonant Ties

In knowledge-intensive work, performance is largely a product of solving complex, ill-structured tasks with multiple possible solutions and solution paths by applying creativity and analytical thinking (Alvesson, 2004; Cross & Cummings, 2004; Vincenti, 1990). Effective employees are able to work out a solution for a given task despite numerous constraints related to the task itself (e.g., the amount of time and money available) or its outcomes (e.g., costs, product features, or service features) (Sheppard, Colby, Macatangay, & Sullivan, 2007; Stokes, 2014). To arrive at a solution, employees in knowledge-intensive workplaces habitually seek assistance via professional network ties. Problem-solving interactions in which assistance providers offer constructive criticism and prompt new perspectives (Hargadon & Bechky, 2006; Shah et al., 2018) enhance assistance seekers' abilities to generate solutions to the complex tasks they face (e.g., Rodan & Galunic, 2004). In line with social ledger theory, these positive networks, hence, entail performance benefits. In contrast, difficult ties, as negative network relationships, result in liabilities, such as reduced perceived psychological safety (Schulte et al., 2012) and negative impacts on performance (Baldwin et al., 1997).

The performance consequences of positive-negative tie multiplexity have not previously been examined. Social ledger theory assumes an additive interplay of the consequences of positive and negative networks. That is, the benefits and costs that the two types of ties entail counterbalance each other. This logic would suggest that dissonant ties have a neutral effect on performance. However, merging social ledger theory with a network multiplexity perspective, this assumption may no longer hold. Overlapping as dissonant ties, positive and negative network ties may bring about consequences that differ from neutrality. Suggesting a synergistic interplay, I argue that seeking problem-solving assistance from difficult colleagues gives rise to three distinct benefits that promote performance in knowledge-intensive work.

First, the employment of dissonant ties as networking behavior provides access to unique resources. Specifically, it allows sourcing and benefiting from rare problem-solving capabilities or knowledge not extensively used within an organization as a reputation of being difficult to work with dissuades the majority of employees from approaching a colleague. This assumption is in line with findings on individuals' help-seeking preferences—individuals typically target others who are accessible and with whom it is easy to interact (e.g., Borgatti & Cross, 2003; Hofmann et al., 2009). It is also consistent with the finding that employees often concur on which colleagues they find difficult (Robins, Pattison, & Wang, 2009). By risking to approach a difficult person, investing the time and mental resources needed to cope with potential distress (Denham, Ackers, & Travers, 1997; Melwani & Rothman, 2015), or, put simply, being "prepared to put up with that" (opening quote #2), assistance seekers relying on dissonant ties gain a competitive advantage. Accessing capabilities and knowledge not extensively used by their colleagues and combining them with their own knowledge, they can increase the likelihood of constructing viable solutions to their complex tasks (Hargadon & Bechky, 2006).

The performance benefits of dissonant ties do, however, not depend on colleagues being widely regarded as difficult. Dissonant ties can also be idiosyncratic, resulting from interpersonal differences (Robins et al., 2009) and can still promote performance. A second rationale for employees involved in knowledge-intensive work to consciously seek problem-solving assistance from difficult colleagues lies in the desire to have their assumptions challenged. As described in the opening quotes, difficult working relationships can be triggered by individuals questioning others' decisions and assumptions or presenting opposing opinions. Hence, dissonant ties imply confrontation with disagreement, dissenting viewpoints, and diverse perspectives that assistance seekers have not previously considered. These factors have been linked to divergent thinking and an expansion of focus (e.g., Nemeth, 1995; Nemeth & Kwan, 1987), which are critical for knowledge-intensive work (Alvesson, 2004). They may lead to reflective reframing (Hargadon & Bechky, 2006), a shift in the conception of a given problem, and the uncovering of novel connections, thereby allowing for alternative recognition and enhanced solution generation. Evidence of individuals deliberately employing such networking behavior to succeed at work is provided by Marineau et al. (2018), who demonstrate that employees seek advice from colleagues with whom they have task conflicts, presumably to prevent groupthink (Janis, 1972). Establishing the link to performance, research on devil's advocacy and dialectical inquiry suggests that intentional use of such strategies leads to superior outcomes (Schweiger, Sandberg, & Rechner, 1989).

The two arguments outlined above explicitly build on the conceptualization of dissonant tie formation as a form of instrumental networking—employees consciously seek problem-solving assistance from difficult colleagues anticipating access to unique resources and challenge of their assumptions. While they do not necessarily drive individuals' networking behavior, unintended cognitive processes may additionally play a role in the influence of dissonant ties on performance. Dissonant ties are characterized by cognitive inconsistency, which may give rise to distress or perceived unpleasantness (Festinger, 1957). This may be distracting and shift attention away from jointly generating problem solutions to engaging in coping strategies (Denham et al., 1997; Hinojosa et al., 2017); yet, several studies provide evidence that perceived inconsistencies may actually promote performance. Research on their cognitive consequences has linked dissonance and controversy to enhanced cognitive activity, creativity, and performance (e.g., De Dreu & De Vries, 1997; Harmon-Jones, 2012; Schulz-Hardt, Mojzisch, & Vogelgesang, 2007). Dissonant attitudes increase the intensity of information processing (Rydell, McConnell, & Mackie, 2008; Schulz-Hardt et al., 2007), while controversy leads individuals to find more novel solutions (De Dreu & De Vries, 1997; Nemeth & Kwan, 1987). The tension between positive and negative cognitions experienced when approaching difficult colleagues for assistance may, hence, function as a cognitive catalyst in employees' search for solutions to complex tasks. All three mechanisms—access to unique resources, challenge of assumptions, and cognitive catalysis—involve a synergistic rather than additive interplay of cognition-based positive-negative tie multiplexity and suggest:

H1: There is a positive relationship between individuals employing dissonant ties and their performance.

Drivers of Dissonant Tie Formation in the Workplace

In this section, I argue that employees consciously decide whether to seek problem-solving assistance from difficult colleagues by weighing the distinct benefits associated with dissonant ties against their perceived costs. Specifically, in line with the conceptualization of dissonant ties as based on cognitions, I build upon a cognitive-consequentialist approach to instrumental networking behavior centered on cost-benefit evaluations (Borgatti & Cross, 2003; Nebus, 2006). This approach matches the accounting logic inherent in social ledger theory. At the same time, by bringing in positive-negative tie multiplexity, I again move beyond a key assumption of social ledger theory, namely that the benefits of positive ties are compared to the costs of negative ties. I reason that employees assess dissonant ties as a whole by comparing the benefits of the combined positive-negative ties to their combined costs. As I outline in detail below, they weigh the benefits of access to unique resources and challenge of assumptions against potential unpleasantness resulting from tie-inherent cognitive inconsistency and practical risks associated with approaching a difficult colleague. Similar to mere problem-solving and difficult ties, dissonant tie formation is, hence, based on the cognitive coalescence of experiences, perceptions, cues, and observations of another individual—which in this case are simultaneously positive and negative—into an overall cost-benefit judgement.

As a critical aspect determining the net benefits an employee will associate with dissonant ties and, thus, a critical driver of dissonant tie formation, I draw attention to the organizational context, which has long been argued to shape work-related cognitions and behaviors (e.g., Elsbach, Barr, & Hargadon, 2005; March & Simon, 1958; Simon, 1990), including networking behavior (e.g., Blau, 1955; Lincoln & Miller, 1979; McEvily et al., 2014). Suggesting that the interplay of positive and negative intraorganizational networks is context driven, I investigate employees' formal hierarchical rank, tenure, and unit membership as contextual elements that define their embeddedness in the organizational architecture. These contextual elements specify roles, responsibilities, resource endowments, and authority levels (Galbraith, 1973; March & Simon, 1958), and they create intraorganizational boundaries, thereby providing a basis for self-categorization (Hogg & Terry, 2000; Turner, 1987). As such, they influence which benefits and costs employees associate with specific types of network ties. Accordingly, they have repeatedly been highlighted as important determinants of positive and negative tie formation (e.g., Kleinbaum et al., 2013; Labianca, Brass, & Gray, 1998; McEvily et al., 2014; Merluzzi, 2017; Oh et al., 2006; Soda & Zaheer, 2012; Srivastava & Banaji, 2011).

Formal hierarchical rank creates a vertical organizational boundary accompanied by power differentials, which are reflected in the unequal distribution of resources, responsibilities, and decision-making rights. High-ranking employees have more formal power and authority than low-ranking employees; they typically control the allocation of means, rewards, and punishments (French & Raven, 1959), influence promotion decisions and have superior access to resources (March & Simon, 1958), and are able to provide administrative support (Ibarra, 1993). In contrast, tenure is not part of the formal organizational structure, and it is not associated with formal power and access to resources. However, differences in tenure also create a vertical boundary between employees, as longer tenure is associated with greater experience and more tacit knowledge about the organization (Becker, 1964), higher levels of expert power (French & Raven, 1959), and the potential ability to provide superior technical and task-related support (Ibarra, 1993). Although some organizations consider tenure a criterion for promotion, it is not necessarily related to formal hierarchical rank (Ng & Feldman, 2010). Particularly in knowledge-intensive workplaces, high-ranking positions that comprise leadership responsibilities are increasingly staffed with external hires (Royal & Althauser, 2003); at the same time, longer tenured knowledge workers are often less interested in taking on leadership roles and instead pursue expert careers (Allen & Katz, 1986; Brousseau, Driver, Kristina, & Larsson, 1996). In addition to formal hierarchical rank and tenure, I consider employees' membership in discrete units, such as divisions, functions, or work teams. Unit membership creates horizontal boundaries in the organization, and the antecedents and consequences of network ties spanning these boundaries are among the most popular topics in organizational network research (e.g., Kleinbaum et al., 2013; Lomi, Lusher, Pattison, & Robins, 2014). Due to their different resource implications (e.g., formal or expert power) and ways of structuring the organization (e.g., vertical or horizontal boundaries), formal hierarchical rank, tenure, and unit membership are assumed to exert unique influences on evaluations of the benefits and costs associated with network ties and, hence, affect tie formation.

To provide a comprehensive picture of how the different elements of the organizational architecture drive dissonant ties, I follow Cross and Sproull (2004) in considering tie formation from three perspectives: ego, alter, and dyad. The *ego perspective* focuses on the individual (the "ego") proactively engaging in instrumental networking. Previous research shows that low-ranking and shorter tenured egos are particularly likely to seek advice and information (e.g., Lazega, Mounier, Snijders, & Tubaro, 2012; Lomi et al., 2014), but not necessarily problem-solving assistance (Cross & Sproull, 2004). Moreover, formal hierarchical rank is positively related to egos finding colleagues difficult (Merluzzi, 2017). In this study, the ego perspective sheds light on how egos' embeddedness in the organizational architecture affects their evaluation of the benefits and costs of dissonant tie formation and, thereby, influences the propensity to seek problem-solving assistance from difficult colleagues—irrespective of the organizational embeddedness of those colleagues.

The latter is attended to from the *alter perspective* describing the relationship between alters' embeddedness in the organizational architecture and their being approached with dissonant ties. Prior research demonstrates that high-ranking and longer tenured alters are typically sought-after and valued advisors (e.g., Lazega et al., 2012; Lincoln & Miller, 1979). High-ranking employees can offer administrative guidance and authoritative legitimacy, and longer tenured colleagues often possess superior subject-matter expertise, experience, and expert legitimacy (Becker, 1964; Ibarra, 1993). At the same time, high-ranking and longer tenured colleagues are more likely to be perceived as difficult due to the vertical boundaries and the associated power differences that separate them from their colleagues.

Finally, the *dyad perspective* refers to the two parties—the individual employing the dissonant tie and the difficult assistance provider—as a unit. It allows adding a unique focus on boundary spanning to the analysis, examining whether dissonant tie formation is more likely within or across vertical and horizontal boundaries in the organizational architecture. Prior research raises opposing expectations regarding the role of such boundaries for positive and negative tie formation. The principle of homophily proposes that individuals form positive network ties with similar others (McPherson, Smith-Lovin, & Cook, 2001); hence, within, rather than across, boundaries. At the same time, arguments that support a positive relationship between similarity and positive network ties imply a negative relationship between similarity and negative ties. Mechanisms such as similarity-attraction and in-group favoritism (Byrne, 1971; Turner, 1987), which lead to positive tie homophily, as flipside suggest the formation of negative ties among employees with dissimilar formal hierarchical rank, tenure, or unit membership and, hence, across vertical and horizontal boundaries. This raises the question of how boundaries influence the interplay of positive and negative network ties and drive dissonant tie formation.

Table 1 summarizes the distinctions among ego, alter, and dyad that guide my subsequent theorizing on the drivers of dissonant tie formation. It demonstrates that formal hierarchical rank and tenure relate to all three perspectives. In contrast, unit membership does not comprise hierarchical ordering and does, therefore, not affect ego and alter independently. Reflecting horizontal differentiation, it only concerns the dyad, as network ties may either occur between employees with the same or with different unit membership.

--- Insert Table 1 about here ---

The ego perspective. The ego perspective explains how employees' formal hierarchical rank and tenure influence their propensity to purposefully employ dissonant ties. Building on the cost-benefit logic, I argue that while high-ranking and longer tenured employees may be more inclined to find colleagues difficult (Merluzzi, 2017), low-ranking and shorter tenured employees are more likely to seek problem-solving assistance from those colleagues they find difficult. First, due to their inferior formal hierarchical and informal tenure-based power credentials, these employees should assign a comparatively high value to the benefits associated with problem-solving assistance from difficult colleagues, namely access to unique resources and challenge of assumptions. To gain these benefits and thereby potentially improve their standing in the organization, these employees should be more willing to jump through the proverbial hoops (Super, 1980) by employing dissonant ties at work. In support of this claim, psychological research on age, which is typically closely correlated with tenure (Ng & Feldman, 2010, 2013), reveals that younger employees demonstrate stronger orientations towards growth (Ebner, Freund, & Baltes, 2006; Freund, 2006). The knowledge intensity of the workplace further fuels the assumption—access to unique assistance providers and divergent thinking can foster complex problem solving and norms demand that low-ranking and shorter tenured employees speak up to ensure task success rather than keep their heads down (Cross & Parker, 2004).

Second, low-ranking and shorter tenured employees may be more willing to tolerate cognitive inconsistency and practical risks, such as interpersonal complications, associated with dissonant ties and, therefore, associate fewer costs with their formation. With regards to formal hierarchical rank, psychological research provides evidence of a negative relationship with individuals' risk-taking proclivity (Du Brin, 1988). When transposed to the employment of dissonant ties, low-ranking employees may be more willing than their high-ranking colleagues to "risk" the investment of time and mental resources necessary for simultaneously positive and negative cognition-based ties. Similarly, scholars have established a negative relationship between tenure and experimentation (Miller & Shamsie, 2001). Older, longer tenured employees prioritize tasks that are emotionally satisfying (Carstensen, Isaacowitz, & Charles, 1999) and match their personal interests (Beier & Ackerman, 2001), which indicates a preference for cognitive consistency that is inconsistent with dissonant tie formation.

In conclusion, low-ranking and shorter tenured employees should emphasize the benefits of dissonant ties to get ahead in the knowledge-intensive workplace, and they should tolerate tie-inherent inconsistency and risks. Conversely, high-ranking and longer tenured employees should associate net costs with dissonant tie formation and be less willing to endure counter-attitudinal behavior for the purpose of professional goal attainment. These arguments lead to the following hypotheses on ego's embeddedness in the organizational architecture and the formation of multiplex positive-negative ties in intraorganizational networks:

H2a: There is a negative relationship between egos' formal hierarchical rank and their employment of dissonant ties.

H2b: There is a negative relationship between egos' tenure and their employment of dissonant ties.

The alter perspective. Both an alter's formal hierarchical rank and tenure should positively affect the formation of problem-solving and difficult ties per se. However, the two elements of the organizational architecture should function differently as drivers of positive-negative tie multiplexity, that is, dissonant tie formation. Due to the different types of power and support associated with formal hierarchical rank as compared to tenure the existence of a difficult relationship should tip the balance from net benefits to net costs when employees seek assistance from high-ranking alters but not when they seek assistance from longer tenured alters.

While dissonant ties with high-ranking colleagues may yield work-related benefits, such as dissonant tie-specific benefits as well as access to resources and administrative support, their formation should be perceived as disproportionally risky. Because of their authority and control over the allocation of means, rewards, and punishments (French & Raven, 1959), high-ranking employees, who are also difficult co-workers constitute a threat, rather than an asset, to the assistance seeker. Their difficulty, for instance reflected in challenging or aggressive behavior, makes them less predictable. As they influence promotion decisions, interactions with them have the potential to produce negative career effects and other work-related costs. Given that individuals wish to avoid complications with hierarchical superiors (Bolino, Kacmar, Turnley, & Gilstrap, 2008), these risks should carry substantial weight in the cost-benefit evaluation. In fact, they should outweigh the added value of this form of instrumental networking, thereby leading employees to avoid approaching high-ranking colleagues with problem-solving requests if they simultaneously perceive those colleagues as difficult.

The same risks are not associated with dissonant ties with longer tenured alters, as they do not possess high levels of formal power and control over rewards and punishment. Instead, tenure is positively related to task experience and expert power (Becker, 1964; Ibarra, 1993) of foremost importance for knowledge-intensive work. Thus, when approaching longer tenured, difficult alters for problem-solving assistance, individuals can not only reap dissonant tie-specific benefits—access to unique resources and challenge of their assumptions. In addition, they can obtain benefits owing to these colleagues' superior knowledge and experience. Thus, approaching longer tenured alters with dissonant ties is doubly beneficial for knowledge-intensive work, which should outweigh the tie-inherent costs.

Overall, the distinction between power over rewards and punishments associated with formal hierarchical rank as opposed to task experience and expert power associated with tenure is critical for the benefits and practical risks associated with problem-solving interactions with difficult colleagues. It explains why, from the alter perspective, these two elements of the organizational architecture should function differently as drivers of dissonant ties and we need to account for both when attempting to understand the interplay of positive and negative intraorganizational networks. I hypothesize:

H3a: There is a negative relationship between alters' formal hierarchical rank and their being approached with dissonant ties.

H3b: There is a positive relationship between alters' tenure and their being approached with dissonant ties.

The dyad perspective. The dyad perspective accounts for similarity in egos' and alters' formal hierarchical rank, tenure, and unit membership, and allows for determining whether network tie formation is more likely within or across vertical and horizontal boundaries in the organizational architecture. As outlined above, prior theoretical and empirical evidence leads to opposing expectations regarding boundaries as drivers of positive and negative network ties. With respect to positive-negative multiplexity, I argue that the employment patterns of dissonant ties differ for formal hierarchical rank and tenure as opposed to unit membership. While seemingly counterintuitive, employees should establish dissonant ties within vertical boundaries but across horizontal boundaries. The following comparison of the distinct benefits and costs of dissonant ties in light of the three architectural elements will demonstrate why.

With regard to formal hierarchical rank, I suggest that although difficult ties may occur more frequently between dissimilar employees, these ties are less likely to turn dissonant. Instead, similarity of formal hierarchical rank should decrease the practical risks as well as the perceived unpleasantness that egos associate with dissonant tie formation. First, the above-mentioned risks of dissonant ties with high-ranking alters should weigh even higher for low-ranking assistance seekers. Given their lack of formal power and authority, dissonant ties with difficult alters of high formal rank should seem particularly daunting and, hence, disproportionately costly. In contrast, similarity implies a balance of formal power and control over rewards and punishments and mitigates the likelihood that negative career implications will result from problem-solving interactions with difficult colleagues. Second, a similar formal hierarchical rank establishes common ground, which is reflected in a shared language and similar thought worlds (Dougherty, 1992). This common ground may attenuate perceived unpleasantness resulting from the inconsistent cognitions inherent in dissonant ties, making it easier for the assistance seeker to focus on their instrumental benefits. This argument suggests that homophily as ubiquitous principle that guides human interaction (McPherson et al., 2001) also influences dissonant tie formation.

A similar homophily-argument applies to tenure. Even if the above theorizing predicting a negative effect of ego tenure and a positive effect of alter tenure on tie formation seems to imply that dissonant ties are formed between dissimilar employees—directed from shorter tenured to longer tenured individuals—this is not necessarily the case. The above perspectives concern egos' and alters' involvement in dissonant ties irrespective of their counterparts' tenure. Moreover, longer tenured individuals have no particular inducements to seek assistance from lower tenured, difficult colleagues. Instead, shared experiences and a common language developed among employees who entered the organization around the same time (Zenger & Lawrence, 1989) provide commonality, which should make enduring counter-attitudinal behavior for the purpose of professional goal attainment seem less costly for ego and, hence, lower the hurdles for dissonant tie formation. My reasoning that homophily might attenuate the unpleasantness associated with dissonant ties is in line with findings by Lazega et al. (2012), who show that interpersonal similarity can lessen the hindering effects of various barriers to seeking advice.

With regard to unit membership, I propose a different outcome of the cost-benefit evaluation that determines dissonant tie formation. Unit membership diverges markedly from formal hierarchical rank and tenure, as it creates horizontal rather than vertical boundaries. Moreover, it structures the day-to-day organization of work—individuals in the same unit are typically spatially co-located, collaborate closely, and meet one another frequently. Thus, even if homophily triggered by joint unit membership attenuates the perceived unpleasantness caused by cognitive inconsistency inherent in dissonant ties, the closeness that joint unit membership creates makes dissonant tie formation disproportionately risky from a practical point of view. Any complication from interactions with a difficult colleague could directly affect the workflow of not only the involved ego and alter but also of other unit members. Conversely, boundary-spanning ties are episodic and determined by nonrecurring tasks (Kleinbaum et al., 2013). Hence, cross-unit dissonant ties are likely to involve targeted interactions with few negative repercussions for the assistance seeker's day-to-day work. In other words, even if a problem-solving interaction with a difficult colleague aggravates the negative component of a dissonant tie, the unit boundary creates a safe distance between the involved parties, making it easier to avoid each other in the future. Moreover, seeking assistance from difficult colleagues in other units has the additional appeal of providing access to heterogeneous viewpoints and knowledge unavailable in ego's own unit (e.g., Burt, 1992; Oh et al., 2006). These benefits complement dissonant tie-specific benefits, such as access to unique resources and challenge of assumptions, making boundary-spanning dissonant ties particularly valuable for knowledge-intensive work.

Based on the above arguments, I propose:

H4a: There is a positive relationship between similarity in formal hierarchical rank and dissonant tie formation between dyads.

H4b: There is a positive relationship between similarity in tenure and dissonant tie formation between dyads.

H4c: There is a negative relationship between working in the same unit and dissonant tie formation between dyads.

DATA AND METHODS

Research Design and Empirical Setting

I use a combined quantitative and qualitative approach, as recommended for introducing a new construct to the literature (Edmondson & McManus, 2007). I rely on a large-scale survey to formally test my hypotheses through quantitative analyses, while qualitative interviews provide greater insight into the mechanisms underlying the numerical results. This combination of methods offers an in-depth understanding of the consequences and drivers of dissonant ties.

All data were collected from the engineering department of a large manufacturing firm active in the aerospace industry in a developed economy as an exemplar of a highly knowledge-intensive workplace. The aerospace industry builds on broad and sophisticated knowledge; aerospace manufacturers construct complex, heterogeneous systems; and they rely on continuous innovation to increase economic and technological returns (Sammarra & Biggiero, 2008). The firm under study delivers specialized designs and produces complex, technical components as part of an international supply chain. Its engineering department comprises 11 cross-functional units, each with its own formal leader, and a general leadership unit.[1] The engineers engage in a variety of complex tasks in design engineering and analysis. As is typical in aerospace engineering as complex problem-solving activity (Vincenti, 1990), the engineers' day-to-day work is laden with ambiguities, which frequently require them to make judgement calls (Downer, 2011). At the same time, they need to deal with constraints imposed by deadlines and cost-reduction targets, and meet strict aviation-safety requirements. Overall, the chosen setting is comparable to other studies of engineers and technical professionals in knowledge-intensive workplaces, such as Grodal, Nelson, and Siino (2015), Hargadon and Bechky (2006), and Perlow (1999).

Survey Data

To collect the quantitative data, I conducted an online survey of members of the engineering department in which I asked questions about their networks, individual characteristics, and performance. The firm's management provided information on the engineers' positions in the formal organization (i.e., formal hierarchical rank, unit membership, and reporting lines). Of the 239 engineers invited to participate in the survey, 171 returned completed questionnaires, representing a response rate of 72 percent. I compared respondents to non-respondents in terms of the number of nominations received as: a provider of problem-solving assistance, difficult to work with, an alter in dissonant ties, and a high-performing colleague. The t-test results revealed no significant differences between respondents and non-respondents with respect to these characteristics. All non-respondents were of low hierarchical rank, as defined

[1] Members of the general leadership unit are high-ranking engineers, some of whom function as supervisors for employees and unit leaders.

below. In line with common practice (e.g., Soda et al., 2018), ties to non-respondents were excluded from the empirical analysis.

In the following, I describe the different types of quantitative data before explaining how they were transformed into variables for investigating the consequences and drivers of dissonant ties.

Networks. As recommended by Labianca and Brass (2006), I collected whole-network data using the roster method. I captured *seeking problem-solving assistance* as the positive network in my study by asking: “When you need to engage in creative problem-solving regarding your job, who are the people you go to, to help you think outside of the box and consider different aspects of the problem innovatively?” (Casciaro & Lobo, 2008). To capture the negative network, I measured *difficult relationships* by asking: “Who do you find difficult to work with?” (Schulte et al., 2012). Network data were collected as asymmetric and binary data (i.e., a network tie from ego to alter is either present or absent).

Performance. To capture *individual performance*, I asked participants: “With respect to the current position at work, who are the most effective people that you work with?” This question was agreed upon with the firm’s management as a parsimonious way to identify employees with exemplary in-role performance. As with problem solving and difficult network ties, I provided respondents with a roster of all members of the engineering department and collected binary data. For a similar approach using influence instead of effectiveness, see Sparrowe and Liden (2005).

Individual attributes. The analyses consider *formal hierarchical rank*, which is a binary variable distinguishing between high-ranking (1) and low-ranking (0) employees. Unit leaders and members of the general leadership unit were coded as high-ranking employees. I account for *tenure* in the organization measured in years. *Unit membership* is a categorical variable that captures each individual's affiliation with one of the engineering units. *Level of education* is measured on a scale from (1) high-school education to (4) Ph.D. Finally, I account for *gender* with (1) being male and (0) female.

Dyadic attribute. When modeling the drivers of dissonant ties, I consider reporting lines as dyadic *supervisor-supervisee relationships*. For this purpose, I use a dyadic network attribute to capture whether an employee is the direct subordinate of another employee.

Quantitative Analysis: Consequences of Dissonant Ties

I transformed the effectiveness nominations each engineer could receive into two performance variables. To achieve comparability with more traditional approaches to performance evaluations, I first created a binary variable that captured whether an engineer was nominated as particularly effective by their direct supervisor. Evaluations by one's supervisor are the most common approach to measuring performance used in research and practice (see Arvey & Murphy, 1998; Bretz, Milkovich, & Read, 1992; Mehra, Kilduff, & Brass, 2001). Second, I counted the number of effectiveness nominations that each engineer received from formal leaders (i.e., high-ranking individuals) within the engineering department. Specifically, in the organization under study, high-ranking individuals engage in task-related interactions with other supervisors' employees if doing so serves a task. As such, they are able to evaluate employee effectiveness.[2]

---

[2] To develop a more detailed understanding of how these employees viewed day-to-day work and what might have been salient when they nominated employees for high effectiveness, see Appendix A.

In the investigation of performance consequences, the network data provide the information for the independent and control variables. Ego's *number of dissonant ties* is the key independent variable. To construct the variable, I counted the number of instances in which an ego indicated seeking problem-solving assistance from a colleague with whom ego also found it difficult to work. I control for the influence of ego's problem-solving and difficult ties on performance as follows. In line with prior research on the influence of positive network ties on performance (e.g., Brands & Kilduff, 2014; Tortoriello, 2015), I account for the *number of ties seeking problem-solving assistance* and the tendency to bridge structural holes. Following established practice (e.g., Tortoriello, 2015), the *structural holes* variable is calculated using Burt's (1992) constraint measure subtracted from 1. With regard to the negative network, I account for ego's *number of ties nominating others as difficult to work with* as a key component of dissonant ties. I additionally control for their *number of nominations as difficult to work with* provided by the alters (i.e., their in-degree in the difficult-tie network), as prior research has shown that receiving negative tie nominations can negatively affect performance (Marineau et al., 2016; Sparrowe et al., 2001). Finally, I control for ego's *formal hierarchical rank*, *tenure*, *level of education*, and *gender*.

I rely on logistic regressions to investigate the consequences of seeking problem-solving assistance from difficult colleagues for effectiveness nominations by direct supervisors. As my second performance indicator is a count variable and as diagnostics revealed that it is overdispersed, I use negative binomial regressions (Cameron & Trivedi, 2013) to examine the influence of dissonant ties on effectiveness nominations by all formal leaders. In both cases, standard errors are clustered around units.

Quantitative Analysis: Drivers of Dissonant Ties

I use ERGM to investigate the conditions that determine the likelihood of observing dissonant ties among engineers. ERGM is increasingly utilized to investigate tie formation in intraorganizational networks (e.g., Lomi et al., 2014; Rank, Robins, & Pattison, 2010). The approach accounts for tie interdependence in network data (Lusher et al., 2013) and treats the occurrence of network ties as the dependent variable. It enables estimation of parameters associated with the variables of theoretical interest, while providing an accurate characterization of the overall network structure in which individual ties are embedded (Lomi et al., 2014). More precisely, ERGM allows me to estimate the likelihood of observing problem-solving and difficult ties—separately and overlapping as a dissonant tie—as a function of two sets of variables: network patterns related to individual attributes, such as those describing employees' embeddedness in the organizational architecture; and network-endogenous patterns that capture the tendency of intraorganizational network ties to self-organize into meaningful structure (e.g., Lomi et al., 2014; Rank et al., 2010). By considering the influence of these two sets of network patterns on the likelihood of observing problem-solving, difficult, and dissonant ties all in one model, I can control for drivers of problem-solving and difficult network ties, thereby permitting empirical isolation of the drivers of dissonant ties.

In the following, I first describe the specific network patterns that I account for in the two variable sets, and then provide additional details on the estimation technique.

Individual attribute patterns. I use *formal hierarchical rank, tenure,* and *unit membership* to capture employees' embeddedness in the organizational architecture. I include other attributes that might influence the likelihood of observing dissonant ties as control variables. Relating to the ego, alter, and dyad perspectives on network tie formation, I transformed all attributes into variables for the empirical model as follows. First, I include *attribute ego* and *attribute alter* patterns for formal hierarchical rank and tenure to capture the influence of the two variables on individuals' tendencies to seek problem-solving assistance, nominate others as difficult to work with, and employ dissonant ties (*attribute ego*), and their tendencies to be nominated as providers of problem-solving assistance, difficult to work with, and being approached with dissonant ties (*attribute alter*), respectively. Moreover, the model includes *attribute similarity/dissimilarity* patterns relating to formal hierarchical rank, tenure, and unit membership and additionally to employees' *level of education* and *gender*, which have been shown to affect the formation of positive and negative network ties (e.g., Ibarra, 1993; Lomi et al., 2014; Merluzzi, 2017). *Attribute similarity/dissimilarity* patterns refer to the dyad perspective on tie formation and account for the tendency of network ties to occur between individuals who are similar or dissimilar with respect to an attribute. For binary and categorical attributes (i.e., *formal hierarchical rank*, *gender*, and *unit membership*), they capture mere similarity, with a positive value indicating that the tied individuals have the same characteristic. For continuous attributes (i.e., *tenure* and *level of education*), they capture dissimilarity, more precisely, the difference between the values of the attribute. A negative value indicates a small absolute difference and suggests that individuals are similar. Finally, following Casciaro and Lobo (2015) and Lomi et al. (2014), I include data on *supervisor-supervisee relationships* to control for formal reporting lines. The influence of this dyadic attribute is captured in the form of *entrainment* patterns, which describe the likelihood of observing either type of tie if the dyadic attribute is present. All individual attribute patterns are included for positive and negative network ties per se as well as for multiplex, dissonant ties. Table 2 provides an overview of the individual attribute patterns included in the model.

--- Insert Table 2 about here ---

Network-endogenous patterns. As demonstrated by Rank et al. (2010), the formation of intraorganizational networks cannot be fully understood without accounting for tendencies of network ties to self-organize. Employees' networking behaviors are influenced by their own network ties and by their network partners' ties with others. For instance, employees may seek assistance from colleagues to whom many others also turn (a mechanism known as the "rich get richer" or the "Matthew effect;" see Merton, 1968). To control for basic principles of network self-organization, the model includes different network-endogenous patterns related to problem-solving and difficult-tie networks. I selected these patterns based on previous studies on positive and negative ties in the workplace (e.g., Lomi et al., 2014; Robins et al., 2009). I include *reciprocity* as an important structuring principle of social networks (Gouldner, 1960). Moreover, I account for differences in the engineers' tendencies to nominate others as a provider of problem-solving assistance or as difficult to work with (*activity spread*) and to be nominated (*popularity spread*). This controls for the in-degree and out-degree distributions of the two networks, and reflects the finding that ties in social networks are seldom distributed evenly but, rather, driven by such mechanisms as the above-mentioned Matthew effect. I also include patterns to capture clustering—specifically, tendencies towards *transitive closure* and *cyclic closure*—and I account for *multiple connectivity*, which may indicate the presence of brokerage in the two networks (Robins et al., 2009).

In their entirety, the above patterns control for self-organizing principles in the positive and negative tie networks from which dissonant ties emerge. Ignoring these patterns can lead to spurious results regarding the drivers of tie formation (Krackhardt, 1987, 1988). To account for endogenous dependencies determining the overlap of positive and negative ties, I include a pattern that captures individuals' general tendencies to seek problem-solving assistance from difficult colleagues (*general multiplexity*). This allows me to confirm whether dissonant ties are more than a random by-product of the co-existence of positive and negative networks in the workplace. Table 3 summarizes the endogenous patterns included in the model.

--- Insert Table 3 about here ---

Exponential random graph modeling. I use ERGM to investigate which patterns of network ties characterize the observed network and, on that basis draw conclusions regarding the drivers that generated the network. Unlike statistical approaches, such as regression analysis, ERGM accounts for single tie observations not being independent of one another. It assumes a stochastic process in which the presence of a particular tie is influenced by the two sets of variables, individual attribute patterns and network-endogenous patterns. Parameters are estimated for each pattern, with a positive (negative) value indicating that a network pattern is observed more (less) often[3] than would be expected if ties emerged randomly, conditional on all other patterns in the model. The estimated parameter values are log odd ratios that can be transformed into odd ratios by taking the exponential.

Formally, ERG models can be stated as:

$$\Pr\,(X = x \,|\, Y = y) = \left(\frac{1}{\kappa}\right)\exp\left(\textstyle\sum_{Q}\theta_Q Z_Q(x,y)\right), \qquad (1)$$

where (i) X denotes the network variable for a network with n nodes and x denotes the corresponding realizations; (ii) Y is an array of individual attribute variables with realizations y; (iii) $Z_Q(x, y)$ is a network statistic counting the number of network patterns of type Q for a

[3] A different logic, which is explained in the subsection on individual attribute patterns, applies to *attribute similarity/dissimilarity* patterns.

particular network realization x and given the vector of attributes y; (iv) θ_Q is the parameter estimate corresponding to the statistic $Z_Q(x, y)$; and (v) κ is a normalizing constant included to ensure that equation (1) is a proper probability distribution. The summation is taken over all network patterns (Q) included in a given model. The probability of observing any network x in this distribution (including the one that is actually observed) is dependent on the statistics $Z_Q(x, y)$ and the corresponding parameter estimates θ_Q for all patterns in the model.

Based on Pattison and Wasserman (1999), this general form of ERGM has been extended to the multiplex case to allow for the simultaneous investigation of two networks. In the multiplex case, the formation of a network tie is assumed to depend on individual attribute patterns, network-endogenous patterns, and other types of network ties. In other words, in line with my theoretical assumptions regarding the interplay of positive and negative intraorganizational networks, multiplex ERGM treats different types of ties as conditionally dependent—the presence of a problem-solving tie is modelled considering the presence or absence of a difficult network tie and vice versa. Accordingly, $Z_Q(x)$ is a multigraph in which two nodes can be connected by multiple types of ties, such that:

$$Z_k(x) = \sum_{Q \in Q_k (i,j,m) \in Q} \prod x_{ijm}, \qquad (2)$$

where Q_k is a collection of isomorphic patterns Q of tie variables (Wang, 2013). I used Markov-Chain Monte-Carlo maximum-likelihood implemented in the XPNet-software (Wang, Robins, & Pattison, 2006) to estimate the parameter values for each pattern. Given the tie interdependence in network data, all parameter estimates are dependent on one another. That is, the interpretation of one pattern is conditional on all other patterns that characterize the observed network. In line with existing ERGM applications (e.g., Zappa & Robins, 2016), I fixed the network density to aid model convergence. To lessen the influence of outliers, I further fixed ties for employees with in-degrees or out-degrees in either network that exceeded three standard deviations (for a similar approach, see Lusher, Robins, Pattison, & Lomi, 2012).

Qualitative Interviews

I conducted semi-structured interviews with 18 engineers. Interviewees were selected to ensure diversity in formal hierarchical rank, tenure, and unit membership. The interviews, which typically lasted 45 to 75 minutes, were audio-recorded and transcribed. The interview questions concerned different types of task-related interactions and network ties that formed part of the engineers' day-to-day work, including perceptions of and interactions with difficult colleagues. The interviews also provided insights into the types of engineering work in which individuals were involved. For example, they revealed that some engineers worked on pooled tasks while others worked on independent tasks, and that the workflow was sequential rather than reciprocal (Thompson, 1967).

I used NVivo to content-analyze the interview transcripts, coding for information on why relationships were perceived as difficult, what interactions with difficult colleagues comprised in terms of behavioral repertoires, the performance consequences of these interactions, and the role of the organizational architecture in employees' decisions to seek assistance from difficult colleagues. In the following, I rely on this information to interpret the quantitative findings and enhance the understanding of the mechanisms underlying the uncovered relationships.

RESULTS

Descriptive Statistics

As summarized in Table 4, the problem-solving network has a density of 5.7 percent, while the difficult-tie network is sparser, with a density of 1.4 percent. This ratio of positive and negative network ties is in line with prior research showing that negative ties in organizations are rare (Baldwin et al., 1997; Labianca et al., 1998). Similarly, the number of dissonant ties is 50 and, thus, relatively low. However, as Labianca and Brass (2006) assert, it may be precisely the rarity of negative—or, in this case, dissonant—ties that is responsible for their impact. Table 5 provides descriptive statistics and correlations for the variables included in the models.

--- Insert Table 4 about here ---

--- Insert Table 5 about here ---

Consequences of Dissonant Ties

Table 6 presents the results of the regression analyses examining the influence of dissonant ties on individual performance. Models 1 and 2 present logistic regression results for the effect of dissonant ties on performance evaluations provided by one's immediate supervisor. The full Model 2 shows a positive influence of dissonant ties on egos' performance. Models 3 and 4 relate to performance evaluations by all formal leaders. Model 4 confirms the positive effect of dissonant ties on performance. Overall, these findings support Hypothesis 1. The control variables further suggest that formal hierarchical rank, tenure, and the bridging of structural holes in the problem-solving network positively influence performance, while the number of nominations as difficult to work with negatively affects performance evaluations.

--- Insert Table 6 about here ---

In line with Gibson's (2017) account of the strengths of mixed-method research, my interviews enable triangulation of the findings by corroborating the positive performance impact of dissonant ties. Moreover, they allow for deeper elaboration of the results by illustrating cognitions and behavioral repertoires associated with dissonant ties. Finally, they enhance the interpretation by substantiating the proposed theoretical mechanisms. First, and in line with the second opening quote, the interviewees confirmed that dissonant ties provided access to unique resources, as not everyone was willing to invest time and energy interacting with difficult colleagues:

> *If you are able to manage the relationship, you can gain beneficial information out of it. It's hard work and for many people it might not seem worthwhile. But the people who do step up become more effective because they can get all the information that they need.*

A high-ranking interviewee shared the following observation:

> *You do see those sorts of challenges with certain people. Which then leads on to if that sort of behavior is acceptable.... A lot of these people have good technical knowledge and they've got a lot to offer. But if people see it as challenging to approach them, then they won't do that.*

In further support of the unique resources-mechanism, several interviewees mentioned that individuals developed a *"reputation"* as difficult co-workers, which leads to them not being approached by their colleagues. This was also supported by another interviewee who noted that individuals avoided colleagues whom they perceived as *"frosty"* or *"grumpy."* Moreover, the interviewee's statement reiterates the sentiment in the first opening quote, and supports the second theoretical mechanism I propose as underlying the positive link between dissonant ties and performance—seeking assistance from difficult colleagues serves to challenge assumptions:

> *There is one person who's got nearly 30 years of experience. If you go to him with a proposal, he'll say, "Nope, I'm not signing it." And where he's coming from is not that he doesn't want to help you, he's challenging you to think of a better way of doing it. So he is constructive in that way and I believe our ultimate solutions have been better for it. It's just that people don't understand where he's coming from and avoid approaching him because they feel that he's frosty or grumpy.*

Another interviewee's reflections on the benefits of assistance from difficult colleagues stressed the connection between dissonant ties and consideration of diverse perspectives:

> *If I was to ask someone I found difficult for assistance, I think I would be perceived as more open to multiple points of view and therefore not just stuck in making decisions unilaterally. People would see me more as a team player, as someone who is able to consider multiple points of view and synthesize an outcome that satisfies everyone.... and that's why I do it. I believe I'm more effective if I don't just take a singular point of view and get multiple singular points of view on any one problem. I think that is a more effective way of solving a problem, and a quicker one as well.*

The interviewees further discussed the cognitive processes triggered by dissonant ties. For instance, one employee explained:

> *If I strongly disagree with their point of view or if they haven't adequately dealt with my concerns, I will consider additional options and look at other sources of information.*

Other interviewees described carefully preparing for this form of instrumental networking, indicating increased cognitive activity even before actual problem-solving interactions with difficult colleagues:

> *I just really think about how I'm going to ask the question and the reasons for asking and then I find that works far better, and I get a lot of benefit out of him.… But you have to really think about how you're going to raise a topic and talk about it. A vast number of people find him extremely difficult when they go to him, and initially I did too, but I've learned how to work that.*

A longer tenured interviewee—who, when asked about difficult colleagues instantly asserted *"I'm classing myself as one of them,"*—confirmed:

> *By now, people know to come to your desk and are prepared for the battle. They have to build up a bit of courage and be prepared to be cross-examined.*

Finally, the interviewees clearly articulated that although they viewed interactions with difficult colleagues as beneficial for achieving task-related goals, dissonant ties were still perceived as unpleasant. Difficult colleagues were described as *"obnoxious," "belligerent,"* or *"a bit awkward,"* and they left the interviewees *"frustrated," "exhausted,"* needing to *"go back to [their] desk and have a rest."* Taken together, my quantitative and qualitative findings provide evidence that establishes dissonant ties as a construct with important implications for knowledge-intensive work.

Drivers of Dissonant Ties

ERGM results. Table 7 presents the results of the quantitative analysis for the drivers of dissonant ties.[4] The *general multiplexity* pattern is included as a control variable that captures the overall likelihood of observing dissonant ties. The positive parameter value (1.478, $p < 0.05$) indicates that engineers are more likely than would be expected in a random network to seek problem-solving assistance from colleagues they find difficult. In other words, dissonant ties are more than just a coincidence resulting from the co-existence of positive and negative networks in the workplace. Instead, engineers consciously employ these ties as a form of instrumental networking in anticipation of task and professional benefits.

With regard to the organizational architecture, the results show that from the ego perspective tenure matters for dissonant tie formation while formal hierarchical rank does not. In support of Hypothesis 2b, the *tenure ego multiplexity* parameter is negative (-0.167, $p < 0.01$). In contrast, the *formal hierarchical rank ego multiplexity* parameter is insignificant and I reject Hypothesis 2a. Engineers with shorter tenure but not low hierarchical rank are more likely to employ dissonant ties. In corroboration of the tenure finding and engineers' general tendency to rely on dissonant ties as instrumental networking behavior, an engineer who had been with the organization for less than two years emphasized that (s)he would not avoid difficult colleagues:

> *That's not my personal motto. For me, if I'm ever in that situation, I remind myself that I have to keep it professional.*

Another engineer stressed his/her focus on the benefits of employing dissonant ties:

---

[4] Appendix B contains supplemental analyses of conditional odds ratios calculated based on the parameter estimates in Table 7 to allow for extended interpretation of the findings.

> *To solve the problem. Because my job depends on solving that problem. If I don't solve that problem, it won't take long before I lose my job. No question about it.…You have to get over yourself.*

The quantitative results also support Hypotheses 3a and 3b, which address alters' embeddedness in the organizational architecture. The negative *formal hierarchical rank alter multiplexity* parameter indicates that high-ranking individuals are less likely to receive problem-solving requests if they are simultaneously viewed as difficult. At the same time, the relationship between alter tenure and the likelihood of observing dissonant ties (*tenure alter multiplexity*) is positive. Thus, longer tenured difficult engineers are popular assistance providers. The interviewees explained the difference between high-ranking and longer tenured assistance providers as follows:

> *If you're junior and you have a difficult interaction with a person who is high up in the hierarchy, you're going to think that they think less of you after that interaction, and that might then affect your career.*

Conversely:

> *If you really want to step it up then you have to get along with the people who are more experienced than you.*

The first opening quote illustrates what "getting along" might imply from the perspective of a longer tenured engineer *"reputed to be difficult."* A high-ranking employee further explained that even management had noted difficulty of working with some longer tenured engineers:

> *We have a few senior [longer tenured] engineers, which, for various reasons, they're very knowledgeable, but they're very difficult to get on with… certainly I know this happens, and it's an area that we've identified pretty clearly and are working on trying to break it down… we certainly have some weaknesses here, for sure.… I wouldn't give up because a person is difficult, but it's not an ideal situation.*

Finally, from the dyad perspective, similarity with respect to tenure but not with respect to formal hierarchical rank mitigates the unpleasantness created by difficult ties. As the *formal* *hierarchical rank similarity multiplexity* parameter is insignificant, I reject Hypothesis 4a. On the other hand, in support of Hypothesis 4b, the *tenure dissimilarity multiplexity* parameter is negative, indicating that dissonant ties are more likely among engineers who entered the organization around the same time. While this finding provides evidence that dissonant ties are formed within vertical boundaries, I also find that they tend to span horizontal boundaries. In support of Hypothesis 4c, there is a negative relationship between working in the same unit and the likelihood of observing dissonant ties between individuals (negative *unit membership similarity multiplexity* parameter). An interviewee explained this as follows:

> *Communicating across groups can be difficult because everyone's got different agendas, everyone's got different goals, experience, ways that they normally communicate day-to-day… I vary my communication styles depending on which group I am talking to.*

Another statement underscores the reasoning that engineers associate within-unit dissonant ties with the cost of disturbing the unit's working climate and therefore avoid them:

> *…people who do step up become more effective because they can get all the information that they need. And if they can do it in a way that doesn't cause office riots—I can think of a few *laughs*… We have quite robust conversations where people have opinions and want to make sure that those opinions are heard, but this is not good in the sense that the office sees it and it contributes to this [difficulty] perception.… It does get noticed, yeah. We've found a few times we've said, 'can you go into a conference room please' *laughs*.*

--- Insert Table 7 about here ---

In addition to these findings, the control variables for patterns relating to dissonant ties show that individuals are more likely to seek problem-solving assistance from difficult colleagues with a similar level of education (negative *level of education dissimilarity multiplexity* parameter). Moreover, individuals typically approach their direct supervisors for problem-solving assistance, even if they find them difficult to work with (positive *supervisor dyadic covariate multiplexity* parameter).

The results also show that different individual attribute and endogenous patterns characterize the problem-solving and difficult-tie networks from which dissonant ties emerge. With regard to individual attributes, the findings confirm that formal hierarchical rank is not related to egos seeking problem-solving assistance per se (Cross & Cummings, 2004) while tenure is positively related to it. In contrast, neither formal hierarchical rank nor tenure influence ego's propensity to nominate others as difficult. In line with my assumptions, I also find positive *formal hierarchical rank alter* and *tenure alter* parameters in both networks. High-ranking and longer tenured individuals are more likely to receive problem-solving requests and to be nominated as colleagues with whom it is difficult to work. The problem-solving network is also characterized by homophilous tendencies with regard to formal hierarchical rank, tenure, and gender, while the difficult-tie network is not. However, both networks are characterized by positive *unit membership similarity* patterns: individuals are more likely to form problem-solving ties and difficult ties within their units. Finally, the individual attribute patterns show that engineers seek problem-solving assistance from their direct supervisors and that individuals with dissimilar levels of education find each other difficult.

The endogenous patterns relating to problem-solving and difficult ties indicate that while both networks are characterized by *reciprocity* and *transitive closure*, only the difficult-tie network is characterized by positive and significant *activity spread* and *popularity spread*. These patterns are indicative of network centralization—a few central individuals nominate and are nominated by many colleagues as difficult co-workers. These results confirm that employees often hold similar views on which individuals are difficult to work with (Robins et al., 2009). The problem-solving network, on the other hand, is neither particularly centralized nor decentralized. It is characterized by joint tendencies towards *transitive closure* and against *cyclic* *closure*, which suggests hierarchical differences among individuals in the sense that only one person in a triad is approached for assistance by the other two (Rank et al., 2010). Moreover, I find tendencies against *multiple connectivity* in the problem-solving network, indicating that short open paths and, thus, brokerage between individuals are avoided.

Goodness of fit diagnostics. In line with Hunter, Goodreau, and Handcock (2008), I tested the ERG model's goodness of fit (GOF) by simulating 500 million networks from the fitted model and comparing the characteristics of a random sample of 5,000 simulated networks to the observed network's characteristics. Specifically, I first compared observed and simulated network characteristics for all patterns included in the model and found that the GOF statistics for each pattern were below $|t| = .1$ as threshold recommended by Robins et al. (2009) for these patterns, thus indicating an excellent fit. As additional GOF diagnostic, Figure 2 provides visualizations which allow graphically evaluating how well selected patterns of the simulated networks fit the observed network. In line with the research question, the visualizations relate to the patterns linked with Hypotheses 2 to 4. Each boxplot represents the simulated distribution of a given pattern based on the 5,000 sampled networks which is compared to the observed network represented by the black line. In each case, the black line aligns very closely with the median of the simulated distribution. The visualizations, hence underscore the excellent model fit of network patterns relating to formal hierarchical rank, tenure, and unit membership as critical elements of the organizational architecture, thereby corroborating that the observed network could well have resulted from the modeled drivers.

In line with common practice (e.g., Kim, Howard, Cox Pahnke, & Boeker, 2016; Robins et al., 2009), I also compared network characteristics not in the model for the sample of simulated networks to their observed values. As noted by Srivastava and Banaji (2011), this approach represents a stringent test of model fit as it considers the model to fit well if it is able to reproduce local patterns and global network characteristics of the observed network that were not used to construct the model. I found that the majority of GOF statistics for network characteristics not explicitly modeled were below the recommended threshold of $|t| = 2$ for non-modelled patterns. Yet, a few slightly exceeded it[5], which is not uncommon in ERGM applications (e.g., Robins & Lusher, 2013; Srivastava & Banaji, 2011). Overall, the variables of interest and most other features of the data can be adequately reproduced based on the model, indicating that the observed network could have resulted from the modeled drivers.

--- Insert Figure 2 about here ---

DISCUSSION

In this study, I introduced dissonant ties as a new construct that captures the overlap of network ties characterized by an individual's conflicting cognitions of another person. I utilized a mixed-method approach to develop a comprehensive theory of dissonant ties that simultaneously addresses the consequences and drivers of employees' purposeful employment of cognition-based positive-negative ties as instrumental networking behavior. Drawing a link to performance consequences, I establish dissonant ties as a construct with significant implications for management and organization theory. At the same time, this link demonstrates that employees'

[5] For instance, GOF statistics for complex patterns associated with mixed triadic closure do not fit ideally, which I address in my discussion of this study's limitations and opportunities for future research. Moreover, GOF statistics for global network characteristics associated with the standard deviation of the in-degree distribution and global transitive clustering of the problem-solving network were suboptimal, for instance as some engineers received a very high number of nominations as assistance providers. To explore the latter, Appendix C contains an extended GOF analysis including visualizations that allow for the graphical evaluation of model GOF with regards to the global characteristics of the observed problem-solving and difficult-tie networks.

assignment of value to this counter-attitudinal behavior is justified. Subsequently, the study emphasizes elements of the organizational architecture as critical determinants of positive-negative tie multiplexity in the workplace. It demonstrates that the benefits and costs that employees associate with dissonant tie formation and, hence, their willingness to engage in this potentially unpleasant but beneficial form of networking are context driven.

Overall, the study shows that the consequences and drivers of dissonant ties differ from the consequences and drivers of their component parts, that is, positive and negative ties in intraorganizational networks. The interplay of these two types of networks and their convergence into multiplexity give rise to a unique third type of network tie that deserves attention—dissonant ties.

Contributions

By introducing dissonant ties to the literature, my study makes three main contributions to organizational network theory. First, I jointly investigate the construct's consequences and drivers, which allows me to highlight previously overlooked ways in which individuals secure beneficial resources. In doing so, I draw attention to agency in tie formation (e.g., Ahuja et al., 2012; Emirbayer & Mische, 1998) and extend the logic of cognitive-consequentialist networking behavior (Borgatti & Cross, 2003; Nebus, 2006) to the new type of cognition-based positive-negative network tie. This approach to dissonant ties demonstrates that networking may involve engagement in counter-attitudinal behavior as long as the distinct benefits associated with tie formation exceed the perceived costs. By linking these benefits and costs to employees' embeddedness in the organizational architecture, I explicitly take Casciaro et al.'s (2014: 727) suggestion that "[u]nderstanding agency in networking behavior requires an understanding of the structural context within which agency emerges" into account.

Second, my research challenges and refines key assumptions of social ledger theory (Labianca & Brass, 2006). This theory, which calls for the joint analysis of positive and negative networks that co-exist in the workplace, associates positive ties with benefits and negative ties with liabilities, and depicts them as mutually exclusive sides of the social ledger. It assumes that individuals' positive and negative ties are not directed at the same individuals, and that their respective benefits and liabilities counterbalance each other. In merging the joint focus on positive and negative ties with a network multiplexity perspective, this study offers an extended view of the interplay between positive and negative networks in the workplace. Moving beyond the accounting logic inherent in social ledger theory, it demonstrates that the consequences of positive and negative ties do not necessarily counterbalance each other and that negative ties do not always produce liabilities. Overlapping with positive network ties, they yield distinct instrumental benefits. Similarly, with regards to the drivers of tie formation, the extended view presented here suggests that employees weigh the combined benefits of the positive and negative tie components against their combined costs. As such, this view puts key propositions of social ledger theory into perspective. It offers a synergistic understanding of the interplay of positive and negative networks and their convergence into dissonant ties, thereby also adding to research on network multiplexity, which has been largely restricted to investigating overlap of positive—professional or personal—network ties (e.g., Rank et al., 2010; Soda & Zaheer, 2012).

Finally, the study's focus on the drivers of dissonant ties advances the literature on intraorganizational networks. The results on tie formation confirm that problem-solving and difficult ties overlap more often than would be expected by chance. Hence, similar to ambivalent relationships in the workplace (Melwani & Rothman, 2015; Methot et al., 2017), dissonant ties can be seen as an inherent part of intraorganizational networks in knowledge-intensive organizations. In highlighting employees' embeddedness in the organizational architecture as a boundary condition for tie formation, I offer an explanation for the conflicting findings of previous research. In particular, Casciaro and Lobo (2008) show that individuals avoid disliked others for assistance. However, these authors focus on affect-based, rather than cognition-based, negative ties, and do not provide information on the extent or the conditions under which they might observe an overlap between dislike and assistance seeking. In this respect, the findings presented here provide a more nuanced understanding of employee networking.

I demonstrate that formal hierarchical rank, tenure, and unit membership critically affect the employment patterns of dissonant ties. Due to their different power and resource implications and ways of structuring the knowledge-intensive workplace, these three elements of the organizational architecture exert unique influences on evaluations of the benefits and costs associated with dissonant ties. From the ego perspective, tenure, while not linked to difficult working relationships, is positively related to seeking problem-solving assistance but negatively influences dissonant tie formation. The longer tenured an engineer, the more that engineer will seek problem-solving assistance in general, presumably because he or she works on more complex tasks (Zacher & Frese, 2011). Yet the shorter tenured an engineer, the more that engineer employs dissonant ties to reap the distinct tie-inherent benefits. In contrast, ego's formal hierarchical rank is unrelated to positive, negative, or dissonant tie formation. With regards to the latter, a leveling effect may be in play: while low-ranking individuals should associate high benefits with assistance from difficult colleagues, they still face costs; conversely, high-ranking individuals might associate fewer costs with dissonant ties, as their formal hierarchical rank provides them with the authority to admonish difficult colleagues.

From the alter perspective, both longer tenured alters and high-ranking alters are popular providers of problem-solving assistance and they tend to be perceived as difficult. However, only alter tenure is positively related to dissonant tie formation. In comparison, there is a strong tendency to avoid dissonant ties with high-ranking alters, presumably because they possess formal power and control over the allocation of means, rewards, and punishments, making interactions with them disproportionally risky.

The dyad perspective indicates that similarity with respect to tenure but not formal hierarchical rank affects dissonant tie formation. While homophilous tendencies for both tenure and formal hierarchical rank promote problem-solving interactions per se, only tenure-related homophily seems to attenuate the unpleasantness associated with tie-inherent cognitive inconsistencies, thereby fostering individuals' willingness to employ dissonant ties. Notably, similarities in formal hierarchical rank and tenure are unrelated to difficult tie formation.

Overall, the findings establish tenure as a more critical driver of dissonant tie formation than formal hierarchical rank. In line with my findings, prior research (e.g., Gambardella, Panico, & Valentini, 2015; Ibarra, 1993), reinforced by my interviews, indicates that this difference in relevance might be attributable to the knowledge- and engineering-intensity of the workplace. For knowledge-workers, tenure appears to be the more salient driver of networking behavior because it is associated with subject-matter expertise, experience, and expert careers, which they often prioritize over formal hierarchical rank, power credentials, and management responsibilities (Allen & Katz, 1986; Brousseau et al., 1996). As a consequence, tenure influences dissonant tie formation from the ego, alter, and dyad perspectives alike, while formal hierarchical rank does not. From the alter perspective in specific, tenure is typically associated with technical support and higher levels of expertise, which are more critical for day-to-day work in complex engineering than is administrative support provided by high-ranking employees. Dissonant ties with longer tenured alters are, therefore, perceived as especially beneficial for knowledge-intensive work.

Finally, the third element of the organizational architecture under investigation from the dyad perspective, unit membership, is positively related to positive and negative tie formation per se. Engineers are more likely to establish difficult ties and problem-solving ties with colleagues from their own units. At the same time, the results confirm that dissonant ties are more likely to span unit boundaries in knowledge-intensive organizations—these network ties combine the distinct benefits of dissonant ties with access to heterogeneous inputs not available in ego's own unit. Moreover, the unit boundary creates a safe distance between ego and difficult alters.

The dyad perspective sheds light on a seemingly counterintuitive difference among the three architectural elements that is, nevertheless, consistent with the cognitive-consequentialist approach to instrumental networking. I show that dissonant ties are formed within vertical boundaries but across horizontal boundaries of the organization. Thereby, this study adds to research on the drivers of boundary spanning as a topic of foremost interest for organizational network scholars (e.g., Lomi et al., 2014; Soda et al., 2018). In this connection, the empirical finding that the formation of difficult ties is unrelated to similarities in formal hierarchical rank and tenure, but more likely to occur within, rather than across unit boundaries, deserves attention. Focusing on the negative component of dissonant ties, it refutes the assumption that homophily as a mechanism driving positive network ties can simply be reversed and applied to negative networks. As postulated by Labianca and Brass (2006: 599-600), "the formation of negative relationships is not the mere opposite of the way positive relationships form."

Accordingly, cultural differences or ingroup-outgroup categorizations (Turner, 1987) triggered by unit membership are not the main drivers of difficult ties. Instead, the observed boundary-spanning tendencies are distinctly related to employees relying on dissonant ties as an instrumental networking behavior.

Limitations and Future Research

This study's limitations provide some guidance on future research opportunities regarding dissonant ties. First, the cross-sectional nature of the empirical data does not allow for causality testing of the link between dissonant ties and performance or the interplay between positive and negative network ties. While theoretical arguments and qualitative interviews offer support for the proposed causalities, performance may also influence dissonant tie formation. For instance, high performers might be more confident in approaching difficult colleagues. However, based on existing theory as well as meta-analytic evidence on the network-performance relationship (Balkundi & Harrison, 2006), the inverse seems to be the stronger and more direct causal relationship. Ultimately, experimental studies and in-depth longitudinal research are needed for confirmation. Such research should also address the co-evolution of positive and negative tie networks and, thereby, revisit the assumption that multiplex network ties are particularly robust (e.g., Soda & Zaheer, 2012). This assumption might not apply to the extended conceptualization of network multiplexity that incorporates simultaneity of positive and negative ties. Instead, perceptions of difficulty may diminish after repeated problem-solving interactions. Similarly, problem-solving relationships may become difficult if assistance providers perceive the costs of helping as excessive or as threatening their own task performance (Bergeron, 2007). Against this background, future research adopting a dynamic perspective to investigate the short-term fluctuations and long-term stability of dissonant ties would be of interest.

Second, this study's investigation of performance consequences serves to establish dissonant ties as a construct with significant theoretical and practical implications but it lacks depth. The unidimensionality of the performance measure, which only accounts for effectiveness, constitutes one limitation. It would be interesting to examine whether dissonant ties have equally positive consequences for individuals' efficiency or innovativeness. In addition, while I demonstrate the functional value of dissonant ties for performance, they might still also have negative consequences. Several statements made during the interviews as well as prior inconsistency research indicate that dissonant ties may trigger negative affective responses (Hinojosa et al., 2017) and impair individuals' work satisfaction or well-being. Similarly, I propose alternative mechanisms that are likely to give rise to the link between dissonant ties and performance, but I am unable to test them through quantitative analyses. Research is needed to provide insights into the relative importance of each mechanism by testing for mediators of the dissonant tie-performance relationship.

Third, my conceptualization of dissonant ties focuses on the mere simultaneity of cognition-based positive and negative network ties. Following a tradition in organizational network research, the next step would be to refine this conceptualization. For instance, future studies should account for the strength of the positive and negative tie components to offer a more nuanced understanding of the relationship between dissonant ties and performance. Similarly, the difficult tie component could be further differentiated based on the distinct work-related qualities to which it refers (i.e., being perceived as arrogant, having different priorities, or hindering work etc.). Finally, advancing the investigation of drivers of dissonant ties by considering triads in addition to accounting for ego, alter, and dyad might reveal further insights. As the goodness-of-fit simulations indicate, mixed triads comprising positive and negative ties between three individuals might play a role in the formation of dissonant ties. A useful first step in approaching this issue may be to extend the notions of balance theory (Heider, 1958) to positive-negative multiplexity, as seen in Sytch and Tatarynowicz's (2014) investigation of inter-organizational networks.

REFERENCES

Ahuja, G., Soda, G., & Zaheer, A. 2012. The genesis and dynamics of organizational networks. ***Organization Science***, 23: 434–448.

Allen, T. J., & Katz, R. 1986. The dual ladder: motivational solution or managerial delusion? ***R&D Management***, 16: 185-197.

Alvesson, M. 2004. ***Knowledge work and knowledge-intensive firms***. Oxford: Oxford University Press.

Arvey, R. D., & Murphy, K. R. 1998. Performance evaluation in work settings. ***Annual Review of Psychology***, 49: 141–168.

Ashforth, B. E., Rogers, K. M., Pratt, M. G., & Pradies, C. 2014. Ambivalence in organizations: A multilevel approach. ***Organization Science***, 25: 1453–1478.

Baldwin, T. T., Bedell, M. D., & Johnson, J. L. 1997. The social fabric of a team-based M.B.A. program: Network effects on student satisfaction and performance. ***Academy of Management Journal***, 40: 1369–1397.

Balkundi, P., & Harrison, D. A. 2006. Ties, leaders, and time in teams: Strong inference about network structure's effects on team viability and performance. ***Academy of Management Journal***, 49: 49–68.

Becker, G. S. 1964. ***Human capital: A theoretical and empirical analysis with special reference to education***. New York: Columbia University Press.

Beier, M. E., & Ackerman, P. L. 2001. Current-events knowledge in adults: An investigation of age, intelligence, and nonability determinants. ***Psychology and Aging***, 16: 615–628.

Bergeron, D. M. 2007. The potential paradox of organizational citizenship behavior: Good citizens at what cost? ***Academy of Management Review***, 32: 1078–1095.

Blau, P. M. 1955. ***The dynamics of bureaucracy: A study of interpersonal relations in two government agencies***. Chicago: University of Chicago Press.

Bolino, M. C., Kacmar, K. M., Turnley, W. H., & Gilstrap, J. B. 2008. A multi-level review of impression management motives and behaviors. ***Journal of Management***, 34: 1080–1109.

Borgatti, S. P., & Cross, R. L. 2003. A relational view of information seeking and learning in social networks. ***Management Science***, 49: 432–445.

Brands, R. A., & Kilduff, M. 2014. Just like a woman? Effects of gender-biased perceptions of friendship network brokerage on attributions and performance. ***Organization Science***, 25: 1530–1548.

Bretz, R. D., Milkovich, G. T., & Read, W. 1992. The current state of performance appraisal research and practice: Concerns, directions, and implications. ***Journal of Management***, 18: 321–352.

Brousseau, K. R., Driver, M. J., Kristina, E., & Larsson, R. 1996. Career pandemonium: Realigning organizations and individuals. ***Academy of Management Executive***, 10: 52-66.
Burt, R. S. 1992. ***Structural holes: The social structure of competition***. Cambridge: Harvard University Press.
Byrne, D. 1971. ***The attraction paradigm***. New York: Academic Press.
Caimo, A., & Lomi, A. 2015. Knowledge Sharing in Organizations: A Bayesian Analysis of the Role of Reciprocity and Formal Structure. ***Journal of Management***, 41(2): 665-691.
Cameron, A. C., & Trivedi, P. K. 2013. ***Regression analysis of count data***. Cambridge: Cambridge University Press.
Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. 1999. Taking time seriously: A theory of socioemotional selectivity. ***American Psychologist***, 54: 165–181.
Casciaro, T., Gino, F., & Kouchaki, M. 2014. The contaminating effects of building instrumental ties how networking can make us feel dirty. ***Administrative Science Quarterly***, 59: 705–735.
Casciaro, T., & Lobo, M. S. 2008. When competence is irrelevant: The role of interpersonal affect in task-related ties. ***Administrative Science Quarterly***, 53: 655–684.
Casciaro, T., & Lobo, M. S. 2015. Affective primacy in intraorganizational task networks. ***Organization Science***, 26: 373–389.
Chiaburu, D. S., & Harrison, D. A. 2008. Do peers make the place? Conceptual synthesis and meta-analysis of coworker effects on perceptions, attitudes, OCBs, and performance. ***Journal of Applied Psychology***, 93: 1082–1103.
Cross, R., & Borgatti, S. P. 2004. The ties that share: Relational characteristics that facilitate information seeking. In M. Huysman, & V. Wulf (Eds.), ***Social capital and information technology***: 137–161. Cambridge: MIT Press.
Cross, R. L., & Cummings, J. N. 2004. Tie and network correlates of individual performance in knowledge-intensive work. ***Academy of Management Journal***, 47: 928–937.
Cross, R. L., & Parker, A. 2004. ***The hidden power of social networks: Understanding how work really gets done in organizations***: Harvard Business Press.
Cross, R. L., & Sproull, L. 2004. More than an answer: Information relationships for actionable knowledge. ***Organization Science***, 15: 446–462.
De Dreu, C. K. W., & De Vries, N. K. 1997. Minority dissent in organizations. In C. K. W. De Dreu, & E. Van de Vliert (Eds.), ***Using conflict in organizations***: 72–86. London: SAGE Publications.
Denham, N., Ackers, P., & Travers, C. 1997. Doing yourself out of a job? How middle managers cope with empowerment. ***Employee Relations***, 19: 147–159.
Dougherty, D. 1992. Interpretive barriers to successful product innovation in large firms. ***Organization Science***, 3: 179–202.
Downer, J. 2011. "737-cabriolet": The limits of knowledge and the sociology of inevitable failure. ***American Journal of Sociology***, 117: 725–762.
Du Brin, A. J. 1988. Career maturity, organizational rank, and political behavioral tendencies: A correlational analysis of organizational politics and career experience. ***Psychological Reports***, 63: 531–537.
Eagly, A. H., & Chaiken, S. 1998. Attitude structure and function. In D. Gilbert, S. Fiske, & G. Lindzey (Eds.), ***The handbook of social psychology*** Vol. 1: 269–322. New York: McGraw-Hill.

Ebner, N. C., Freund, A. M., & Baltes, P. B. 2006. Developmental changes in personal goal orientation from young to late adulthood: From striving for gains to maintenance and prevention of losses. ***Psychology and Aging***, 21: 664–678.

Edmondson, A. C., & McManus, S. E. 2007. Methodological fit in management field research. ***Academy of Management Review***, 32: 1155–1179.

Elsbach, K. D., Barr, P. S., & Hargadon, A. B. 2005. Identifying situated cognition in organizations. ***Organization Science***, 16: 422–433.

Emirbayer, M., & Mische, A. 1998. What is agency? ***American Journal of Sociology***, 103: 962–1023.

Festinger, L. 1957. ***A theory of cognitive dissonance***. Stanford: Stanford University Press.

Fiske, S., T., & Taylor, S., E. 2008. ***Social cognition: From brains to culture***. New York: McGraw Hill.

French, J. R., & Raven, B. 1959. The bases of social power. In D. Cartwright (Ed.), ***Studies in social power***: 150–167. Ann Arbor: Institute for Social Research.

Freund, A. M. 2006. Age-differential motivational consequences of optimization versus compensation focus in younger and older adults. ***Psychology and Aging***, 21: 240–252.

Galbraith, J. R. 1973. ***Designing complex organizations***. Boston: Addison-Wesley Longman Publishing.

Gambardella, A., Panico, C., & Valentini, G. 2015. Strategic incentives to human capital. ***Strategic Management Journal***, 36: 37-52.

Gibson, C. B. 2017. Elaboration, generalization, triangulation, and interpretation. ***Organizational Research Methods***, 20: 193–223.

Gouldner, A. W. 1960. The norm of reciprocity: A preliminary statement. ***American Sociological Review***, 25: 161–178.

Grodal, S., Nelson, A. J., & Siino, R. M. 2015. Help-seeking and help-giving as an organizational routine: Continual engagement in innovative work. ***Academy of Management Journal***, 58: 136–168.

Hardavella, G., Saad, N., & Bjerg, A. 2015. Doing science: Managing colleagues and collaborations in scientific research. ***Breathe***, 11: 77–79.

Hargadon, A. B., & Bechky, B. A. 2006. When collections of creatives become creative collectives: A field study of problem solving at work. ***Organization Science***, 17: 484–500.

Harmon-Jones, E. 2012. Cognitive dissonance theory. In V. S. Ramachandran (Ed.), ***Encyclopedia of Human Behavior*** 2ed., Vol. 1: 543–549. San Diego: Academic Press.

Heider, F. 1958. ***The psychology of interpersonal relations***. London: Wiley.

Hinojosa, A. S., Gardner, W. L., Walker, H. J., Cogliser, C., & Gullifor, D. 2017. A review of cognitive dissonance theory in management research: Opportunities for further development. ***Journal of Management***, 43: 170–199.

Hofmann, D. A., Grant, A. M., & Lei, Z. 2009. Seeking help in the shadow of doubt: The sensemaking processes underlying how nurses decide whom to ask for advice. ***Journal of Applied Psychology***, 94: 1261–1274.

Hogg, M. A., & Terry, D. J. 2000. Social identity and self-categorization processes in organizational contexts. ***Academy of Management Review***, 25: 121–140.

Hunter, D. R., Goodreau, S. M., & Handcock, M. S. 2008. Goodness of fit of social network models. ***Journal of the American Statistical Association***, 103: 248–258.

Ibarra, H. 1993. Network centrality, power, and innovation involvement: Determinants of technical and administrative roles. ***Academy of Management Journal***, 36: 471–501.

Ingram, P., & Roberts, P. W. 2000. Friendships among competitors in the Sydney hotel industry. ***American Journal of Sociology***, 106: 387–423.

Janis, I. L. 1972. ***Victims of groupthink: A psychological study of foreign-policy decisions and fiascoes***. Boston: Houghton Mifflin.

Kilduff, M., & Brass, D. J. 2010. Organizational social network research: Core ideas and key debates. ***Academy of Management Annals***, 4: 317–357.

Kim, J. Y., Howard, M., Cox Pahnke, E., & Boeker, W. 2016. Understanding network formation in strategy research: Exponential random graph models. ***Strategic Management Journal***, 37(1): 22-44.

Klein, K. J., Lim, B.-C., Saltz, J. L., & Mayer, D. M. 2004. How do they get there? An examination of the antecedents of centrality in team networks. ***Academy of Management Journal***, 47: 952–963.

Kleinbaum, A. M., Stuart, T. E., & Tushman, M. L. 2013. Discretion within constraint: Homophily and structure in a formal organization. ***Organization Science***, 24: 1316–1336.

Krackhardt, D. 1987. QAP partialling as a test of spuriousness. ***Social Networks***, 9: 171–186.

Krackhardt, D. 1988. Predicting with networks: Nonparametric multiple regression analysis of dyadic data. ***Social Networks***, 10: 359–381.

Labianca, G. 2014. Negative ties in organizational networks. In D. J. Brass, G. Labianca, A. Mehra, D. S. Halgin, & S. P. Borgatti (Eds.), ***Contemporary perspectives on organizational social networks***: 239–259. United Kingdom: Emerald.

Labianca, G., & Brass, D. J. 2006. Exploring the social ledger: Negative relationships and negative asymmetry in social networks in organizations. ***Academy of Management Review***, 31: 596–614.

Labianca, G., Brass, D. J., & Gray, B. 1998. Social networks and perceptions of intergroup conflict: The role of negative relationships and third parties. ***Academy of Management Journal***, 41: 55–67.

Lawler, E. J. 2001. An affect theory of social exchange. ***American Journal of Sociology***, 107: 321–352.

Lazega, E., Mounier, L., Snijders, T. A. B., & Tubaro, P. 2012. Norms, status and the dynamics of advice networks: A case study. ***Social Networks***, 34: 323–332.

Lincoln, J. R., & Miller, J. 1979. Work and friendship ties in organizations: A comparative analysis of relational networks. ***Administrative Science Quarterly***, 24: 181–199.

Lomi, A., Lusher, D., Pattison, P. E., & Robins, G. L. 2014. The focused organization of advice relations: A study in boundary crossing. ***Organization Science***, 25: 438–457.

Lusher, D., Koskinen, J., & Robins, G. L. (Eds.). 2013. ***Exponential random graph models for social networks: Theory, methods, and applications***. New York: Cambridge University Press.

Lusher, D., Robins, G., Pattison, P. E., & Lomi, A. 2012. “Trust me”: Differences in expressed and perceived trust relations in an organization. ***Social Networks***, 34: 410–424.

March, J. G., & Simon, H. A. 1958. ***Organizations***. New York: John Wiley & Sons.

Marineau, J. E., Hood, A. C., & Labianca, G. J. 2018. Multiplex conflict: Examining the effects of overlapping task and relationship conflict on advice seeking in organizations. ***Journal of Business and Psychology***, 33: 595–610.

Marineau, J. E., Labianca, G., & Kane, G. C. 2016. Direct and indirect negative ties and individual performance. ***Social Networks***, 44: 238–252.

McEvily, B., Soda, G., & Tortoriello, M. 2014. More formally: Rediscovering the missing link between formal organization and informal social structure. ***Academy of Management Annals***, 8: 299–345.

McPherson, M., Smith-Lovin, L., & Cook, J. M. 2001. Birds of a feather: Homophily in social networks. ***Annual Review of Sociology***, 27: 415–444.

Mehra, A., Kilduff, M., & Brass, D. J. 2001. The social networks of high and low self-monitors: Implications for workplace performance. ***Administrative Science Quarterly***, 46: 121–146.

Melwani, S., & Rothman, N. 2015. Research: Love-hate relationships at work might be good for you. ***Harvard Business Review***, https://hbr.org/2015/01/researchlove-hate-relationships-at-work-might-be-good-for-you.

Merluzzi, J. 2017. Gender and negative network ties: Exploring difficult work relationships within and across gender. ***Organization Science***, 28: 636–652.

Merton, R. K. 1968. The Matthew effect in science: The reward and communication systems of science are considered. ***Science***, 159: 56–63.

Methot, J. R., Melwani, S., & Rothman, N. B. 2017. The space between us: A social-functional emotions view of ambivalent and indifferent workplace relationships. ***Journal of Management***, 43: 1789–1819.

Miller, D., & Shamsie, J. 2001. Learning across the life cycle: Experimentation and performance among the Hollywood studio heads. ***Strategic Management Journal***, 22: 725–745.

Mueller, J. S., & Kamdar, D. 2011. Why seeking help from teammates is a blessing and a curse: A theory of help seeking and individual creativity in team contexts. ***Journal of Applied Psychology***, 96: 263–276.

Nebus, J. 2006. Building collegial information networks: A theory of advice network generation. ***Academy of Management Review***, 31: 615–637.

Nemeth, C. J. 1995. Dissent as driving cognition, attitudes, and judgments. ***Social Cognition***, 13: 273–291.

Nemeth, C. J., & Kwan, J. L. 1987. Minority influence, divergent thinking and detection of correct solutions. ***Journal of Applied Social Psychology***, 17: 788–799.

Ng, T. W. H., & Feldman, D. C. 2010. Organizational tenure and job performance. ***Journal of Management***, 36: 1220–1250.

Ng, T. W. H., & Feldman, D. C. 2013. A meta-analysis of the relationships of age and tenure with innovation-related behaviour. ***Journal of Occupational and Organizational Psychology***, 86: 585–616.

Oh, H., Labianca, G., & Chung, M.-H. 2006. A multilevel model of group social capital. ***Academy of Management Review***, 31: 569–582.

Parker, A., Gerbasi, A., & Porath, C. L. 2013. The effects of de-energizing ties in organizations and how to manage them. ***Organizational Dynamics***, 42: 110–118.

Pattison, P. E., & Wasserman, S. 1999. Logit models and logistic regressions for social networks: II. Multivariate relations. ***British Journal of Mathematical and Statistical Psychology***, 52: 169–193.

Perlow, L. A. 1999. The time famine: Toward a sociology of work time. ***Administrative Science Quarterly***, 44: 57–81.

Rank, O. N., Robins, G. L., & Pattison, P. E. 2010. Structural logic of intraorganizational networks. ***Organization Science***, 21: 745–764.

Robins, G. L., & Daraganova, G. 2013. Social selection, dyadic covariates, and geospatial effects. In D. Lusher, J. Koskinen, & G. L. Robins (Eds.), ***Exponential random graph models for social networks***: 91-101. New York; N.Y: Cambridge University Press.

Robins, G. L., & Lusher, D. 2013. Illustrations: Simulation, Estimation, and Goodness of Fit. In D. Lusher, J. Koskinen, & G. L. Robins (Eds.), ***Exponential random graph models for social networks***: 167-185. New York: Cambridge University Press.

Robins, G. L., Pattison, P. E., & Wang, P. 2009. Closure, connectivity and degree distributions: Exponential random graph (p*) models for directed social networks. ***Social Networks***, 31: 105–117.

Rodan, S., & Galunic, C. 2004. More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness. ***Strategic Management Journal***, 25: 541–562.

Rothman, N., Pratt, M., Rees, L., & Vogus, T. 2017. Understanding the dual nature of ambivalence: Why and when ambivalence leads to good and bad outcomes. ***Academy of Management Annals***, 11: 33–72.

Royal, C., & Althauser, R. P. 2003. The labor markets of knowledge workers: Investment bankers' careers in the wake of corporate restructuring. ***Work and Occupations***, 30: 214-233.

Rydell, R. J., McConnell, A. R., & Mackie, D. M. 2008. Consequences of discrepant explicit and implicit attitudes: Cognitive dissonance and increased information processing. ***Journal of Experimental Social Psychology***, 44: 1526–1532.

Sammarra, A., & Biggiero, L. 2008. Heterogeneity and specificity of inter-firm knowledge flows in innovation networks. ***Journal of Management Studies***, 45: 800–829.

Schulte, M., Cohen, N. A., & Klein, K. J. 2012. The coevolution of network ties and perceptions of team psychological safety. ***Organization Science***, 23: 564–581.

Schulz-Hardt, S., Mojzisch, A., & Vogelgesang, F. 2007. Dissent as a facilitator: Individual-and group-level effects on creativity and performance. In C. K. De Dreu, & M. Gelfand (Eds.), ***The psychology of conflict and conflict management in organizations***: 149–177. Hillsdale, NJ: Erlbaum.

Schweiger, D. M., Sandberg, W. R., & Rechner, P. L. 1989. Experiential effects of dialectical inquiry, devil's advocacy and consensus approaches to strategic decision making. ***Academy of Management Journal***, 32: 745–772.

Shah, N. P., Cross, R., & Levin, D. Z. 2018. Performance benefits from providing assistance in networks: Relationships that generate learning. ***Journal of Management***, 44: 412–444.

Sheppard, S., Colby, A., Macatangay, K., & Sullivan, W. 2007. What is engineering practice? ***International Journal of Engineering Education***, 22: 429–438.

Sherf, E. N., & Venkataramani, V. 2015. Friend or foe? The impact of relational ties with comparison others on outcome fairness and satisfaction judgments. ***Organizational Behavior and Human Decision Processes***, 128: 1–14.

Simon, H. A. 1990. Invariants of human behavior. ***Annual Review of Psychology***, 41: 1–20.

Snijders, T. A. B., Pattison, P. E., Robins, G. L., & Handcock, M. S. 2006. New specifications for exponential random graph models. ***Sociological Methodology***, 36: 99–153.

Soda, G., Tortoriello, M., & Iorio, A. 2018. Harvesting value from brokerage: Individual strategic orientation, structural holes, and performance. ***Academy of Management Journal***, 61: 896–918.

Soda, G., & Zaheer, A. 2012. A network perspective on organizational architecture: Performance effects of the interplay of formal and informal organization. ***Strategic Management Journal***, 33: 751–771.

Sparrowe, R. T., & Liden, R. C. 2005. Two routes to influence: Integrating leader-member exchange and social network perspectives. ***Administrative Science Quarterly***, 50: 505–535.

Sparrowe, R. T., Liden, R. C., Wayne, S. J., & Kraimer, M. L. 2001. Social networks and the performance of individuals and groups. ***Academy of Management Journal***, 44: 316–325.

Srivastava, S. B., & Banaji, M. R. 2011. Culture, cognition, and collaborative networks in organizations. ***American Sociological Review***, 76: 207–233.

Stokes, P. D. 2014. Crossing disciplines: A constraint-based model of the creative/innovative process. ***Journal of Product Innovation Management***, 31: 247–258.

Super, D. E. 1980. A life-span, life-space approach to career development. ***Journal of Vocational Behavior***, 16: 282–298.

Sytch, M., & Tatarynowicz, A. 2014. Friends and foes: The dynamics of dual social structures. ***Academy of Management Journal***, 57: 585–613.

Thompson, J. D. 1967. ***Organizations in action***. New York: McGraw Hill.

Tortoriello, M. 2015. The social underpinnings of absorptive capacity: The moderating effects of structural holes on innovation generation based on external knowledge. ***Strategic Management Journal***, 36: 586–597.

Turner, J. C. 1987. ***Rediscovering the social group: A self-categorization theory***. Oxford: Basil Blackwell.

Umphress, E. E., Labianca, G., Brass, D. J., Kass, E., & Scholten, L. 2003. The role of instrumental and expressive social ties in employees' perceptions of organizational justice. ***Organization Science***, 14: 738–753.

Varella, P., Javidan, M., & Waldman, D. A. 2012. A model of instrumental networks: The roles of socialized charismatic leadership and group behavior. ***Organization Science***, 23: 582–595.

Venkataramani, V., & Dalal, R. S. 2007. Who helps and harms whom? Relational antecedents of interpersonal helping and harming in organizations. ***Journal of Applied Psychology***, 92: 952–966.

Venkataramani, V., Labianca, G., & Grosser, T. 2013. Positive and negative workplace relationships, social satisfaction, and organizational attachment. ***Journal of Applied Psychology***, 98: 1028–1039.

Vincenti, W. G. 1990. ***What engineers know and how they know it. Analytical studies from aeronautical history***. Baltimore: John Hopkins University Press.

Wang, P. 2013. Exponential random graph model extensions: Models for multiple networks and bipartite networks. In D. Lusher, J. Koskinen, & G. L. Robins (Eds.), ***Exponential random graph models for social networks: Theory, methods, and applications***: 115–129. New York: Cambridge University Press.

Wang, P., Robins, G. L., & Pattison, P. E. 2006. PNet: A program for the simulation and estimation of exponential random graph models. Melbourne School of Psychological Sciences: University of Melbourne, Australia.

Zacher, H., & Frese, M. 2011. Maintaining a focus on opportunities at work: The interplay between age, job complexity, and the use of selection, optimization, and compensation strategies. ***Journal of Organizational Behavior***, 32: 291–318.

Zappa, P., & Robins, G. 2016. Organizational learning across multi-level networks. ***Social Networks***, 44: 295–306.

Zenger, T. R., & Lawrence, B. S. 1989. Organizational demography: The differential effects of age and tenure distributions on technical communication. ***Academy of Management Journal***, 32: 353–376.

FIGURE 1 Conceptual Framework

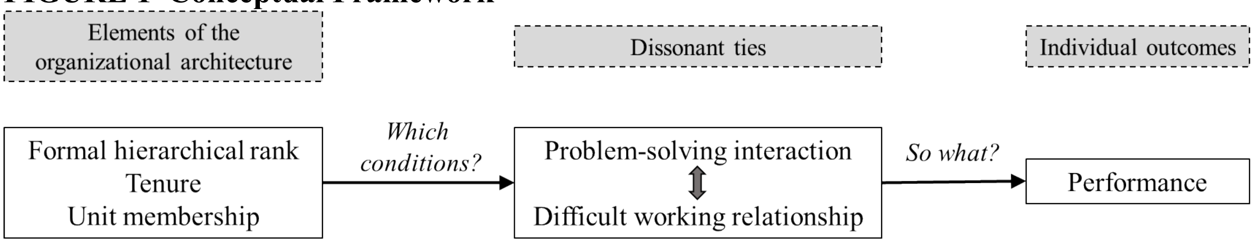
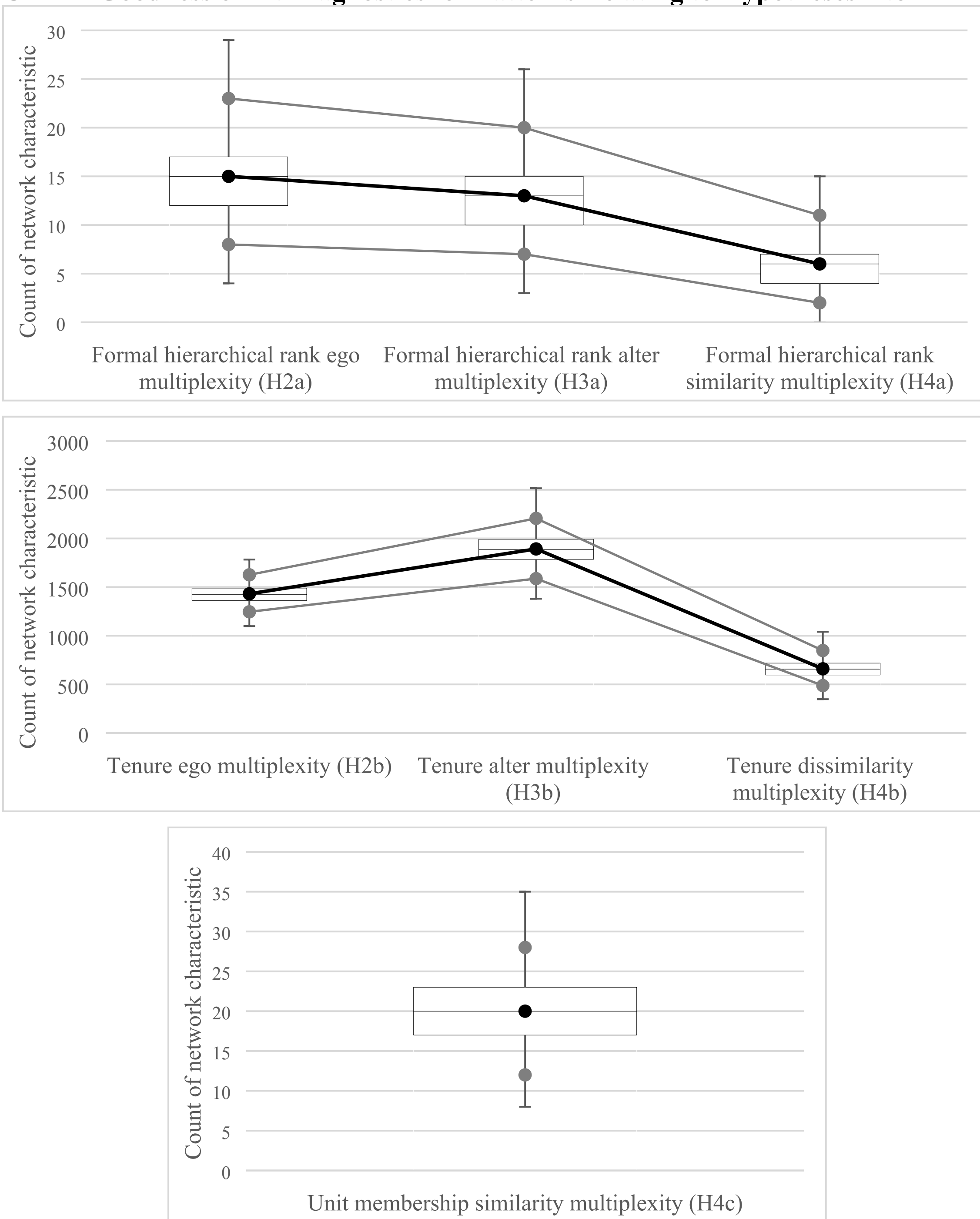


FIGURE 2 Goodness of Fit Diagnostics for Patterns Relating to Hypotheses 2 to 4



Note: The black solid line represents a given statistic from the observed networks. The boxplots represent the same statistic from the 5000 sampled simulated networks; they include the median and interquartile range. The light-gray lines represent the range in which 95 percent of simulated networks fall.

TABLE 1 Schematic Depiction of Ego, Alter, and Dyad Perspectives

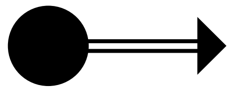
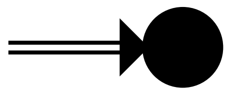
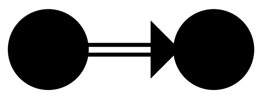
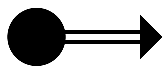
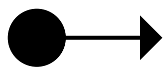
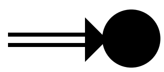
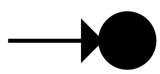
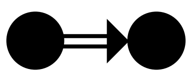
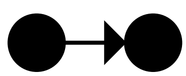
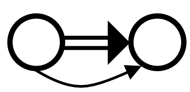
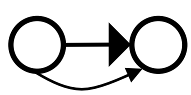
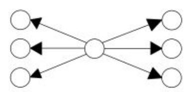
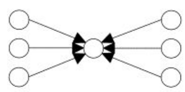
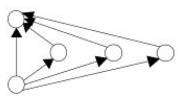
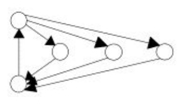
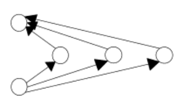
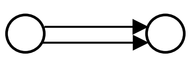
Ego perspective		Influence of ego's formal hierarchical rank (H2a) and tenure (H2b) on dissonant tie formation
Alter perspective		Influence of alter's formal hierarchical rank (H3a) and tenure (H3b) on dissonant tie formation
Dyad perspective		Influence of similarity in formal hierarchical rank (H4a), tenure (H4b), and unit membership (H4c) on dissonant tie formation

TABLE 2 Individual Attribute Patterns Included in Empirical Model of Drivers of Dissonant Ties

Variable	Visualization	Included to account for	Network statistics
Attribute ego multiplexity		Tendency for individuals with a specific continuous or binary attribute to seek problem-solving assistance from a person *and* nominate that person as difficult to work with	$\sum x_{ijm} y_i$
Attribute ego		Tendency for individuals with a specific continuous or binary attribute to seek problem-solving assistance or nominate others as difficult to work with	$\sum x_{ij} y_i$
Attribute alter multiplexity		Tendency for individuals with a specific continuous or binary attribute to be nominated by others as providers of problem-solving assistance *and* difficult to work with	$\sum x_{ijm} y_j$
Attribute alter		Tendency for individuals with a specific continuous or binary attribute to be nominated by others as providers of problem-solving assistance or difficult to work with	$\sum x_{ij} y_j$
Attribute similarity/ dissimilarity* multiplexity		Tendency for problem-solving *and* difficult ties to occur between dyads of individuals who are (dis-)similar with respect to a categorical, continuous, or binary attribute	$\sum x_{ijm} y_i y_j$
Attribute similarity/ dissimilarity*		Tendency for problem-solving or difficult ties to occur between dyads of individuals who are (dis-)similar with respect to a categorical, continuous, or binary attribute	$\sum x_{ij} y_i y_j$
Dyadic attribute entrainment multiplexity		Tendency for problem-solving *and* difficult ties to occur between dyads of individuals if a dyadic attribute is present	$\sum x_{ijm} v_{ij}$
Dyadic attribute entrainment		Tendency for problem-solving or difficult ties to occur between dyads of individuals if a dyadic attribute is present	$\sum x_{ij} v_{ij}$

Note. ⟶ = seeking problem-solving assistance *or* nominating others as difficult to work with; ○ = individual; ● = individual with a binary or categorical attribute or high values on a continuous attribute; ⤻ = dyadic covariate. * For binary and categorical attributes, the variable captures similarity. For continuous attributes, it captures dissimilarity (i.e., the difference between values of the attribute). A negative value indicates a small difference, suggesting that individuals are similar. Statistical notation: x_{ij} = network tie between individuals *i* and *j*, x_{ijm} = multiplex network tie between individuals *i* and *j*, y = individual attribute of *i* or *j*, v_{ij} = dyadic covariate between *i* and *j*.

TABLE 3 Network-endogenous Patterns Included in Empirical Model of Drivers of Dissonant Ties

Variable	Visualization	Included to account for	Network statistics
Reciprocity		Tendency to reciprocate problem-solving or difficult relationships	$\sum x_{ij}x_{ji}$
Activity spread		Tendency for variation in the degree to which individuals seek problem-solving assistance or nominate others as difficult to work with	$\sum_{k=2}^{n-1}(-1)^{k}\frac{S_{k\_out}}{\lambda^{k-2}}$
Popularity spread		Tendency for variation in the degree to which individuals are nominated as providers of problem-solving assistance or as difficult to work with	$\sum_{k=2}^{n-1}(-1)^{k}\frac{S_{k\_in}}{\lambda^{k-2}}$
Transitive closure		Tendency for triadic closure in problem-solving or difficult-tie networks, indicative of transitivity	$\lambda\sum_{i<j} x_{ij}\left\{1-\left(1-\frac{1}{\lambda}\right)^{L_{T2ij}}\right\}$
Cyclic closure		Tendency for cyclic closure in problem-solving or difficult-tie networks, indicative of a prevailing generalized exchange	$\lambda\sum_{i<j} x_{ij}\left\{1-\left(1-\frac{1}{\lambda}\right)^{L_{C2ij}}\right\}$
Multiple connectivity		Tendency for problem-solving or difficult ties to form as part of formations involving multiple short paths between individuals	$\lambda\sum_{i<j}\left\{1-\left(1-\frac{1}{\lambda}\right)^{L_{T2ij}}\right\}$
General multiplexity		Tendency to seek problem-solving assistance from a colleague nominated as difficult to work with	$\sum x_{ijm}$

Note. ⟶ = seeking problem-solving assistance *or* nominating others as difficult to work with; ○ = individual. Statistical notation: x_{ij} = network tie between individuals *i* and *j*, x_{ijm} = multiplex network tie between individuals *i* and *j*, n = number of individuals included in the network, S stands for "star" and the subscript *k* indicates the size of the star (e.g., 2-star, 3-star, … 1 k-star), k_in refers to the in-degree of individuals, k_out refers to the out-degree of individuals, λ is a dampening factor (Snijders, Pattison, Robins, & Handcock, 2006), L*2*ij* represents the number of indirect paths of length 2 between *i* and *j* with T standing for transitive patterns and C standing for cyclic patterns (Lomi et al., 2014).

TABLE 4 Descriptive Statistics for the Networks

Statistic	Problem-solving network	Difficult-tie network
Density	0.057	0.014
# of ties	1663	413
Reciprocity rate	0.275	0.102
Mean in-/out-degree	9.725	2.415
Standard deviation out-degree	10.483	3.261
Minimum out-degree	0	0
Maximum out-degree	47	22
Standard deviation in-degree	9.47	4.170
Minimum in-degree	0	0
Maximum in-degree	68	23
# of ties seeking problem-solving assistance from difficult colleagues (i.e., dissonant ties)	50	

TABLE 5 Descriptive Statistics and Correlations

	Variables	N	Mean	SD	1	2	3	4	5	6	7	8	9	10
1	Effectiveness nomination by own supervisor	163	0.362	-										
2	# of effectiveness nominations from all formal leaders	171	1.889	2.079	0.368**									
3	# of dissonant ties	171	0.292	0.733	0.095	0.353**								
4	# of ties seeking problem-solving assistance	171	9.725	10.483	-0.093	0.199**	0.309**							
5	Structural holes (problem-solving)	171	0.680	0.214	0.015	0.355**	0.279**	0.556**						
6	# of ties nominating others as difficult to work with	171	2.415	3.261	-0.051	0.214**	0.350**	0.131	0.187*					
7	# of nominations as difficult to work with	171	2.415	4.170	-0.066	0.233**	0.162*	0.229**	0.275**	0.235**				
8	Formal hierarchical rank	171	0.099	-	-0.014	0.536**	0.268**	0.276**	0.248**	0.120	0.442**			
9	Tenure	171	10.230	9.510	0.025	0.232**	0.042	0.271**	0.333**	0.169*	0.419**	0.180*		
10	Gender	171	0.894	-	0.103	-0.074	0.059	0.082	0.191*	-0.015	0.062	-0.077	0.046	
11	Level of education	171	2.058	0.675	-0.068	0.126	0.037	0.067	0.062	-0.014	0.136	0.087	-0.204**	-0.027

*$p < .05$
**$p < .01$

TABLE 6 Regression Analyses for Performance Consequences

Variable	Model 1 Own supervisor	Model 2 Own supervisor	Model 3 All formal leaders	Model 4 All formal leaders
Formal hierarchical rank	0.318 (0.804)	-0.075 (1.007)	1.048** (0.121)	0.965** (0.099)
Tenure	0.012 (0.034)	0.016 (0.032)	0.016 (0.009)	0.019* (0.007)
Level of education	-0.124 (0.242)	-0.111 (0.264)	0.179 (0.116)	0.184 (0.112)
Gender	0.750 (0.814)	0.667 (0.823)	-0.208 (0.229)	-0.259 (0.223)
# of ties seeking problem-solving assistance	-0.034 (0.019)	-0.046 (0.024)	-0.013 (0.008)	-0.016 (0.008)
Structural holes (problem-solving)	0.849 (1.247)	0.751 (1.250)	2.007** (0.770)	1.939* (0.787)
# of ties nominating others as difficult to work with	-0.023 (0.050)	-0.059 (0.048)	0.032 (0.017)	0.018 (0.016)
# of nominations as difficult to work with	-0.052 (0.065)	-0.054 (0.060)	-0.030* (0.015)	-0.030* (0.014)
# of dissonant ties		0.537* (0.258)		0.157* (0.066)
Intercept	-1.242 (0.885)	-1.111 (0.884)	-1.243 (0.631)	-1.170 (0.631)
Log likelihood	-103.59585	-101.645	-280.906	-278.839
Chi^2	21.36**	41.43**	203.59**	294.28**
N	163	163	171	171

Note. N = 163 for Models 1 and 2 whereas N = 171 for Models 3 and 4 because some employees report to administrative leaders who are not part of the sample. Unstandardized coefficients; clustered standard errors in parentheses; two-tailed significance tests are reported; Models 1 and 2 rely on logistic regressions; Models 3 and 4 utilize negative binomial regressions.

*$p < .05$

**$p < .01$

TABLE 7 Multiplex Exponential Random Graph Model for the Drivers of Tie Formation

	Network pattern	**Parameter Estimate (SE)**	
		Problem-solving ties	*Difficult ties*
	Formal hierarchical rank ego	0.108 (0.061)	-0.150 (0.213)
	Tenure ego	0.007** (0.002)	0.003 (0.006)
	Formal hierarchical rank alter	0.139* (0.069)	0.753** (0.161)
	Tenure alter	0.013** (0.002)	0.017** (0.006)
	Formal hierarchical rank similarity	0.471** (0.155)	-0.449 (0.476)
	Tenure dissimilarity	-0.016** (0.003)	-0.001 (0.008)
	Unit membership similarity	0.821** (0.048)	1.364** (0.165)
	Gender similarity	0.135** (0.045)	-0.030 (0.125)
	Level of education dissimilarity	-0.025 (0.029)	0.154* (0.078)
	Supervisor dyadic covariate	0.771** (0.231)	-1.265 (0.706)
	Reciprocity	1.117** (0.135)	1.610** (0.310)
	Activity spread	0.114 (0.110)	1.206** (0.117)
	Popularity spread	-0.072 (0.124)	1.192** (0.117)
	Transitive closure	1.216** (0.045)	0.212* (0.104)
	Cyclic closure	-0.153** (0.025)	0.030 (0.096)
	Multiple connectivity	-0.071** (0.004)	-0.008 (0.014)
Dissonant ties	General multiplexity	1.478* (0.598)	
	Formal hierarchical rank ego multiplexity (H2a)	0.332 (0.478)	
	Tenure ego multiplexity (H2b)	-0.167** (0.061)	
	Formal hierarchical rank alter multiplexity (H3a)	-1.997** (0.631)	
	Tenure alter multiplexity (H3b)	0.146* (0.064)	
	Formal hierarchical rank similarity multiplexity (H4a)	1.186 (0.907)	
	Tenure dissimilarity multiplexity (H4b)	-0.156* (0.071)	
	Unit membership similarity multiplexity (H4c)	-0.858* (0.358)	
	Gender similarity multiplexity	0.089 (0.423)	
	Level of education dissimilarity multiplexity	-0.574* (0.265)	
	Supervisor dyadic covariate multiplexity	2.022* (0.924)	

Note. $N = 171$; density fixed; unstandardized estimates; two-tailed significance tests are reported.
*$p < .05$
**$p < .01$

APPENDIX A Selected Quotes from Formal Leaders on Daily Working Procedures and Effectiveness

Several high-ranking interviewees confirmed that they engaged in task-related interactions with other supervisors' employees, allowing them to evaluate their effectiveness in the first place:

> *[Name], for example, tends to delegate most of the work to the engineers, so my interaction is actually not much with [name] but more with the guys. […] They are less experienced, so I typically offer support to them as well. Is it part of my job? I guess. I don't see it otherwise because ultimately we're trying to reach the same solution.*

> and

> *I talk to their employees as well, yeah. In fact, most of the time it's a 50/50 thing […] I'll go straight to the person […] I deal with some things that are fairly urgent and I need a quick response.*

> and

> *I sit in on multiple design reviews and similar meetings a week to see all the structure side - that's my prime responsibly.*

Describing the work within the engineering department, they emphasized high pressure to provide timely solutions that reduce costs and improve working processes. Their quotes underline the complexity and knowledge-intensity of the engineers' work. Exemplary statements are:

> *We provide design solutions and analysis solutions. We make design changes for cost reduction and also defect reductions in support of the production line, so if there is a problem down the line with a design that we can make better, then that is a change that we go through. …making sure that we do the work correctly in terms of procedures, making sure that the people doing the work are supported in completing the task.*

> and

> *We'd be running fatigue tests… and we had to get a test ready in three or four weeks. It was just a shambles. But a lot of the young guys did really good. … The people who actually helped me organize that test have moved on [to high-ranking positions in the company]. They've done really well. Solutions were worked out.*

> and

> *Because the cost of manufacturing the product is too high… the challenge… is to work out ways to redesign either the components themselves or the manufacturing process to reduce cost. And some of the ideas that we've come up with and that we've implemented this year have had a high disruption. [Gives two technical examples.] So these are examples of what disruptive requests are and their scale could be huge, but the driver is all around cost reduction.*

The following quotes illustrate behavioral expectations and reflect that there is a fine line between exploration and exploitation:

> *It's very easy to get pulled into many side elements or side branches in a project and there are times when you just need to stop. Don't investigate all the side roads, just keep going down there and execute on what we need. So, the business is becoming very focused around fabrication rate and cost and engineering costs and reduction of hours and effective use of hours.*
>
> and
>
> *We're always encouraging people to come up with new ideas and new designs and better ways of doing things. ...we do focus a lot on continuous improvement as well, so looking at processes that we have in place, what works, what doesn't work. ...we have weekly design reviews. So we make sure that the teams bring their design to a forum, and other design leads or analyst leads provide feedback, and it's a good, open discussion in terms of the maturity of their design and how it is going.*

One formal leader described the case of an employee who in his words "*wasn't a great performer"* and who struggled to integrate knowledge form different functional areas, trying to get him to:

> *...study his functions separately at a detail level. "Go and read the procedures relative to planning. Go and read the procedures relative to manufacturing engineering."*

and commented that in such cases:

> *They [the engineers] just don't seem as agile in their thought process… they don't seem to be able to flip over the mind-set.*

Finally, also commenting on performance assessment, another interviewee talking about engineers ("the technical guys") in comparison to administrative managers stated:

> *The technical guys are more about the technical specialty that they are recognized for… their performance isn't rated on how well the business is going or how well the engineering group is going. It's much more about quality of technical answers.*

APPENDIX B Qualitative Implications of the ERGM Estimates

To deepen the interpretation of the ERGM results, I transformed the parameter estimates into conditional odds ratios (Lomi et al., 2014; Robins & Daraganova, 2013). This approach can be compared to calculating the odds ratio in a logistic regression with the difference that the ERGM-based odds refer to the likelihood of observing a network tie. They are conditional on all other things being equal—a tie is in the identical structural position (captured by the network endogenous patterns in the model) and the involved employees have the same values on all other attributes. Because no two ties may actually fulfil this condition, calculating the conditional odds can best be seen as "abstract thought experiment" that "does help us interpret attribute effects" (Robins & Daraganova, 2013: 97)

How to calculate conditional odds differs for unit membership as categorical attribute variable, formal hierarchical rank as binary variable, and tenure as continuous variable. Therefore, the following analyses are presented according to types of variables, from least to most complex, rather than ego, alter, and dyad perspectives used to structure the main body of the manuscript.

Unit membership. With regards to unit membership as categorical variable, the conditional odds are calculated by simple exponentiation of the estimated unit membership similarity parameters. For problem-solving and difficult tie estimates, they refer to the likelihood of observing each type of tie while holding everything else constant: ceteris paribus, the odds of observing problem-solving ties among members of the same unit are more than twice (exp (0.821) = 2.3) the odds of observing problem-solving ties across units. The odds of observing difficult ties within units are four times (exp (1.364) = 3.9) the odds of observing them across unit boundaries. In contrast, for multiplex parameter estimates, the conditional odds reflect the extra effect given by both types of ties being present at the same time. When an individual has a difficult working relationship with a colleague in the same unit, the odds for this individual to also seek problem-solving assistance from the colleague—thereby establishing a dissonant tie—are more than halved (exp (-0.858) = 0.42) within as compared to across unit boundaries. This implies that the within-unit "advantage" for problem-solving ties is more than cancelled out when members of a dyad are simultaneously connected by a difficult working relationship; in line with the negative and significant ERGM parameter estimate, employees are more likely to establish dissonant ties across unit boundaries.

Formal hierarchical rank. For formal hierarchical rank as binary variable the calculation of conditional odds ratios becomes gradually more complex, because ego, alter, and similarity effects play a role. Given that high-rank = 1, the case of two employees without the attribute (i.e., low-ranking employees) can be defined as the baseline and conditional odds ratios for ego, alter, and similarity effects are calculated relative to that baseline. For ego and alter effects, the odds result from exponentiation of the estimated parameters. In contrast, when computing the odds for observing ties between two high-ranking employees (compared to two low-ranking employees as the baseline), ego and alter effects need to be taken into account. The latter odds are calculated as exp (θ_{ego} +θ_{alter} +$\theta s_{imilarity}$). Results based on this logic for problem-solving, difficult, and dissonant ties are shown in Table B1.

For the interpretation, I concentrate on formal hierarchical rank alter effects because the parameter estimates they are based upon are consistently statistically significant in the ERG model. All else being equal, the odds to be approached for problem-solving assistance are exp (0.139) = 1.15 for high-ranking as compared to low-ranking alters. The odds of them being nominated as difficult are more than twice the odds of their low-ranking colleagues. In contrast, the odds of a receiving problem-solving requests drop to about one-seventh for high-ranking as compared to low-ranking alters if a difficult relationship is simultaneously present.

TABLE B1 Conditional Odds for Observing Problem-Solving, Difficult, and Dissonant Ties Based on Formal Hierarchical Rank

	Problem-solving ties	Difficult ties	Dissonant ties
Baseline	1.00	1.00	1.00
Formal hierarchical rank ego	1.11	0.86	1.39
Formal hierarchical rank alter	1.15	2.12	0.14
Formal hierarchical rank similarity	2.05	1.17	0.62

Tenure. For tenure as continuous variable, I follow advice by Robins and Daraganova (2013) and calculate conditional odds by assigning attribute scores based on the variable's mean (= 10.23) and standard deviation (= 9.51) to hypothetical egos and alters.

For ego and alter effects, the calculation follows the above logic. From the ego perspective, the modelling results indicate that the odds of seeking problem-solving assistance increase by exp (0.007 * 9.51) = 1.07 if ego tenure rises by one standard deviation. As the estimate for difficult tie formation is insignificant, I refrain from interpreting its effect size. Regarding dissonant ties, the odds of seeking problem-solving assistance decrease by 0.2 per rise in standard deviation if a difficult working relationship is simultaneously present, other conditions being equal. From the alter perspective, the odds of employees to be approached for problem-solving assistance increase by 1.13, to be nominated as difficult by 1.18, and by an additional factor of 4 for both types of ties being present at the same time if alter tenure rises by one standard deviation.

For the dyad perspective, that is, similarity in tenure, first remember that the estimated parameters capture dissimilarity, specifically the difference between the values of the attribute. Conditional odds for observing ties between employees from the dyad perspective are calculated by assigning tenure values to ego and alter. I assigned values of the mean plus/minus one standard deviation reflecting short and long tenure respectively. The conditional odds are computed as exp (attribute value ego * θ_{ego} + attribute value alter * θ_{alter} + (|attribute value ego - attribute value alter|) * $\theta_{dissimilarity}$).

Following the example of Lomi et al. (2014), results are summarized in Table B2 for problem-solving, difficult, and dissonant ties. Each entry reflects the odds of a tie from ego with long/short tenure to alter with long/short tenure, compared to a tie from a baseline ego to a baseline alter. The baseline refers to egos and alters who have just entered the organization; the odds observing a tie between two employees with short tenure (10.23 - 9.51 = 0.72) come very close to this baseline.

Results for problem-solving ties show that, relative to the baseline, the odds for employees with long tenure decrease to 0.85 for seeking problem-solving assistance from employees with short tenure and rise to 1.48 for problem-solving assistance from employees with similarly long tenure. For difficult ties, the odds to find alters with long tenure difficult are 1.38 compared to the baseline for egos with short tenure and 1.48 for egos with similarly long tenure. As only the estimate for tenure alter is actually statistically significant in the ERG model, the observed differences with regards to difficult tie formation are driven by an alter effect rather than a dissimilarity effect. Finally, when an ego with short tenure has a difficult relationship with a long tenured alter, the odds of simultaneously observing a problem-solving tie decline only slightly to 0.81 relative to the baseline. In contrast, for long tenured alters the odds of observing a problem-solving and difficult tie with an ego with short tenure at the same time are close to zero and with an ego with similarly long tenure are 0.66 relative to the baseline. In line with the significant ERGM parameter estimates, dissonant ties, hence, tend to be established to a greater extent by employees with short tenure, and preferably target employees with similarly short but also with longer tenure.

TABLE B2 Conditional Odds for Observing Problem-Solving, Difficult, and Dissonant Ties among Dyads Depending on Tenure

	Alter tenure	
Ego tenure	Short	Long
Problem-solving ties		
Short	1.01	0.96
Long	0.85	1.48
Difficult ties		
Short	1.01	1.38
Long	1.05	1.48
Dissonant ties		
Short	0.98	0.81
Long	0.01	0.66

APPENDIX C Extended Goodness-Of-Fit Analysis for the ERG Model

As extended GOF assessment, ERGM allows to evaluate how well the estimated model is able to reproduce not only local network patterns that are of theoretical interest in this research, but also global network characteristics, or general structural features, such as the degree distribution and global clustering of a network (Caimo & Lomi, 2015). In the case of multiplex ERGM, these global network characteristics are assessed for the two networks that are modelled together, here the problem-solving and difficult-tie networks from which dissonant ties emerge. As reported in the results section, the GOF assessment can first be based on t-statistics, computed by comparing observed network characteristics to characteristics simulated based on the fitted model presented in Table 7. T-statistics for the global network characteristics are reported in Table C1.

TABLE C1 Goodness-of-Fit Statistics for Global Network Characteristics

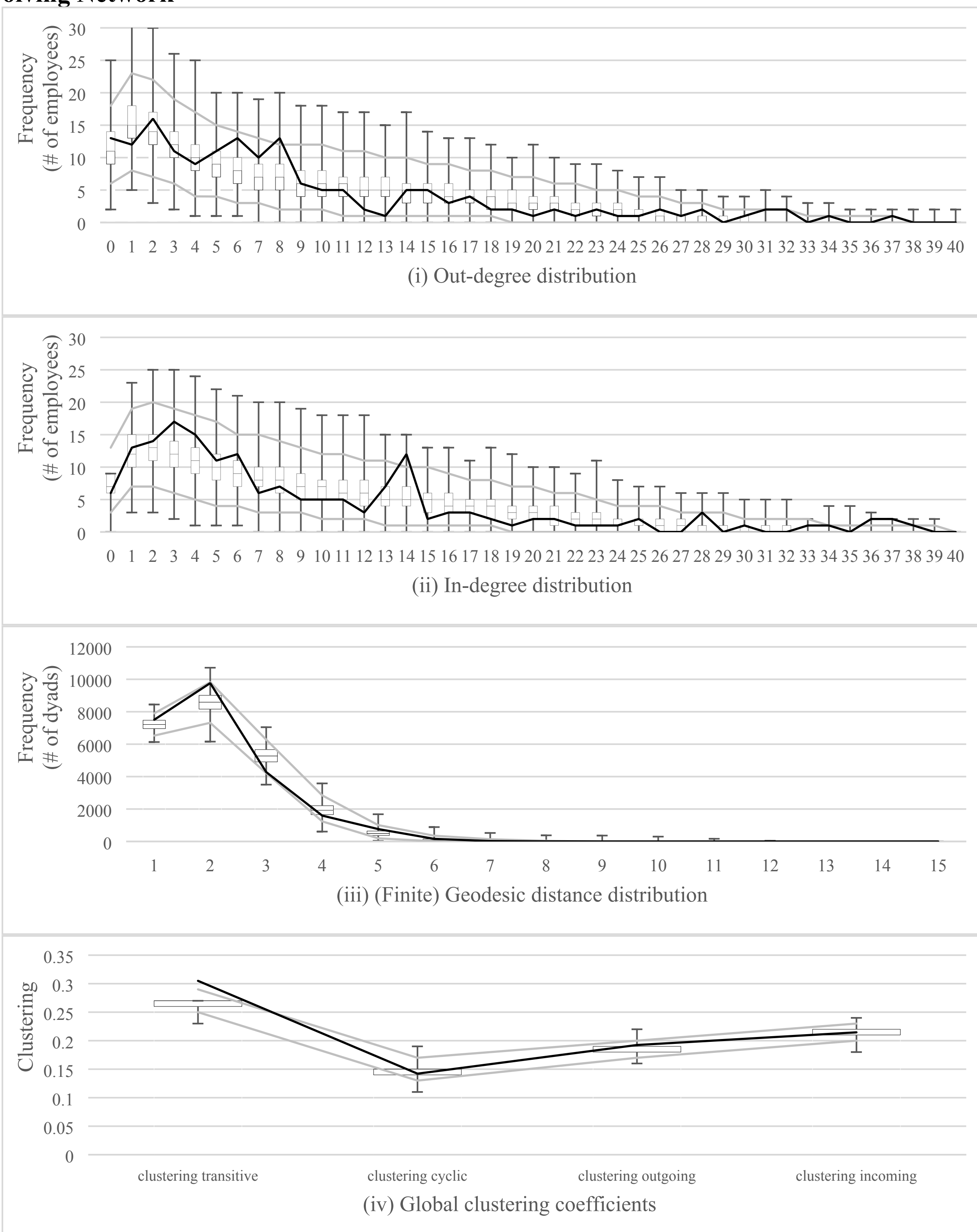
Global network characteristic	Observed	Simulated Mean (SE)		t-statistic
Problem-solving network				
Standard deviation out-degree distribution	10.452	9.792	(0.384)	1.720
Skewness out-degree distribution	2.283	2.394	(0.195)	-0.569
Standard deviation in-degree distribution	9.442	8.315	(0.353)	3.197
Skewness in-degree distribution	1.661	1.456	(0.108)	1.908
Global clustering transitive	0.305	0.267	(0.011)	3.429
Global clustering cyclic	0.142	0.146	(0.010)	-0.348
Global clustering outgoing	0.192	0.182	(0.008)	1.340
Global clustering incoming	0.215	0.213	(0.009)	0.122
Difficult-tie network				
Standard deviation out-degree distribution	3.251	3.162	(0.080)	1.112
Skewness out-degree distribution	2.272	2.272	(0.086)	0.004
Standard deviation in-degree distribution	4.157	4.098	(0.069)	0.857
Skewness in-degree distribution	2.726	2.780	(0.084)	-0.653
Global clustering transitive	0.121	0.126	(0.011)	-0.510
Global clustering cyclic	0.040	0.041	(0.012)	-0.096
Global clustering outgoing	0.076	0.080	(0.008)	-0.557
Global clustering incoming	0.051	0.053	(0.006)	-0.389

Note. SE = standard error; the different clustering coefficients capture the four possible ways to complete a triangle in a directed network from the perspective of ego (for further details, see Robins et al. 2009).

An inspection of the t-statistics reveals that the values for the standard deviation of the in-degree distribution and global transitive clustering of the problem-solving network exceed the recommended threshold of $|t| = 2$; these global characteristics of the network can, hence, not be reproduced accurately based on the model. Yet, as stressed by Robins and Lusher (2013), it cannot be expected that an ERG model fits all characteristics of an observed network, just as a regression model cannot be expected to explain 100 percent of the variance.

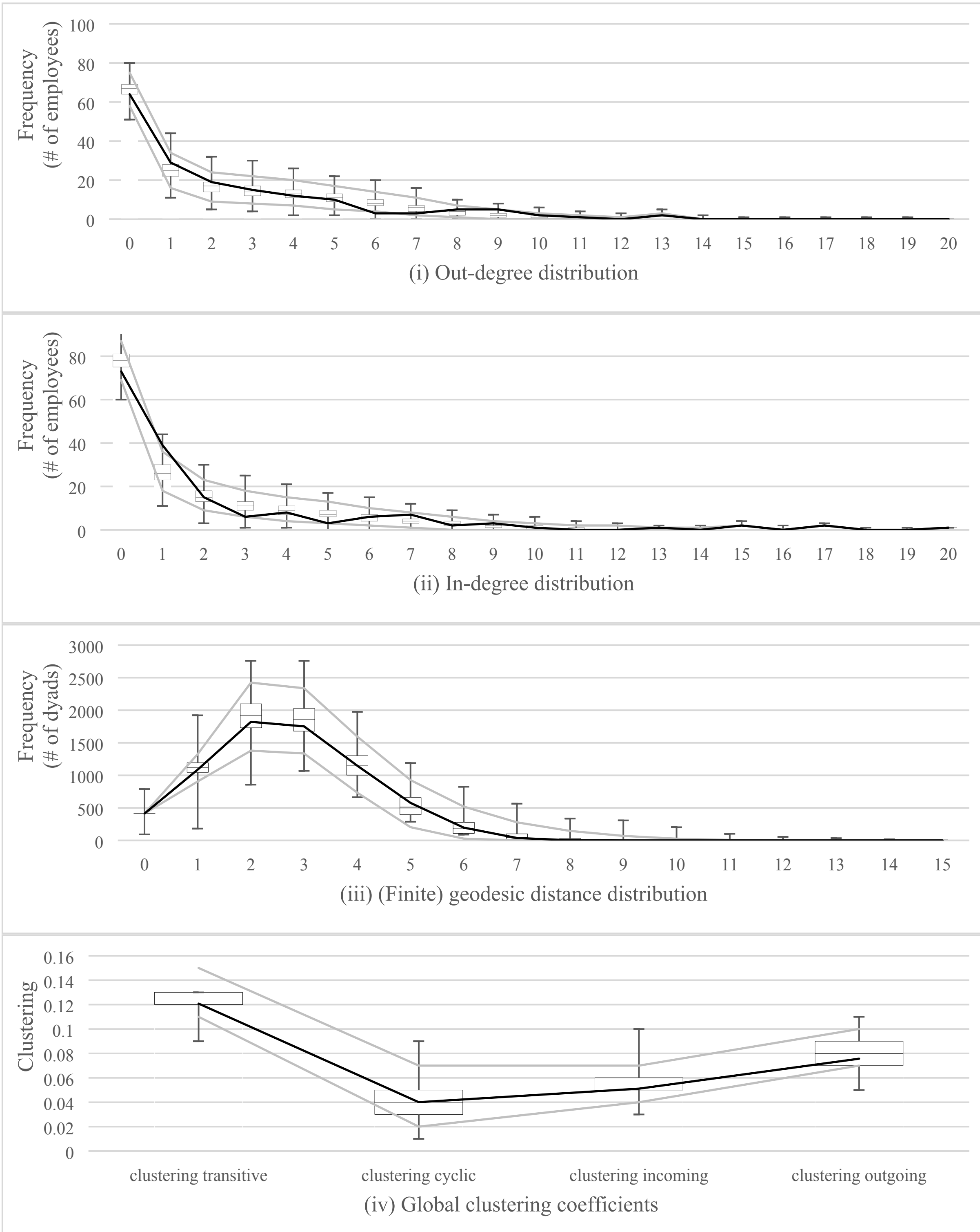
To gain further insights on the global fit characteristics, it is possible to draw sample (i) out-degree distributions—the distribution of outgoing ties for each individual in a network, here egos' number of ties seeking problem-solving assistance and nominating others as difficult to work with; (ii) in-degree distributions—the distribution of incoming ties for each individual in a network, in this case the number of nominations as assistance provider and as difficult to work with that alters receive; (iii) minimum geodesic distance distributions—the distribution of the length of shortest path between two individuals; and (iv) global clustering coefficients for the problem-solving assistance and difficult-tie networks and graphically compare the characteristics of these samples to the characteristics of the observed network (see for instance Kim et al., 2016; Robins et al., 2009). These GOF visualizations are shown in Figures C1 and C2 below and allow gaining a visual sense of model GOF. The graphics relating to the problem-solving network in Figure C1 underscore that the model does a relatively good, but not a perfect, job of producing networks that reflect the actual global characteristics of the observed network: The black line that represents the observed network does not in all cases lie within the light-gray lines capturing the range in which 95 percent of simulated networks fall, which would be seen as graphical indication of a perfect fit (Caimo & Lomi, 2015). By contrast, Figure C2 highlights that the difficult-tie network can be reproduced with almost perfect precision from the fitted model.

FIGURE C1 Goodness-of-Fit Visualizations for Global Characteristics of the Problem-Solving Network



Note. The black solid line represents a given statistic from the observed networks. The boxplots represent the same statistic from the 5000 sampled simulated networks; they include the median and interquartile range. The light-gray lines represent the range in which 95 percent of simulated networks fall.

FIGURE C2 Goodness-of-Fit Visualizations for Global Characteristics of the Difficult-Tie Network



Note. The black solid line represents a given statistic from the observed networks. The boxplots represent the same statistic from the 5000 sampled simulated networks; they include the median and interquartile range. The light-gray lines represent the range in which 95 percent of simulated networks fall.

Julia Brennecke (julia.brennecke@liverpool.ac.uk) is a Senior Lecturer in Innovation and Knowledge Management at the University of Liverpool Management School, UK. She received her PhD from the University of Göttingen, Germany. Her research interests include intra- and inter-organizational networks, knowledge transfer, and innovation.