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Ties with potential: nature, antecedents, and consequences of social networks in school teams

Moolenaar, N.M.

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Ties with Potential

Nature, antecedents, and consequences
of social networks in school teams

Nienke Moolenaar

Stellingen

Behorend bij het proefschrift 'Ties with potential:
Nature, antecedents, and consequences of social networks in school teams'

1. Relationships matter (dit proefschrift)

2. The saying 'birds of a feather flock together' also holds for Dutch elementary school educators (dit proefschrift)

3. Hulpvaardigheid leidt niet zonder meer tot een uitgebreid sociaal netwerk (dit proefschrift)

4. The saying 'Who you know defines what you know' should be more accurately 'How you lead defines who you lead' (dit proefschrift)

5. Een overdaad aan wederzijdse relaties kan wijzen op een gebrek aan vertrouwen (dit proefschrift)

6. Social networks in school teams support and constrain the uptake, depth, and spread of educational reform (dit proefschrift)

7. Social networks can be compared to rail roads and the train vehicles that travel these roads can be considered as resources; but what really matters to social capital is whether the train passengers reach their desired destination

8. The world of educational research will become increasingly irrelevant unless we are able to better translate our scholarship into practice

9. The pizzicato law: it will never be perfect

10. If a picture tells more than a thousand words, then music tells more than a thousand pictures

Ties with Potential

Nature, antecedents, and consequences of
social networks in school teams

Nienke Moolenaar

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Netherlands Organisation for Scientific Research

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Ties with Potential

Nature, antecedents, and consequences of
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ACADEMISCH PROEFSCHRIFT

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door

Nienke Marcella Moolenaar

geboren te Harlingen

Promotores: Prof. Dr. S. Karsten
                   Prof. Dr. P.J.C. Sleegers

Overige leden: Prof. Dr. A. Nauta
                   Prof. Dr. K. Sanders
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                   Prof. Dr. W.M.M.H. Veugelers
                   Prof. Dr. A.M.L. van Wieringen

Faculteit der Maarschappij- en Gedragswetenschappen

CONTENTS

'In the quantum world, relationships are not just interesting;

to many physicists, they are all there is to reality'

(Wheatley, 1992, p. 32)

INTRODUCTION

Around the globe, educational researchers, practitioners, and policy-makers are showing interest in the potential of relationships among educators to foster systemic improvement in instructional quality and student achievement. Research suggests that relationships among teachers are important in building strong school communities (Penuel, Riel, Krause, & Frank, 2009), and that strong teacher networks can enhance teacher commitment and give teachers a sense of belonging and efficacy (Grodsky & Gamoran, 2003). Moreover, recent studies indicate that strong social relationships in and among schools play a crucial role in policy implementation and instructional change (Coburn & Russell, 2008; Daly & Finnigan, 2009; Veugelers & Zijlstra, 2002).

The urge to capitalize on teacher relationships is reflected by a growing number of concepts that focus on teacher interaction in support of teachers' professional development and school improvement, such as community of practice, organizational (shared, collaborative) learning, professional (learning) community, and teachers' social networks (Coburn & Stein, 2006; Lee & Smith, 1996; Louis, Marks, & Kruse, 1996; Louis & Marks, 1998; McLaughlin & Talbert, 2001; Newmann, King, & Youngs, 2000; Smylie & Hart, 1999; Wenger, 1998). These concepts share an underlying assumption that teachers' relationships are important as they provide access to information, knowledge and expertise (Frank, Zhao, & Borman, 2004; Hansen, 1999; Reagans & McEvily, 2003), facilitate joint problem solving (Uzzi, 1997) and shape an environment of trust (Bryk & Schneider, 2002).

Despite the rising popularity of these concepts in educational policy, practice, and research, yet, studies on the nature and structure of social relationships among teachers are scarce. Our understanding of how teachers' relationships achieve the assumed beneficial outcomes is limited. Moreover, current research has not yet provided insights in antecedents that shape social relationships within social networks, as well as mechanisms through which teacher relationships may influence valuable school outcomes. This dissertation addresses these important issues by examining the nature, antecedents, and consequences of social networks in school teams.

Ties with Potential
The fundamental notion underlying this dissertation is that relationships among teachers, as captured by teachers' social networks, can provide individuals and groups with resources that may be utilized to accomplish individual and organizational goals. This notion represents the main

proposition of social capital theory. Social capital theory, briefly, postulates that social capital is generated through social relationships. The social relationships among teachers can thus be understood as 'ties with potential'. Drawing on social capital theory, this dissertation describes eight studies that each offer a different perspective on the role that teacher networks may play in achieving their school's potential.

The main aim of this dissertation is to empirically explore the nature and potential antecedents and consequences of teachers' social networks. Results of the studies are expected to provide deepened understanding of the pattern of social relationships in elementary school teams and the elements that shape, and result from, these relationships that may eventually influence school outcomes. Increased knowledge on teachers' social networks may offer valuable insights for a broad audience, including teachers, educational leaders, and policy-makers. In addition to contributing to educational practice and policy, this dissertation aims to add to the development of social network theory as an autonomous area of interdisciplinary research into relationships among individuals, groups, and systems.

Given the relative infancy of research on social networks in education, there are few substantial findings that provide evidence of a comprehensive theoretical framework to examine teachers' networks. To provide the conceptual background of this dissertation, the next section will start with a review of social capital theory and social network theory. After reviewing the relevant literature, we will describe the eight studies designed to assess the nature, antecedents, and consequences of social networks in school teams.

THEORETICAL FRAMEWORK

Social capital theory

The rise of interest in social capital as a mechanism for understanding sociological and socioeconomic phenomena is one of the most striking developments in social science over the last decade. The popularity of social capital has resulted in a myriad of definitions of social capital, each highlighting other facets and offering a nuanced interpretation of the concept. The fundamental notion of social capital is that social relationships provide access to resources that can be exchanged, borrowed and leveraged to facilitate achieving goals. Commonly cited definitions of social capital (see Table 1) share a focus on some form of social structure, network, or pattern of relationships that plays a role the exchange of resources and the facilitation of collective purposive action.

Social capital belongs to the family of "intangible assets" that can be accrued and leveraged by individuals, groups, or systems, similar to human capital and intellectual capital. While each of the definitions places an emphasis on slightly different elements in social capital, they all focus on the potential of relationships ('ties') to exchange resources. Comparable to financial, human or intellectual capital, in which money, manpower, or intellectual resources are the valuable assets, social capital reflects valuable sources that exist in social relationships among linked individuals.

Social capital in education. In the last decade, Dika and Singh (2002) notice a sharp increase of the visibility of social capital in educational research. This research is mainly focused on students' social capital as a means to explain differences in educational achievement, educational attainment, high school completion and psychosocial factors related to education like aspirations (Stanton-Salazar & Dornbusch, 1995) and expectations of parents (Muller & Ellison, 2001). Indicators of a students' social capital range from family structure and number of close friends to extracurricular involvement. In an influential study, Coleman and Hoffer (1987) associated significantly lower dropout rates in Catholic schools compared to public education with social capital in the schools' community and the students' families. Remarkably, educational research has paid little attention to social capital from other resources than family and close friends of students. The social capital that resides in the school organization is mostly overlooked as a source of beneficial outcomes for schools, teachers, and students. By studying the consequences of teachers' social networks, this dissertation aims to attend to this largely untouched area of study.

Social capital of organizations. The idea that social capital of the school as an organization may contribute to outcomes at the school, teacher, and student level has been suggested in the literature. Several studies have shown relationships between (aspects of) social capital and organizational functioning. For example, tight and stable networks of communication have proven to contribute to the functioning of organizations (Katzenbach & Smith, 1993a; Lawler, 1992). Organizations with dense informal network structures within and between organizational units generally achieve higher levels of performance than those with sparse connections (Reagans & Zuckerman, 2001). However, those same densely connected networks may also inhibit performance due to the stability of ties which may limit the introduction of novel information (Szulanski, 1996), reduce flexible organizational response, and primarily move redundant information (Hannan & Freeman, 1984; Burt,

Table 1. Leading definitions of social capital

Social capital is 'the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition'

(Bourdieu, 1986, p. 249)

'Social capital is defined by its function. It is not a single entity, but a variety of different entities, having two characteristics in common: they all consist of some aspect of a social structure, and they facilitate certain actions of individuals who are within the structure'

(Coleman, 1990, p. 302)

'Whereas physical capital refers to physical objects and human capital refers to the properties of individuals, social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them'

(Putnam, 2000, p. 19)

Social capital comprises 'the resources embedded in social relations and social structure which can be mobilized when an actor wishes to increase the likelihood of success in purposive action'

(Lin, 2001, p. 24)

Social capital refers to 'features of social organization - such as networks […], high levels of interpersonal trust and norms of mutual aid and reciprocity - which act as resources for individuals and facilitate collective action'

(Lochner, Kawachi & Kennedy, 1999, p. 260)

1992). Many scholars have identified dense social capital as a critical source of organizational advantage (e.g., Adler & Kwon, 2002; Leana & Van Buren, 1999; Nahapiet & Ghoshal, 1998; Walker, Kogut, & Shah, 1997). Empirical analysis suggests that social capital, in the form of social interaction and trust, can add significantly to a firm's value creation through innovation (Tsai & Ghoshal, 1998). However, this suggestion has not yet been validated in an educational context. Knowledge on how schools' social capital may contribute to organizational improvement and, ultimately, student achievement, is scarce, and, given increasing pressure for educational performance, critical.

Social network theory

A valuable starting point for understanding how social capital is generated through the configuration of social ties is social network theory. Social network theory and social capital theory are related streams of theory, as both theories assert that social structure may offer potential for the exchange of resources. Social capital theory is often used as a lens to frame social network studies (e.g., Coburn & Russell, 2008; Daly et al., in press; Penuel et al., 2009) that primarily focus on how the constellation of relationships in social networks may facilitate or constrain the flow of resources through the network in support of gaining access to, and leveraging, social resources (Degenne & Forsé, 1999). While notions about human agency in obtaining social resources were predominantly discussed within social capital literature, social network studies are also starting to incorporate a human agency perspective (Borgatti & Foster, 2003). With social capital as an effective lens to describe the potential of ties for acquiring resources, social network theory can provide insights in the mechanisms that are responsible for social capital outcomes (Burt, 2000).

The most distinguishing feature of social network theory is its two-fold focus on both the individual actors and the social relationships connecting them (Wasserman & Galaskiewicz, 1994). Social network theory regards social structure as a network of relationships that poses constraints and opportunities for the actors in the network (Degenne & Forsé, 1999). According to early social network theorists, many of the important social phenomena can be explained primarily, if not completely, by social structure (Berkowitz, 1982; Burt 1982; Wellman. 1983).

Central to the idea of social structure is the notion of social embeddeddness (Granovetter, 1985; Gulati, 1998; Jones, Hesterly, & Borgatti 1997; Uzzi, 1996, 1997). Social embeddedness refers to the hierarchical, or nested, nature of a social structure. In a social network, individuals are embedded within dyadic relationships, and dyadic relationships are embedded

in larger sub-groups of three, four, or more actors that eventually shape a social network. Even a social network itself is embedded in a larger social structure, for instance an organization, a community, or a country. Social embeddedness also implies that changes at a single level (e.g., the dyadic level) will have consequences for a higher-order level (e.g., the whole network) and vice versa. As such, the significance of a dyadic relation extends beyond the two actors (Burt, 2000; Degenne & Forsé, 1999).

At least three assumptions underlie social network theory and the resulting social network research (Degenne & Forsé, 1999). First, actors in a social network are assumed to be interdependent rather than independent (Degenne & Forsé, 1999; Wasserman & Faust, 1997). Second, relationships are regarded as conduits for the exchange or flow of resources such as information, knowledge, and materials (Burt, 1982; Kilduff & Tsai, 2003; Powell, Koput, & Smith-Doerr, 1996). Third, patterns of relationships, captured by social networks, may act as 'constraints' and offer opportunities for individual action (Brass & Burkhardt, 1993; Burt, 1982; Gulati, 1995a).

Social network theory takes shape in a variety of mechanisms that may explain the flow of resources in a network. Leading examples of network mechanisms are homophily and the related concept of structural balance (Davis, 1963; Festinger, 1954; Heider, 1958; Sherif, 1958), the strength of weak ties (Granovetter, 1973, 1982), and structural holes (Burt, 1980, 1992, 2000). While each mechanism highlights a distinctive facet of the interplay of individuals and their 'ties', together they offer a nuanced understanding of social structure and its implications for individual behavior, opinions, and preferences. We will now briefly review each of the four mechanisms mentioned above, as they exemplify the diversity as well as the common ground underlying social network theory and research.

Homophily. Homophily, colloquially described as 'birds of a feather flock together,' is a well-established sociological principle that proposes that individuals with similar attributes tend to form ties over time at higher rates than dissimilar individuals (Kossinets & Watts, 2006; McPherson, Smith-Lovin & Cook, 2001). Studies of homophily suggest that resources flowing through a network tend to be localized around a specific attribute such as age, gender, or education level (Ibarra, 1995; Marsden, 1988; McPherson & Smith-Lovin, 1987). Therefore, the more similar individuals are on a specific attribute, including position in a network structure, the more quickly resources will flow among these individuals. The converse is also true in that individuals who are 'distant' (different) on a specific attribute are also more 'distant' in the network. The principle of homophily shapes individuals' networks into relatively

homogeneous networks in regard to many intrapersonal and sociodemographic characteristics (McPherson, Smith-Lovin, & Cook, 2001). Network homophily may negatively affect individuals' social networks by limit individuals' access to new resources through weak and non-redundant ties (Granovetter, 1973).

Structural balance. Research on the emergence of networks over time, mostly outside of education, suggests that relationships and subsequently network structures tend toward structural balance (Heider, 1958). The concept of structural balance rests on the assertion that ties are formed, maintained, or terminated in order to reduce psychological discomfort arising from cognitive dissonance. Individuals are more likely to create new strong direct ties with friends of friends and discontinue weaker relations with friends of enemies and enemies of friends (Wasserman & Faust, 1997). The concept of structural balance has been used in describing intra- and interorganizational structure (Davis, 1963; Larson, 1992) and suggests that cliques will emerge as a consequence of preference for balance of strong positive relationships. These cliques are suggested to stabilize the network despite fluctuations over the entire network (Kossinets & Watts, 2006). However, when relationships are weak or negative, then the pressure towards balance is less powerful or absent, which explaining why weak ties are more likely to serve as bridges that can serve so-called structural holes (Kilduff & Tsai, 2003).

The strength of weak ties. Relationships can vary in the strength with which individuals are connected. Ties can be classified as strong or weak depending on the frequency and duration of interactions, as well as the emotional intensity associated with the interaction (Granovetter, 1973). Strong ties, such as friendship relationships, are suggested to be important in times of uncertainty and change (Krackhardt, 1992), and the pattern of friendship ties in an organization may be critical to its ability to deal with crisis situations (Krackhardt & Stern, 1988). Research suggests that being involved in many weak ties can be valuable for seeking information and innovation because of the diversity of connections, whereas dense networks often exist of many redundant relationships with overlapping knowledge and information (Granovetter, 1982, 1985). Moreover, Hansen (1999) found that weak ties between teams were favorable for transferring simple, procedural knowledge, whereas strong ties worked best for the exchange of more complex knowledge.

Structural holes. Structural holes are holes in social structure that result from weaker (or absent) connections between individuals or groups in a social structure. Research into structural holes focuses on the importance of individuals that 'bridge' or 'broker' between individuals or groups that are themselves sparsely or weakly connected. Structural holes can be regarded as

buffers between two groups of people, that each have their own flow of resources (Burt, 2000). Individuals that span structural holes in a network occupy a position that may benefit them in terms of information access and information diversity (Burt, 1992; Thornton, 1999). While moving new resources, these brokers may also filter, distort, or hoard those resources which inhibits overall organizational performance (Baker & Iyer, 1992; Burt, 1992). Also, occupying such a position offers social control over projects that bring together people from both sides of the hole (Burt, 2000). In general, the greater the density, or cohesion, of a network, the fewer structural holes exist in the network. In contrast, sparse networks must, by implication, rely on a few members to act as brokers between disconnected parts of a network. According to Burt (2000), both structural holes and dense networks are important network configurations that affect the distribution of social capital. In sum, the above described concepts are key to describing how social networks move resources in a variety of contexts.

Towards a nomological network of social networks in school teams

The study of social networks in education is receiving increased attention. Studies has been conducted in a range of contexts, including school and teacher networks (Bakkenes, De Brabander & Imants, 1999; Coburn & Russell, 2008; Daly, Moolenaar, Bolivar, & Burke, in press; Lima, 2007, 2009; Moolenaar, Daly, & Sleegers, in press; Moolenaar, Karsten, Sleegers, & Zijlstra, 2009; Penuel, Frank & Krause, 2007b; Penuel & Riel, 2007; Penuel, et al., 2009); leadership networks and departmental structures (Friedkin & Slater, 1994; Lima, 2003, 2004; Spillane, 2006); school-parent networks (Horvat, Weininger, & Laureau., 2003); between school networks (Lieberman, 2000; Mullen & Kochan, 2000; Veugelers & Zijlstra, 2002); and student networks (Baerveldt et al., 2004; Lubbers et al., 2006). The gap in the contemporary literature discourse on teachers' social networks is the paucity of large-scale empirical investigation into the nomological network of teachers' social networks. A nomological network represents a set of concepts of interest, their observable manifestations, and the interrelationships among and between these (Cronbach & Meehl, 1955). They argue that:

> *"Learning more about" a theoretical construct is a matter of elaborating the nomological network in which it occurs, or of increasing the definiteness of the components. At least in the early history of a construct the network will be limited, and the construct will as yet have few connections.*

<div align="right">(Cronbach & Meehl, 1955, p. 290)</div>

As is the case in many developing concepts and theories, the need to increase our understanding of social networks is accompanied by an urgency to develop a nomological network that includes empirical evidence of the concepts of interest surrounding the focal concept, observable manifestations, and the interrelationships among and between these concepts. This urgency is reflected in an often voiced critique on social network research, namely that social network research is focused too much on techniques and statistical models and not enough on the ways in which social network structure relates to 'any larger substantive part of social life' (Granovetter, 1979, p. 507-508). This dissertation aims to contribute to an exploration of possible elements of an explanatory nomological network of social networks in school teams. This dissertation is structured around three elements of such a nomological network, namely the nature, antecedents, and consequences of social networks. Figure 2 provides a graphical overview of these three elements and the variables that are chosen as manifestations of these elements in relation to teachers' social networks.

The nature of social networks
While practical and scholarly interest in educational social networks is growing rapidly, knowledge on the actual nature of teachers' social networks in practice is still scarce. Therefore, this dissertation starts with an extensive exploration of the nature of teachers' social networks in the participating Dutch sample schools.

Network content. Social networks can be characterized by the content that is exchanged within the social relationships (Scott, 2000). The study described in *Chapter 1* explores the nature of teachers' social networks by examining how network content shapes social network structure in elementary school teams. This study focuses on a phenomenon called 'network multiplexity'. Network multiplexity refers to the extent to which a link between two individuals serves more than a single purpose. In short, multiplexity is concerned with the 'overlap' or similarity between social networks that transfer different content among the same individuals. In order to understand how teacher networks are shaped by their content, different networks (e.g., friendship, advice, and collaboration networks) are compared and contrasted. By discerning underlying dimensions that may explain the observed similarities among the networks, we work towards a typology of social networks in school teams.

Figure 1. Main elements of this dissertation: antecedents, nature, and consequences of social networks in school teams

Antecedents

Principals

Transformational Leadership

School teams

Organizational Citizenship Behavior

Nature

Social networks

School characteristics
(E.g., density, reciprocity, centralization)

Dyadic characteristics
(E.g., attribute similarity)

Individual characteristics
(E.g., number of relationships, centrality)

Consequences

School teams

Trust

Shared Decision-making

Innovative Climate

Students

Cognitive Achievement

Individual and organizational demographics

School team demographics. Social network studies suggest that social relationships are at least partly shaped by demographics of individuals and their network (Heyl, 1996; Lazega & Van Duijn, 1997; Veenstra et al., 2007; Zijlstra, Veenstra, & Van Duijn, 2008). This assumption is only scarcely addressed by empirical studies, especially in the context of education (Borgatti & Foster, 2003). The study in *Chapter 2* therefore examines the influence of school team demographics on social relationships. In particular, we aim to predict the probability of social relationships from individual and school level demographic characteristics such as teachers' gender, age, individual experience, school and team size, team composition and team experience, and students' socio-economic status. This analysis was conducted to discover potential tendencies around, for example, structural balance and homophily.

Antecedents of social networks

An important underlying assumption of social network research is that individuals' actions and behaviors may affect the shape and size of their social network (Degenne & Forsé, 1999; Leydesdorff, 1991). This assumption, however, has been scarcely addressed by empirical work (Borgatti & Foster, 2003). Insights into the antecedents of social relationships would contribute to the construction of a nomological network. In search of such behavioral antecedents, two studies were conducted. The first study examined teacher behavior as antecedent of teacher relationships, whereas the second study focused on transformational leadership behavior as an antecedent of the principal's social network position.

Organizational citizenship behavior. A form of individual behavior that is often associated with social structure is organizational citizenship behavior (Bolino, Turnley, & Bloodgood, 2002; Bowler & Brass, 2006; Leider, Möbius, Rosenblat, & Do, 2009; Putnam, 2000). In *Chapter 3*, helping behavior, as a specific form of organizational citizenship behavior, is introduced as a potential antecedent that may shape social relationships among educators. This chapter addresses the question whether the probability of having relationships is dependent on the amount of helping behavior as reported by educators. In addition, the study examined whether helping behavior shaped work related networks and friendship networks in a different way.

Transformational leadership behavior. Previous network studies in education suggest that leadership behavior may play a vital role in developing and nurturing schools' social capital (Friedkin & Slater, 1994, Hallinger & Heck, 1998). Recent educational studies suggest that having access to leaders who possess expertise may significantly affect teachers' use of innovation (Penuel et

al., 2007a; Penuel et al., 2007b). However, there remains an empirical gap in the leadership literature in regard to the social network position of formal leaders (Daly & Finnigan, 2009). In specific, limited empirical evidence exists on the extent to which leader behavior can shape organizational outcomes through occupying a certain structural position. Therefore, the study described in *Chapter 4* examines the extent to which transformational school leadership behavior predicts a principal's position in his/her school's social network. Moreover, the study investigates whether 'occupying the principal position' can serve as a mechanism that mediates between transformational leadership and schools' innovative climate. As such, this study offers a distinctive contribution to this dissertation and the study of school teams' social networks by investigating both an antecedent (leadership behavior) and consequence (a school's innovative climate) of occupying the principal position in a school team's social network.

Consequences of social networks

An equally significant underlying assumption of social network research is that social structure may affect individuals' preferences and actions, as well as organizational outcomes. In the context of social networks among educators, however, few studies have concentrated on collecting empirical evidence to investigate this assumption. Insights in possible consequences of teachers' social networks would greatly add to the development of a nomological network. In search of consequences of social networks in schools, the studies in this dissertation investigate teacher trust, schools' innovative climate, shared decision-making, cognitive student achievement, and the implementation of reform.

  Teacher trust. Besides social networks, trust is often mentioned as an important facet of organizational social capital (Leana & Van Buren, 1999; Nahapiet & Ghoshal, 1998). While social networks and trust are the cornerstones on which social capital theory has been building, empirical research into the relationship between social networks and trust is surprisingly scarce. Therefore, *Chapter 5* is dedicated to linking social networks and trust in the context of professional learning communities. The premise of the study is that social network characteristics of teachers and schools may contribute to trust among elementary school educators. Noteworthy is this study's hierarchical approach to examining the relationship between trust and social networks at multiple levels of analysis. First, trust of individual school team members is predicted from individual social network characteristics, such as the number of relationships and individual-level reciprocity. Second, this

relationship is tested at the school level, predicting the amount of trust in a school team from characteristics of the team's social network structure, such as density and reciprocity, above and beyond the effect of individual social network characteristics. As such, the study is, to my knowledge, the first one to investigate the additive effect of different levels of social network characteristics.

Schools' innovative climate and shared decision-making. Recently, a developing set of educational studies associate social network structures with schools' capacity to change (Coburn & Russell, 2008; Penuel et al., 2007b; Penuel & Riel, 2007). In literature outside education, the generation of new knowledge and practices is believed to be closely linked to social relationships ('ties') within and across systems (Ahuja, 2000; McGrath & Krackhardt, 2003; Tenkasi & Chesmore, 2003; Tsai & Ghoshal, 1998). The study described in *Chapter 6* adds to the existing literature by exploring the extent to which a school's innovative climate can be predicted from its social network structure. Moreover, the study examines the mediating role of shared decision-making in the relationship between teachers' social networks and schools' innovative climate. While scholars have suggested that social relationships are valuable in terms of joint problem solving and teacher involvement (Uzzi, 1997; Liden, Wayne & Sparrowe, 2000), evidence on the interplay between social network structure and shared decision-making is lacking. Therefore, this study scrutinizes both schools' innovative climate and shared decision-making as potential consequences of social networks in schools.

Student achievement and teachers' collective efficacy. A common outcome measure of social capital research in education is students' cognitive achievement (Dika & Singh, 2002; Stanton-Salazar & Dornbusch, 1995). While studies have suggested that social capital of school teams and teacher networks have the potential to affect student achievement (Daly et al., in press; Daly & Finnigan, 2009; Penuel et al., 2007b), this suggestion has not yet been subject to empirical investigations. Since empirical evidence on the consequences of teachers' social networks for student achievement is scarce, the next study in this dissertation is aimed at clarifying this relationship. Literature further suggests that the relationship between teacher networks and student achievement may be indirect, meaning that teacher networks may benefit teacher practice, which in turn will affect student achievement (Goddard, Goddard, & Tschannen-Moran, 2007). As a concept that may play such an intermediate role since it is linked to both teacher collaboration and student achievement (Ashton & Webb, 1986; Goddard, 2002), we introduce teachers' collective efficacy. The study in *Chapter 7* thus examines the effect of schools'

social network structure on school level student achievement, as mediated by teachers' perceptions of collective efficacy.

Relationships in reform: A mixed-method U.S. example. The goal of the final study in this dissertation is to substantiate findings of the previous studies in a different context and through the use of additional methods. The study described in *Chapter 8* offers an in-depth mixed-method investigation of teachers' social networks in five Californian elementary schools, aimed at uncovering important social network characteristics that may facilitate or impede efforts at system-wide reform. Research on educational reform poses that changes in educational systems are often socially constructed (Datnow, Lasky, Stringfield, & Teddlie, 2006; Hubbard, Mehan, & Stein, 2006). The speed, direction, and depth of a planned change may thus be moderated, influenced, and even determined by the organizational interdependence that is reflected in teachers' social networks (Krackhardt, 2001; Mohrman, Tenkasi & Mohrman, 2003). To date, there is little empirical understanding of how teachers' social networks, in which district-wide change efforts take place, support or constrain reform efforts (Coburn & Russell, 2008). The study in this chapter examined the role of teachers' social networks in the uptake of reform by employing a design that combined both quantitative and qualitative methods. This mixed method design provided the opportunity to gain deepened insights in how teachers' networks take shape in a dynamic environment involved in systemic change. The triangulation of data, together with the different setting in which the study took place, offers a validation of findings of the earlier studies, and as such a rich extension to this dissertation.

Contribution

This dissertation contributes to educational policy, practice, and research by examining the nature, antecedents, and consequences of teachers' social networks. In addition to the theoretical and practical relevance of this dissertation, its significance is underlined by the use of both 'traditional' statistical methods and specific, advanced techniques for the analysis of social network data. A diverse palette of research methods and an emphasis on a multilevel approach to studying social networks add further to the importance of this dissertation. By building a nomological network around teachers' social networks in schools, this dissertation offers valuable insights for practitioners, educational leaders, policy makers, researchers, and all those who are interested in 'ties with potential' for school improvement.

PART I

Nature
of social networks
in school teams

CHAPTER 1

The Social Fabric of Elementary School Teams:
How Network Content Shapes Social Networks [1]

ABSTRACT

Background. Social networks among teachers are receiving increased attention as a vehicle to support the implementation of educational innovations, foster teacher development, and ultimately, improve school achievement. While researchers are currently studying a variety of teacher network types for their impact on educational policy implementation and practice, knowledge on how various types of networks are interrelated is limited. Moreover, studies that examine the dimensionality that may underlie various types of social networks in schools are scarce.

Purpose. The goal of this chapter was to increase our understanding of how network content shapes social network structure in elementary school teams. The study examines the extent to which various work-related (instrumental) and personal (expressive) social networks among educators are related. In addition, we explore a typology of social networks in schools and investigate whether the common distinction between instrumental and expressive social networks could be validated in the context of elementary school teams.

Method. Social network data were collected among 775 educators from 53 elementary schools in a large educational system in the Netherlands. The interrelatedness of seven social networks was assessed using the Quadratic Assignment Procedure (QAP) correlations. Multidimensional Scaling (MDS) was used to discern underlying dimensions that may explain the observed similarities. Finally, we describe and visualize the seven networks in an exemplary sample school.

Conclusions. Findings suggest small to moderate similarity between the social networks under study. Results support the distinction between instrumental and expressive networks in school teams and suggest a second dimension of mutual in(ter)dependence to explain differences in social relationships between educators.

INTRODUCTION

The rapidly growing interest in social networks can be characterized as one of the major trends in social science research. According to scientific databases (ERIC, Picarta, and Web of Science), the number of publications in social sciences using the word 'social network(s)' in the title, keywords, or abstract, has increased exponentially over the last two decades (Borgatti & Foster, 2003) (see Figure 1). Evidence of this trend in education is exhibited by an increasing number of articles focusing on the intersection of social networks and education in a growing variety of settings and areas of emphasis. The thesis that 'relationships matter' is currently inspiring educational researchers around the world to study social networks in school teams (Daly, in press; Daly & Finnigan, 2009; Daly et al., in press; McCormick, Fox, Carmichael, & Procter, in press; Penuel, Riel, Krause, & Frank, 2009) (see also Figure 1). An important prerequisite for gaining insights in the potential of social networks for schools is the emergence of social network studies that provide a deepened understanding of the structure and content of teachers' professional relationships (Coburn & Russell, 2008).

Social network scholars emphasize that social networks are shaped by the content or purpose of the social resources that are exchanged in the network (Burt, 1992; Coleman, 1990; Lin, 2001; Putnam, 2000; Scott, 2000; Wasserman & Faust, 1997). Studies suggest that the distribution of resources in a network may depend on the content of the network (Haines & Hurlbert, 1992; Raider & Burt, 1996). For instance, a social network that is maintained for the purpose of exchanging work related knowledge and expertise may look significantly different from a social network that is created for personal support. Even though both social networks contain social resources that may be accessed and leveraged, both networks may be shaped quite differently. Several scholars have therefore voiced the need to examine multiple relationships simultaneously (Friedkin, 2004; Ibarra & Andrews, 1993; McPherson, Smith-Lovin, & Cook, 2001; Mehra, Kilduff, & Brass, 1998; Monge & Contractor, 2003; Pustejovsky & Spillane, 2009; Wasserman & Faust, 1997). Yet, few studies have been conducted into the ways in which social networks are shaped differently depending on the content of their ties (Hite, Williams, & Baugh, 2005; Moolenaar, Daly, & Sleegers, in press).

The goal of this chapter is to examine the extent to which multiple social networks among educators are shaped differently depending on their content. We will address this goal by exploring the similarity between multiple social networks in school teams and working towards a typology of social networks in

school teams according to underlying dimensions. Our enquiry is guided by social network theory and the social network concept of 'network multiplexity'. In short, network multiplexity is concerned with the 'overlap' between social networks that that transfer different content among the same individuals. With this chapter, we aim to contribute to recent knowledge on the nature of social networks in school teams by comparing and contrasting different networks (e.g., friendship, advice) in 53 Dutch elementary schools located in a single district. We will start with an overview of social network theory and network multiplexity as these provide the conceptual background to the study.

Figure 1. Number of peer-reviewed publications over the period 1953-2009 containing the search terms 'social network' and 'social network and education' in title, abstract, and/or keywords
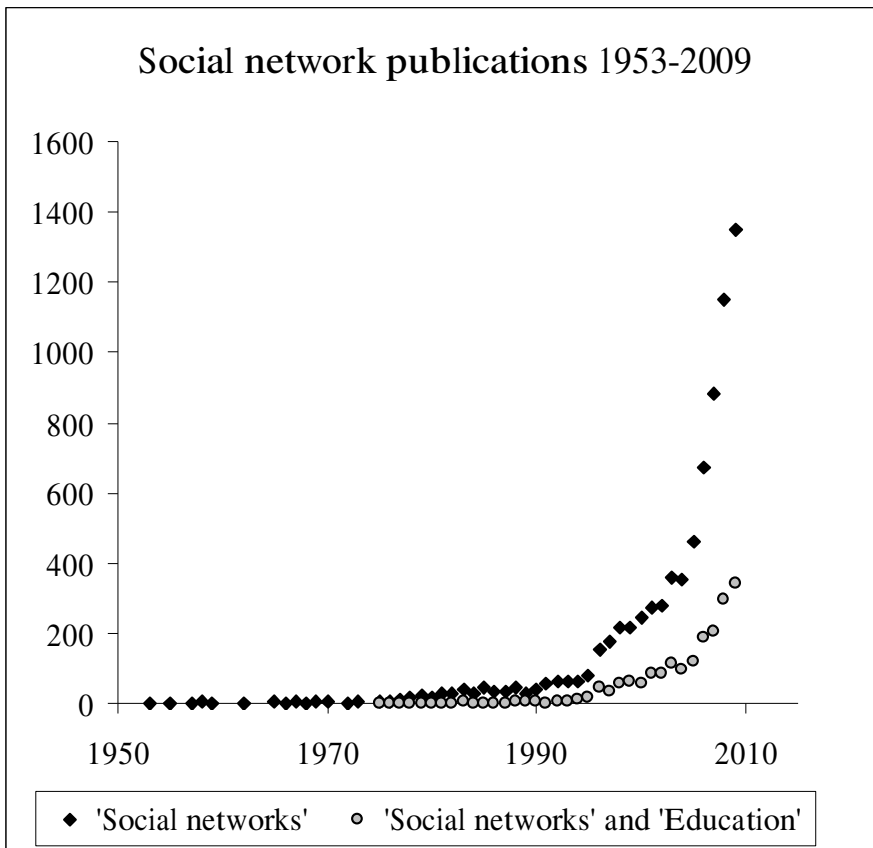
THEORETICAL FRAMEWORK

Social network theory

A growing body of educational research points to the potential of social networks to affect teachers' instructional practice, and ultimately, benefit student achievement (Coburn & Russell, 2008; Daly et al., in press; Penuel, Frank, & Krause, 2007b; Penuel & Riel, 2007). Building on social network theory, these studies examine the extent to which the pattern of relationships among teachers and the exchange of resources within these relationships may support or constrain school functioning and improvement.

An important feature of social network theory is the focus on both the individual actors and the social relationships linking them (Wasserman & Galaskiewicz, 1994). Through social interaction among educators, social relationships develop into a patchwork of ties that knit the social fabric of school teams (Field, 2003; Putnam, 2000). Social network theory argues that the quality and denseness of this social fabric eventually determines the speed, direction and flow of resources through a social network (Burt, 1992). In turn, it is through the flow and use of social resources that collective action may be facilitated and organizational goals may be achieved (Lin, 2001; Lochner, Kawachi, & Kennedy, 1999). For instance, strong social relationships are suggested to facilitate joint problem solving, lower transaction costs, and support the exchange of complex, tacit knowledge among network members (Hansen, 1999; Putnam, 1993a; Uzzi, 1997).

Studies into social networks among educators have focused on various types of social networks that connect teachers within and between schools, such as discussion about curricular issues (content, teaching materials, planning), communication around reform, seeking advice, and friendship among teachers (Coburn & Russell, 2008; Cole & Weinbaum, 2007; Daly & Finnigan, 2009, Hite, Williams, & Baugh, 2005; Pustejovsky & Spillane, 2009). While some studies focus on a single relationship (Coburn & Russell, 2008), others include and contrast multiple relationships (Cole & Weinbaum, 2007; Pustejovsky & Spillane, 2009), although not for the purpose of explicating their similarities or differences per se. Therefore, what is less clear is whether educators' social networks are shaped by the content that defines their ties (Hite, Williams, Hilton, & Baugh, 2006; Podolny & Baron, 1997). Insights in the way network content shapes collegial relationships is important for understanding the extent to which teachers' professional relationships may affect educational practice. As Little (1990) marks: 'It is precisely such "content" that renders teachers' collegial affinities consequential for pupils'. This insight can be provided by

investigating network multiplexity and exploring a typology of social networks in school teams.

Network multiplexity

In social network terms, multiplex relationships are relationships that serve multiple interests or are characterized by a multiplicity of purposes (Gluckman, 1955, 1965). In other words, multiplexity focuses on the extent to which there is overlap between different social relationships, for instance advice and friendship. Many studies focus on multiplex exchanges within a single relationship, for instance, whether a relationship between two individuals is characterized by the exchange of both work related advice and friendship (De Klepper, Van de Bunt, & Groenewegen, 2007; Hansen, Mors, & Lovas, 2005; Hite et al., 2006a; Hite, Williams, & Baugh, 2005, Koehly & Pattison, 2005; Lazega & Pattison, 1999; Lomi, 2002). Less attention has been paid to the issue of multiplexity in regard to whole networks. To advance social network theory in this direction, this chapter therefore focuses on multiplexity of whole networks. Meaning, we will examine the overlap between whole networks among the same set of individuals that are characterized by a multiplicity of purposes.

Multiplex relationships that serve multiple purposes are suggested to be stronger than relationships that only serve a single purpose, and individuals who are connected through multiplex networks will have greater success in accessing and mobilizing resources (Kapferer, 1969; Doreian, 1974). Multiplex, or multi-dimensional social networks have been studied outside education to validate name generator questions (Ruan, 1998), to examine the pattern of relationships among lawyers (Lazega & Pattison, 1999), to differentiate between different types of support networks (Bernard et al., 1990) and advice networks (Cross, Borgatti, & Parker, 2001). Yet, knowledge on the extent to which social networks in school teams can be differentiated is scarce.

Towards a typology of social networks in school teams

Teacher-to-teacher exchange can be captured by a variety of references that all refer to some form of collegiality (Little, 1990; Rosenholtz, 1989), such as sharing, giving advice, discussing work, and collaborating. Little (1990) argues that these exchanges are not just a straightforward collection of activities, but rather 'phenomenologically discrete forms that vary from one another in the degree to which they induce mutual obligation, expose the work of each person to the scrutiny of others, and call for, tolerate, or reward initiative in matters of curriculum and instruction' (p. 512). Little (1990) places various collegial forms

on a dimension of mutual interdependence, with storytelling as an example of collegiality that entails low mutual interdependence, and joint work as an example of collegiality that involves high interdependence. She poses that a shift on this dimension toward increased interdependence relates to changes in the frequency and intensity of teachers' interactions and the likelihood of mutual influence. Moreover, increased interdependence poses rising demands for collective autonomy and teacher-to-teacher initiative (Little, 1990). While this dimension of mutual interdependence could serve as a valuable guide in typifying various forms of social relationships in school teams, it has not yet received much empirical attention. Given the popularity of social network studies in education, the question in which forms the amorphous concept of 'collegiality' permeates teachers' daily practice is more relevant than ever before.

Another useful dimensionality of social relationships that has become common practice in social network research is the distinction between instrumental and expressive relationships (Ibarra, 1993, 1995). These distinct relationships are believed to provide different kinds of support and transfer unique knowledge and information (Erickson, 1988). *Instrumental relationships* encompass social interactions that are ultimately aimed at achieving organizational goals, such as work related advice or collaboration. Instrumental ties are believed to be 'weak' ties through which work related information and knowledge is exchanged between experts and people who seek information (Granovetter, 1973). *Expressive relationships* are formed through social interaction that is not directly aimed at work related issues, that often places the individual's interest above that of the organization (Burt, 1997), and that is mostly characterized by an affective component, such as personal support and friendship. In general, expressive ties are believed to be stronger, more durable and trustworthy, and offer greater potential to exert social influence (Granovetter, 1973; Ibarra, 1993; Marsden, 1988; Uzzi, 1997).

Increased understanding of a typology of social networks in school teams is indicated as social network studies often examine various types of networks without specifically addressing differences between the social networks under investigation [1]. By exploring multiple social networks this chapter not only aims

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[1] In fact, Burt (1997) writes: "Network content is rarely a variable in the studies - analysts agree that informal coordination through interpersonal networks is important as a form of social capital, but their eyes go shifty like a cornered ferret if you push past the network metaphor for details about how specific kinds of relations matter" (p. 357).

to deepen our insights in the social fabric of school teams, but also addresses the validity of the common instrumental-expressive distinction in the context of education. The boundaries between instrumental and expressive relationships are fuzzy and often tend to overlap (Borgatti & Foster, 2003). In addition, recent research has suggested that one type of relationship can in part determine or reinforce another type of relationship (Casciaro & Lobo, 2005). Since a systematic investigation of multiple networks in school teams is missing, this chapter is one of the earliest to explore a typology of social networks in school teams. In addition to advancing social network theory, the study thereby offers a unique insight in the social fabric of Dutch elementary schools.

METHOD

Context

We conducted a survey study at 53 elementary schools in south of The Netherlands. The schools formed the Avvansa School District [1] and resided under a single board that provided the schools with IT, financial, and administrative support. The schools participated in the study as part of a district-wide school improvement program focused on school monitoring and teacher development. The 53 sample schools were located in rural as well as urban areas and served a student population ranging from 53 to 545 students in the age of 4 to 13. While the schools differed slightly regarding students' SES and ethnicity, the schools' student population can be considered as rather homogeneous in comparison to the Dutch average.

Sample

All principals and teachers were asked to participate in the survey study. A total of 51 principals and 724 teachers responded to this call, reflecting a return rate of 96.8 %. Of the sample, 72.9 % was female and 52.5 % worked full-time (32 hours or more). The age of educators in the sample ranged from 21 to 63 (M = 45.7, sd = 10.7). Additional sample characteristics are included Table 1 and 2.

[1] All names are psudonyms

Table 1. Sample characteristics of schools (N = 53) and educators (n = 775)

Individual level			
Gender	Male	210	(27.1 %)
	Female	565	(72.9 %)
Working hours	Part time (less than 32 hours)	368	(47.5 %)
	Full time (32 hours or more)	407	(52.5 %)
Experience at school	1-3 years	152	(19.6 %)
	4-10 years	256	(33.0 %)
	> 10 years	367	(47.4 %)
Grade level [1]	Lower grade (K – 2)	353	(45.4 %)
	Upper grade (3 – 6)	422	(54.5 %)
School level			
Team experience	6 months to 2 years	20	(37.8 %)
	More than 2 years	33	(62.2 %)

Table 2. Sample characteristics of schools (N = 53) and educators (n = 775)

	N	M	Sd	Min.	Max.
Individual level					
Age	775	45.7	10.7	21	63
School level					
Gender ratio [2]	53	76.8	10.7	57.0	100.0
Average age	53	45.3	3.7	35.4	52.8
School size (number of students)	53	213.0	116.6	53	545
Team size (number of educators)	53	14.8	6.8	6	31
Socio-economic status (SES) [3]	53	7.9	9.5	0.4	47.3

[1] Educators who can be considered to be a part of both lower and upper grade were asked to choose with which grade level they worked most (e.g., principal, specialist staff).
[2] Gender ratio is calculated as the percentage of female team members
[3] SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

Instruments

Social networks. To discern common types of interaction among teachers in elementary education, we interviewed seventeen elementary school teachers, two principals and one coach[1] who volunteered in reaction to a canvas call among the personal social network contacts of the principal researcher. We asked the educators to describe a regular work week and give examples of the types of social interaction they had with their colleagues. The hour-long interviews were audio-recorded and conducted using a semi-structured interview guide (Patton, 1990; Spradley, 1980). We analyzed the interview data using a constant comparative analysis method (Boeije, 2002; Glaser & Strauss, 1967). We compared perspectives of educators with different formal roles and at different grade levels, grouped different forms of social interaction mentioned by the educators, and checked and rechecked emerging types of social interaction (Miles & Huberman, 1994). From this preliminary analysis, we deduced seven social networks that capture the forms of social interaction as described by the interviewed educators. As a member-check procedure (Miles & Huberman, 1994), these social networks were then shared with a new group of educators. This group comprised eleven principals and six teachers who formed a pilot sample to establish face validity of the social network questions. Based on their comments, slight adjustments were made that resulted in the final questions to assess social networks of educators in elementary school teams (see Table 3).

We include *discussing work* as social interaction concerning the discussion of work related issues. The nature of teaching requires the accumulation, transfer and exchange of ideas, experiences, expertise, and knowledge, all which can be shared through the discussing of work with colleagues (Monge & Contractor, 2003). Discussing work can be regarded a general form of resource exchange related to work and can pertain to various topics, such as instruction, planning, or use of teaching materials.

Collaboration refers to joint work among educators who are collectively responsible for the product of collaboration, and as such, collaborative relationships address collective action among teachers (Little, 1990). Interaction through collaboration may offer valuable opportunities for the exchange of knowledge and ideas, and the alignment of shared goals and expectations. Given the nature of schools as 'loosely coupled' systems (Weick, 1976) and the relative autonomy that teachers have in their classrooms (Lortie, 2002),

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[1] In Dutch: intern begeleider

Table 3. The seven social network questions to assess social networks in Dutch elementary school teams

Network	English equivalent of the original Dutch question	Social network questions (in Dutch)
Discussing work	Whom do you turn to in order to discuss your work?	Met welke collega's kunt u goed over uw werk praten?
Collaboration	With whom do you like to collaborate the most?	Met welke collega's werkt u het liefst samen?
Asking advice	Whom do you go to for work related advice?	Aan welke collega's vraagt u meestal advies over uw werk?
Spending breaks	With whom do you like to spend your breaks?	Met welke collega's brengt u graag pauzes door?
Personal guidance	Whom do you go to for guidance on more personal matters?	Met welke collega's heeft u wel eens meer persoonlijke gesprekken?
Contact outside work	Who do you sometimes speak outside work?	Met welke collega's spreekt u wel eens buiten het werk?
Friendship	Who do you regard as a friend?	Welke collega's beschouwt u als vrienden?

collaboration in Dutch elementary schools often follows formal task hierarchy and is prescribed by formal roles, such as coaches or social support specialists. However, collaboration may also be voluntary, such as participating in a committee for a specific event.

Asking for advice is of interest to the study of teacher networks since receiving advice may be part of ongoing teacher development and may facilitate the adoption and implementation of reform and innovation in schools (Moolenaar, Daly & Sleegers, in press). Asking for advice addresses the issue of 'who seeks out whom' for work-related advice and thereby, in contrast to the previous types of instrumental interaction, implies an interdependence of knowledge, expertise, or information between the advice-seeker and the advice-giver. For the advice-giver, advice relationships are a powerful tool to gain social control as they convey information and disclose vulnerability and risk-taking on the part of the advice-seeker. Research has indicated than advice-seekers often seek advice from people with a higher status than the advice-seeker (Blau, 1964; Lazega & Van Duijn, 1997).The interviewed educators mentioned *spending breaks* as another important form of social interaction. During breaks, teachers may exchange many types of resources, both work related and personal. Relationships based on spending breaks may be seen as mostly expressive since, according to the interviewed educators, breaks imply 'off the job' moments in which teachers may discuss personal issues or social conversation more easily than during formal meetings.

Another social relationship among educators involves going to a colleague for *personal guidance* and to discuss personal matters. This form of interaction explicitly addresses the informal, personal nature of relationships. A relationship around personal guidance and the discussion of personal matters implies a certain level of trust between the people involved in the relationship. Such a personal bond is believed to be more strong and durable than work related relationships such as work related collaborative exchange (Granovetter, 1973). Whereas 'spending breaks' and 'personal guidance' may be described as 'friendly' relationships, the next two relationships tap into interaction that more specifically addresses 'friendship' (Kurth, 1970).

The next social relationship, according to the interviewed educators, entails having *contact outside work*. When teachers have frequent contact with one another outside school, this may indicate a relationship that is built on more personal grounds than work. Therefore, having contact outside work may be a good indicator of some sort of friendship or strong bond, even though both individuals may not define the relationship as a friendship relationship (Ibarra, 1992; Zagenczyk, Gibney, Murrell & Boss, 2008).

The final social relationship addresses *friendship*. Friendship is included in many social network studies as the prototypical expressive relationship (e.g., Cole & Weinbaum, 2007; Lazega & Pattison, 1999) as friendship expresses personal affect and social support (Gibbons, 2004). Individuals depend on friends for counseling and companionship (Krackhardt & Stern, 1988), and friendship ties facilitate open and honest communication that may boost organizational change (Gibbons, 2004).

These seven social network questions were included in a social network survey to assess social relationships among educators. Respondents were provided with a school specific appendix that contained the names of the school team members of their school, accompanied by a letter combination for each school team member (e.g., Mr. Jay Hoffer[1] = AB). They were asked to answer each social network question by writing down the letter combination(s) of the coworker(s) they would like to indicate as being a part of their social network as specified by the question. The number of colleagues a respondent could answer was unlimited.

Data analysis

Social network analysis. The data were examined using social network analysis. Social network analysis is a technique to systematically analyze patterns of relationships in order to understand how individual action is situated in structural configurations (Scott, 2000; Valente, 1995). We first constructed matrices for each network question for each school. The matrices were compiled following the same procedure, namely if educator i nominated educator j as an advice relationship, a 1 was entered in cell Xij. If educator i did not nominate educator j, a 0 was entered in cell Xij. This procedure resulted in an asymmetric matrix that summarized all directed relationships among the educators within a single school. To explore and describe the networks, several social network properties at both the individual and school level were calculated based on the matrices using software package UCINET 6.0 (Borgatti, Everett, & Freeman, 2002; Borgatti, Jones & Everett 1998; Burt, 1983a).

Individual level properties include raw and normalized scores for out-degree and in-degree, and ego-reciprocity. *Out-degree* depicts the number of people nominated by the respondent, and can therefore be interpreted as a measure of individual activity. *In-degree* represents the number of people by whom the respondent was nominated, and can be read as a measure of individual popularity.

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[1] All names are pseudonyms

Raw scores of in- and out-degree encompassed the actual number of educators that were named by the respondents. Because the average in-degree is the same as the average out-degree (each out-going relationship for one educator also implies an in-coming relationship for another educator), we only report the average in-/out-degree. The standard deviations of the out- and in-degrees reflect the variability among educators in the amount of out-going and in-coming relationships, and may thus be different for the out-degrees and in-degrees. For instance, educators may vary greatly in the number of relationships they indicate to have, but there may be less variability in the number of relationships that educators receive. The range of the average raw scores varies from 0 to 14.8 since this is the average team size of the sample schools. Besides these raw scores, we also report normalized scores for out-degree and in-degree to facilitate comparisons among schools with different team sizes.

Normalized scores can be interpreted as the percentage of relationships of the whole network that an educator maintains. The normalized out- and in-degrees range from 0 (the educator has no relationships) to 100 (the educator has a relationship with all of his/her team members). Again, the average percentage of out-going relationships is the same as the average percentage of in-coming relationships. The standard deviations of the normalized out- and in-degrees mirror the variability among educators in the percentage of relationships that are sent (out-going) or received (in-coming).

Ego-reciprocity is a measure of reciprocity at the individual level. Ego-reciprocity is calculated as the number of reciprocal relationships in which in educator is involved, divided by the total number of his/her relationships. Ego-reciprocity thus reflects the percentage of ties of an educator that is reciprocated. Ego-reciprocity ranges from 0 (none of the individual's relationships are reciprocated) to 100 (all of the individual's relationships are reciprocated).

At the school level, we calculated the network measures of density, reciprocity, and centralization. *Density* represents the concentration of relationships in a social network, and is calculated by dividing the number of observed relationships by the total number of possible relationships in a given network. This means that the greater the proportion of social relationships between school staff members, the more dense the social network. The density of a school's network may range from 0 (there are no relationships in the school team) to 1 (all school team members have indicated to maintain a relationship with each other). The density of a network can be thought of as a measure of

cohesion (Blau, 1977). A dense network is believed to be able to move resources more quickly than a network with fewer ties (Scott, 2000).

Reciprocity captures the extent to which the relationships in a social network are reciprocal, and is calculated as the number of reciprocal relationships in a team, divided by the total possible number of reciprocal relationships. Higher levels of reciprocity have been associated with complex knowledge exchange and higher organizational performance (Kilduff & Tsai, 2003). The reciprocity of a school's network may range from 0 (none of the relationships in the school team are reciprocated or mutual) to 1 (all of the relationships in the school team are reciprocated or mutual).

In-centralization was included to examine the central tendency of the social networks. This measure assesses whether the relationships in a given network are evenly dispersed in a network, or whether the relationships are centralized around one (or a few) very central people, who receive many nominations. In-centralization is based on the variability of in-degrees within a given team. High in-centralization reflects a high variability in the school team between educators who are often nominated and educators who are seldom nominated. As such, centralization of a social network refers to the difference between one or a few highly central person(s) and other (more peripheral) people in the network. Centralization ranges from 0 (no variability - all members of the network are chosen for advice as frequently) to 1 (maximum variability - every educator in a network only nominates a single person in the network, while these educators themselves are not nominated at all). The more centralized the social network is, the more resources are disseminated by a single or a few influential people to the rest of the network. In contrast, relationships and resources in a decentralized social network are much more evenly shared among all school team members.

Examining multiplexity. To determine the similarity between the seven social networks within each school, we estimated a series of Quadratic Assignment Procedure (QAP) correlations in UCINET (Borgatti, Everett, & Freeman, 2002; Hanneman & Riddle, 2005; Krackhardt, 1987). The QAP is a procedure to calculate correlations between social networks. When conducting social network research, statistical assumptions of independence are violated because relations between individuals are nested and embedded within the same network. Social network data are often interdependent, thus limiting the use of 'conventional' statistical techniques such as Pearson correlations. The QAP was designed as a variation on conventional correlational analyses for the use with social network data.

The QAP follows a specific process. First, a Pearson correlation coefficient is calculated for two corresponding cells of two matrices that contain network data. Then, it randomly permutes the rows and columns of one of the matrices hundreds of times (each time computing a new correlation coefficient), and compares the proportion of times that these random correlations are larger than or equal to the original observed correlation. A low proportion (p<.05) suggests a strong relationship between the matrices that is unlikely to have occurred by chance (Baker & Hubert, 1981). We calculated QAP correlations for the seven networks within each school, and then aggregated these correlations using matrix algebra to signify overall QAP correlations among the seven networks. These aggregated QAP correlations are measures that represent the similarity between the seven networks over all sample schools.

Towards a typology of social networks in school teams. To detect meaningful underlying dimensions that may explain the observed similarities between the seven networks, we used the aggregated QAP correlations as input in a Multidimensional Scaling (MDS) procedure (Kruskal & Wish, 1978). MDS provides a visual representation of the social networks that best approximates the given QAP similarity information. Since the MDS Alscal procedure as incorporated in the Statistical Packages for the Social Sciences (SPSS Version 16.0) manages data based on distances instead of similarities, the QAP aggregates were subtracted from 1 and then inputted in SPSS. Finally, to visualize the similarity of the seven social networks, we depict and describe the seven networks of an exemplary sample school.

RESULTS

Describing social networks

Table 4 presents the individual level descriptive statistics for the seven social network questions. A comparison of the seven networks at the individual level indicates that there is considerable variation between the networks in the average amount of ties that educators maintain. Educators have the highest number of relationships around spending breaks, on average six relationships. This is followed by about five reported relationships regarding the discussion of work-related matters. Educators maintain much less relationships around friendship and speaking outside work (respectively 1.57 and 1.87 relationships). Also, the standard deviations of the average number of relationships are relatively large, indicating that there is much variation among educators in the

Table 4. Descriptive statistics of the seven social network questions for the individual level network properties (n = 775)

	Raw scores			*Normalized scores*			Ego-reciprocity	
	M	Sd-out [1]	Sd-in [2]	M	Sd-out	Sd-in	M	Sd
Discussing work	5.24	3.67	3.04	35.6	25.1	21.3	37.1	23.5
Collaboration	4.11	3.75	2.40	27.9	21.8	17.8	27.4	21.1
Asking advice	3.07	2.68	2.52	21.7	19.2	19.0	25.2	23.6
Spending breaks	6.06	5.34	2.93	40.8	32.7	21.1	32.9	23.4
Personal guidance	3.84	3.16	2.50	26.1	21.6	17.8	33.5	24.9
Contact outside work	1.87	2.22	1.62	17.3	14.6	9.7	55.5	26.6
Friendship	1.57	2.52	1.42	10.4	16.1	10.2	31.2	33.9

Table 5. Descriptive statistics of the seven social network questions for the school level network properties (N = 53)

	Density		Reciprocity		Centralization	
	M	Sd	M	Sd	M	Sd
Discussing work	.37	.12	.39	.10	.34	.11
Collaboration	.36	.15	.35	.12	.30	.11
Asking advice	.23	.09	.25	.12	.38	.13
Spending breaks	.46	.17	.39	.15	.25	.08
Personal guidance	.30	.11	.37	.13	.33	.12
Contact outside work	.13	.05	.41	.24	.20	.07
Friendship	.12	.06	.35	.23	.18	.09

[1] Standard deviation of the out-degrees
[2] Standard deviation of the in-degrees

number of relationships that they maintain. The normalized scores reflect this pattern. On average, educators have 'spending breaks' relationships with about 40 % of their colleagues, and 'work discussion' relationships with about 36 % of their colleagues. Educators consider about 10 % of their colleagues as friends. Findings regarding ego-reciprocity suggest that the level of reciprocity that educators experience is relatively low (between 22.2 % and 37.1 %), with the exception of reciprocity in regard to contact outside work (55.5 %). This means that of all ties that an educator indicates to maintain, approximately 22 % to 37 % are reciprocated. However, results show a relatively high standard deviation, which means that there is great variability between educators in the percentage of ties that are reciprocated by their team members.

School level descriptive statistics of the seven networks mirror the findings at the individual level (see Table 5). Results indicate that the networks around friendship and contact outside work had the lowest network density (respectively .12 and .13). In other words, of all possible relationships that could exist in a school's network, only 12 % is formed around friendship. In contrast, the highest density of relationships is found around spending breaks. On average, 46 % of all possible relationships around spending breaks are actually reported by educators to exist. Remarkably, this means that on average, the densest social network only incorporates about half of all potential ties. School level reciprocity varies among the seven networks between .25 (asking advice) and .41 (contact outside work). This means that about 25 % of all advice relationships are reported by both educators in the relationship, and 41 % of the contacts outside work are reported mutually. With regard to school level centralization of the seven networks, findings suggest that the friendship network is the least centralized around a few educators (.18), while the work related advice network is the most centralized (.38). This means that in a friendship network relationships are more evenly distributed among educators, whereas in an advice network relationships are more centered on a few educators who are often sought out for advice.

QAP correlation analyses
Table 6 summarizes the average QAP correlations between the seven social networks summarized over the sample schools. In general, results indicate that all seven networks are weakly to moderately correlated (between .27 and .62). This finding suggests that all networks are measuring a different facet of teacher interaction, and none of the networks show extensive similarity with other networks. This supports the notion that educators tend to maintain

different networks for different purposes. In regard to a distinction between instrumental and expressive social networks, the following can be noted.

The correlations between the group of networks around discussing work, collaboration, and asking advice vary between .46 and .55. Similarly, the correlations between the group of networks around personal guidance, contact outside work, and friendship range from .42 and .62. The correlations *within* these groups are noticeably higher than the correlations *between* the groups, which range from .33 to .35. This may be a first indication of a distinction between social networks that are specifically aimed at work (instrumental social networks) and social networks with a more affective connotation (expressive social networks).

Yet, the similarity among the work related networks of discussing work, collaboration, and asking advice appears to be moderate, which signifies only partial overlap between the social networks (maximum average r = .55). This is illustrated by the difference between networks around 'discussing work' and 'asking advice' with regard to density (respectively .37 and .23, t (52) = 18.27, p < .001), reciprocity (respectively .39 and .25, t (52) = 8.51, p < .001), and centralization (respectively .34 and .38, t (52) = - 2.28, p < .05). The personal social networks show similar partial overlap, although the social networks of contact outside work and friendship demonstrate a higher QAP correlation (average r = .62) than the work related networks. These two networks were comparable in network density (respectively .13 and .12, t (52) = 1.31, n.s.), reciprocity (respectively .41 and .35, t (52) = 1.66, n.s.), and centralization (respectively .20 and .18, t (52) = 1.49, n.s.). It thus appears that the social network questions each assess a different social network among teachers.

Table 6. Average QAP correlations (N = 53)

	1	2	3	4	5	6	7
1. Discussing work	1.00	0.51	0.55	0.46	0.48	0.33	0.35
2. Collaboration		1.00	0.46	0.41	0.41	0.34	0.34
3. Asking advice			1.00	0.34	0.45	0.34	0.35
4. Spending breaks				1.00	0.42	0.27	0.32
5. Personal guidance					1.00	0.45	0.42
6. Contact outside work						1.00	0.62
7. Friendship							1.00

Multidimensional Scaling

In order to detect meaningful underlying dimensions that may explain the observed similarities between the seven social networks, we used the aggregated QAP correlations as input for a Multidimensional Scaling (MDS) procedure. A three-dimensional MDS representation fit the data best, accounting for 90.5 % of the variance and the stress (an indication of fit) at the upper norm of acceptability, namely .15 (Borgatti, 1997). We visualize the two-dimensional MDS representation in Figure 2. This two-dimensional representation accounted for 75.7 % of the variance of the scaled data, but the stress exceeds the upper stress limit (stress = .26). To facilitate the discussion of our findings, we chose to depict the two-dimensional representation. While caution should be exercised in interpreting a MDS representation that exceeds stress limits, longer distances tend to be more accurately displayed than shorter distances (Borgatti, 1997), and so the overall pattern is still visible even when stress is above reasonable limits to guarantee good fit. To ensure the trustworthiness of the findings, the results were checked and confirmed with the three-dimensional solution. Two findings stand out from the MDS analysis. First, the two-dimensional representation of MDS results shows a noticeable split between work related and personal relationships. In the upper right quadrant, we find three networks that refer to work related issues, namely discussing work, collaboration, and asking for advice. In and just outside the

Figure 2. Two-dimensional representation of the multidimensional scaling analysis
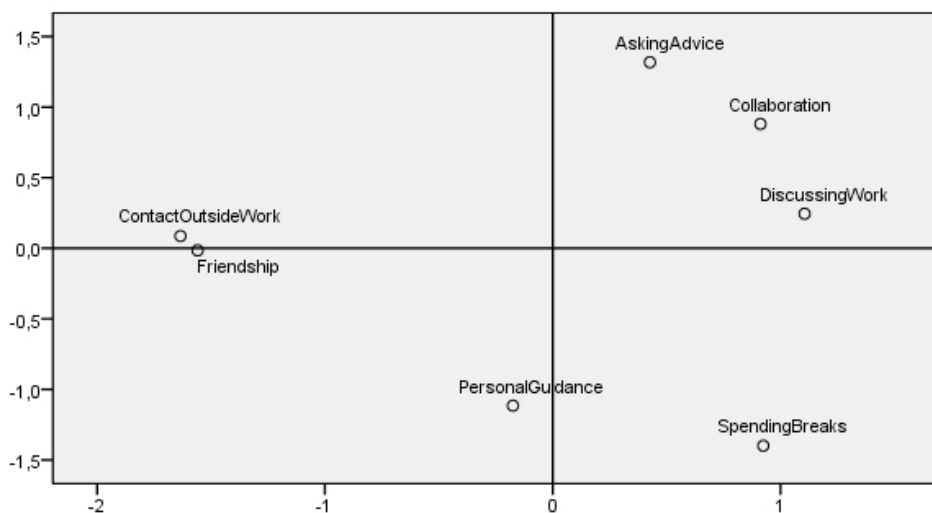
lower left quadrant, we find three networks that represent more personal relationships, namely contact outside work, friendship, and personal guidance. As such, the horizontal dimension may reflect the instrumental-expressive distinction as proposed by Ibarra (1993, 1995). The 'spending breaks' network can be found in the lower right corner and as such differs from the work related and personal networks. This network can thus be considered nor an explicit expressive nor a clearly instrumental social network. What is furthermore insightful is that the social networks around contact outside work and friendship are located in close proximity in the MDS dimensional space. This finding mirrors the highest QAP correlation between these two expressive networks.

Second, we find an interesting difference between asking for advice on one hand and personal guidance and spending breaks on the other. Apparently, the network in which work related advice is transferred is dissimilar to the network that pertains to the exchange of personal matters and spending breaks. As such, this dimension may reflect a scale of mutual in(ter)dependence as discussed by Little (1990). On one end of the dimension, typifying mutual *in*dependence, we find the networks of spending breaks and the discussion of personal matters that hardly detract from the inherited traditions of teacher autonomy, noninterference, and equal status. On the other end, there are the networks of asking work related advice and collaboration, that typify more mutual *inter*dependence. These networks signify social relationships that require teacher-to-teacher initiative, shared responsibility of work, and uniformity of action. This finding also holds in three-dimensional space, pointing to an underlying dimension of mutual in(ter)dependence that may differentiate between social relationships among educators in elementary education and define the extent to which collegial relationships permeate daily educational practice.

In sum, results provide support for the distinction between *instrumental and expressive* networks and reveal a second dimension of *mutual in(ter)dependence* that may be used to typify social networks in elementary school teams. The instrumental networks of work related discussion, collaboration, and advice are interrelated but each tap into a unique part of instrumental relationships. Similarly, personal guidance, contact outside work and friendship networks are interrelated, but still seem to represent distinctive elements of expressive relationships.

*Network visualization: The example of **St. Michael Elementary School***

To visualize our findings, we depict the seven networks as assessed in St. Michael Elementary School. St. Michael Elementary School[1] is a school with 29 educators. This school is chosen because the pattern of QAP correlations in this school resembles the overall sample of schools. The networks are plotted so that individuals with relatively more relationships are centered visually, with individuals that maintain fewer relationships at the periphery. Noteworthy, the software program Netdraw (as incorporated in UCINET 6.0) visualizes these networks using the multidimensional scaling technique to approximate the relative distance between the individuals in the network. Educators are represented by dots, relationships are depicted by the lines that connect the dots, and arrows indicate the direction of the relationship nomination. Female educators are represented in red and male educators in blue. Moreover, educators in the upper grade level (grades 3 through 6) can be identified by squares, whereas educators in lower grades (K - 2) can be identified by circles. The principal of St. Michael is represented by the blue square in the right lower corner. The network visualizations are depicted in Figure 3. Enlarged versions of the visualizations are included in the appendix.

The network visualizations show that the spending breaks network is the densest social network in St. Michael, followed by the networks around discussing work, collaboration and personal guidance. The networks of work related advice and contact outside work appear less dense, with the friendship network being the sparsest network in St. Michael elementary school. It appears that especially the networks of contact outside work and friendship in St. Michael's are formed by relationships among predominantly male educators, with most female teachers indirectly linked or even unconnected by expressive ties. While the classification between grade levels generally follows gender lines, the friendship network appears to indicate that same gender preferences (gender homophily) prevail over same grade level preferences (grade level homophily). In the next chapter, we will elaborate on the suggested gender segregation and homophily effects by examining the extent to which demographic characteristics affect social network structure.

Also noteworthy is that the principal is nominated by four male teachers as a friend and embedded in a locally dense network of friendships among the school's male educators, but the principal himself indicated to be friends with only one male teacher and two female teachers. As such, these female teachers may occupy a strategically important position, as they may have an influence

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[1] All names are pseudonyms

on the network through their friendship tie with the principal. Since the friendship network in St. Michael is much less dense than all other social networks, this network offers ample opportunities for structural holes to be spanned by strategic individuals who may profit from the sparse flow of information (Burt, 1997). In all, the representations of these networks provide a powerful tool to visualize and support network findings in regard to network multiplexity and the pattern of ties among educators.

CONCLUSIONS AND DISCUSSION

In this chapter, we investigated seven social networks to examine the ways in which networks are shaped by their content. Drawing upon social network theory and network multiplexity we examined similarities between the social networks and explored a typology of social networks in school teams based on underlying dimensions that may differentiate between social relationships among educators. By doing so, we investigated whether a common distinction between instrumental and expressive social networks could also be validated in the context of elementary school teams. Key themes that arise from our findings are: the validation of the common distinction between instrumental and expressive networks for the field of elementary education; the addition of a dimension regarding mutual in(ter)dependence of educators; the importance of carefully targeting social networks for research and practice; and the potential and pitfalls of multiple networks for facilitating the flow of information, knowledge, and expertise in elementary school teams.

Validation of the instrumental vs. expressive distinction
In general, all social networks tend to show small to moderate overlap, thus indicating unique patterns of social relationships in school teams. This finding fuels the notion that collegial relationships among teachers take different forms in order to optimally accommodate to the intellectual, emotional, and social demands of teaching (Little, 1990). Building on the idea that different social networks are maintained to transfer different sources of information, knowledge, expertise, or materials, it is therefore vital to understand teacher interaction and informal social routines as going well beyond an intuitive grasp of what it means to 'work together' or 'get along' (Little, 1990; Spillane, 2005).

Figure 3. Visualizations of the seven networks at St. Michael Elementary School

Discussing work

Collaboration

Asking advice

Spending breaks

Personal guidance

Contact outside work

Friendship

●   = lower grade (K - 2)
■   = upper grade (3 - 6)
White = female educator
Black = male educator
Grey   = principal
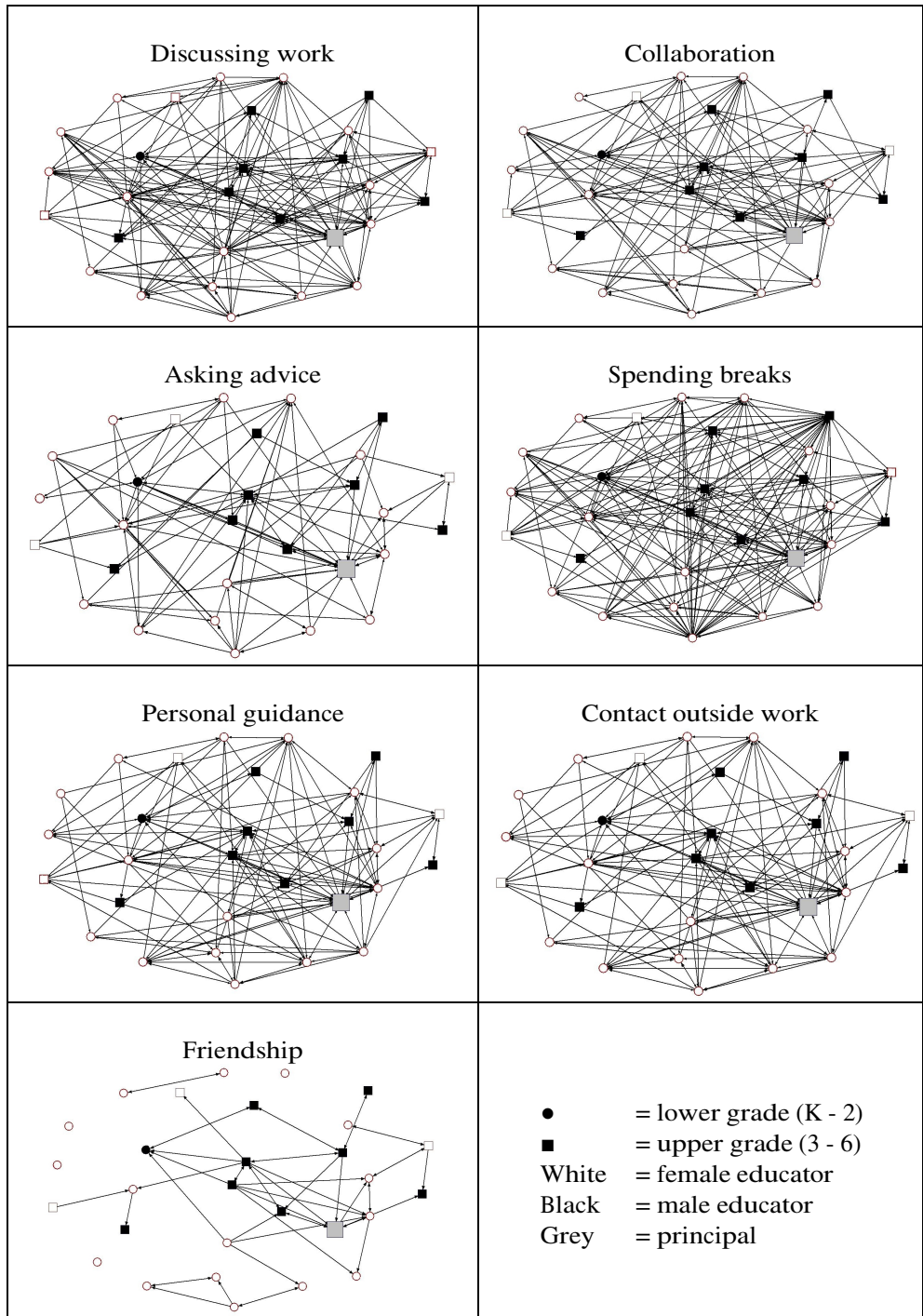
Besides the similarities between networks, this chapter has also gained insights in the dimensions that may underlie various social networks in schools. Results confirm that social networks in elementary school teams can be categorized into instrumental and expressive social networks. Findings suggest that the social networks can be classified into a cluster of instrumental relationships concerning asking for advice, collaboration, and discussing work on the one hand, and a grouping of expressive relationships involving friendship, contact outside work, and, to a lesser extent, personal guidance on the other. Relationships regarding 'spending breaks' may serve both instrumental and expressive purposes. As such, this study confirms earlier work in organizational settings (Ibarra, 1993, 1995) that support a distinction between instrumental social relationships aimed at fulfilling organizational goals, and expressive social relationships that are not directly aimed at work.

Addition of a mutual in(ter)dependence dimension
Besides validating the distinction between instrumental and expressive social networks, this chapter offers a unique contribution to social network research by identifying a second dimension that may differentiate between social networks in school teams, namely the amount of mutual in(ter)dependence involved in the relationship between educators. Our findings suggest that social networks in school teams can be categorized by the extent to which educators are mutually dependent in achieving desired goals. Social relationships around spending breaks imply high levels of independence that may uphold a traditional mode of instructional autonomy and noninterference. In contrast, relationships around asking advice and collaboration may create tension for individual autonomy by requiring teacher initiative, joint work, and shared responsibility. While the typology described in this chapter is informative and useful, we acknowledge that it is a broad stroke approximation of the complexity of social networks in practice. Teacher interaction in school teams is multi-faceted, and teachers may use multiple channels simultaneously to access and leverage resources that may help them achieve their goals.

The importance of targeting the 'right' social networks in research and practice
While educational researchers are interested in teachers' social networks to ultimately explain various teacher and school outcomes, practitioners may regard social networks as a meaningful concept to contextualize teacher interaction in support of teacher development and school improvement (e.g., collaborative practices, collective (organizational) learning, and professional (learning) communities). This study adds to the current debate in educational

practice and policy around such collaborative initiatives by emphasizing that the social networks that underlie these collaborative initiatives are shaped by their content, and as such may be specifically targeted to optimally facilitate organizational goals.

For instance, several scholars point to the value of unplanned or unstructured informal teacher interactions, whether in the hallway or during breaks (e.g., Little, 1990; Spillane, 2005). This study suggests that these types of interactions are indeed not specifically directed towards work or affective purposes. A social network study or professional development program that aims at increasing collegial relationships should be aware that these relationships are not clearly targeted towards a single purpose, and probably incorporate both instrumental and expressive types of resource exchange. This is not to say that these relationships may not be valuable; on the contrary, it may be that during these frequent informal interactions, a solid bond is formed that may later evolve into an advice or friendship relationship (Casciaro & Lobo, 2005). The spending breaks network may resemble other dense networks in that it transfers simple, routine, and explicit information (Hansen, 1999) and consists of many redundant relationships (Burt, 2000). On one hand, information spreads quickly in such a dense network (Degenne & Forsé, 1999), on the other, dense patterns of interaction among teachers may potentially hinder educational change by perpetually repeating redundant information and knowledge (Little, 1990).

Building on this finding, social network studies interested in innovation, which often involves the exchange of new and complex knowledge (Nonaka & Takeuchi, 1995; Paavola, Lipponen, & Hakkarainen, 2004), are advised not to focus on such general networks. Furthermore, our findings indicate that there is a distinction between expressive and instrumental networks in regard to the configuration of relationships. Therefore, researchers and practitioners are advised to target both instrumental and expressive relationships as the structure of these networks may affect the speed and ease with which information is conveyed through its different channels. Different networks only partially overlap, which means that these networks may serve as semi-unique conductors of knowledge, expertise, social support, teaching materials, and other resources valuable to school performance and educational change.

In regard to framing social network questions, recent studies suggests that even within instrumental social networks around advice, the subject matters (Coburn & Russell, 2008; Hayton & Spillane, 2007; Spillane, 2006; Spillane & Diamond, 2007). On average, teachers were found to seek out more colleagues for advice on literacy instruction than on mathematics instruction,

with advice networks for mathematics being about a third less dense than those for literacy (Spillane, 2005). Moreover, research also indicates that the order of social network questions in a survey may affect the shape of social networks (Burt, 1997; Ferligoj & Hlebec, 1999; Pustejovsky & Spillane, 2009; Straits, 2000). These findings emphasize the importance of carefully framing and ordering social networks questions and considering the significance of targeting the 'right' social networks in order to maximize their potential (Cole & Weinbaum, 2007; Pustejovsky & Spillane, 2009).

Delimiters and areas for further research

The underlying assumption of our social network questionnaire is that one type of relationships (e.g., friendship) means something different to teachers than another type of relationships (e.g., collaboration). However, it may be questioned whether different teachers perceive the described social relationships in the same way. For instance, the concept of 'friendship' is ambiguous and open to individual differences in interpretation (Fisher, 1982; Pustejovsky & Spillane, 2009). Fisher (1982) found that the label 'friendship' is likely to be applied. Indeed, in an earlier study placed in the United States, Cole and Weinbaum (2007) found that teachers name more friends than people with whom they discuss curricular or reform related issues, resulting in the densest network being the friendship network. In contrast, the data from this Dutch sample schools suggest that friendship among teachers is in general less common than work related discussion. There may be two issues at play here that relate to the generalizability of the research. On average, Dutch elementary schools are smaller than US elementary schools, which may limit the opportunities of friendship relationship but may not affect the minimum number of work related contacts that an educator needs to perform his/her daily tasks. In addition, there may be a cross-cultural difference in the tendency to form and nominate relationships between the two countries. Therefore, it would be interesting to conduct a comparative study of educators' social networks in multiple countries to examine such cultural differences.

The theoretical framework of this study suggests that different resources may be exchanged within different types of relationships. Yet, in this study, we did not specifically focus on the resources that were exchanged in the network. We focused on similarity among whole networks, and therefore, inferences of the resources that are actually exchanged in these different types of networks should be drawn with caution. We would recommend future research to provide more in-depth knowledge on the actual resources that are transferred in these networks. One valuable route through which deepened understanding

can be gained in the exchanged resources, as well as teachers' perceptions and interpretations of social relationships, is through combining social network analysis with qualitative data (e.g., Daly et al., in press; Spillane, 2005).

The social fabric of school teams

This study demonstrates that 'network content matters'. What is further required from social network research in education is a validation of the underlying assumption that 'relationships matter'. In addition, if scholars, practitioners, and policy-makers are to embrace social networks as a valuable lens to uncover the potential of teacher interaction for innovation, reform efforts, and improved student performance, deepened insights in the elements that shape social relationships among teachers are needed. With this chapter, a first step to understand the nature of the social fabric of school teams has been taken. Now it is time to scrutinize the circumstances that affect the pattern of this social fabric and its potential to warrant school outcomes that matter. It is through these next steps that social network research can make a difference in educational practice.

CHAPTER 2

The Social Forces in Elementary School Teams:
How Demographic Variables Shape Social Networks [1]

ABSTRACT

Background. Research on social networks in schools is increasing rapidly. Network studies outside education have indicated that the structure of social networks is partly affected by demographic characteristics of network members. Yet, knowledge on how teacher social networks are shaped by teacher and school demographics is scarce.

Purpose. The goal of this study was to examine the extent to which teachers' work related social networks are affected by teacher and school demographic characteristics.

Method. Survey data were collected among 316 educators from 13 elementary schools in a large educational system in the Netherlands. Using social network analysis, in particular multilevel *p2* modeling, we analyzed the effect of teacher and school demographics on individual teachers' probability of having relationships in a work discussion network.

Conclusions. Findings indicate that differences in having relationships were associated with differences in gender, grade level, working hours, formal position, and experience. We also found that educators tend to prefer relationships with educators with the same gender and from the same grade level. Moreover, years of shared experience as a school team appeared to affect the likelihood of teacher relationships around work related discussion.

INTRODUCTION

Relationships among educators are more and more regarded as an important element to schools' functioning, and a potential source of school improvement. Educational practitioners and scholars around the world are targeting teacher interaction as a way to facilitate knowledge exchange and shared teacher practice through a variety of collaborative initiatives, such as communities of practice, professional learning communities, and social networks (Daly & Finnigan, 2009; Hord, 1997; Lieberman & McLaughlin, 1992; Wenger, 1998). The growing literature base around these concepts suggests that 'relationships matter' for fostering a climate of trust and a 'safe and open' environment to implement reform and engage in innovative teacher practices (Bryk & Schneider, 2002; Louis, Marks, & Kruse, 1996; Coburn & Russell, 2008; Penuel, Fishman, Yamaguchi, & Galagher, 2007a).

Social network literature asserts that relationships matter because the configuration of social relationships offers opportunities and constraints for collective action (Burt, 1983a, Coleman, 1990; Granovetter, 1973; Lochner, Kawachi, & Kennedy, 1999). For instance, the extent to which an organizational network supports the rate and ease with which knowledge and information flows through the organization may provide it with an advantage over its competitors (Nahapiet & Ghoshal, 1998; Tsai, 2001). While social network studies have mainly concentrated on the consequences of social networks for individuals and groups, less attention has been paid to how social networks are conditioned upon individual characteristics and behavior (Borgatti & Foster, 2003). A developing set of studies in organizational literature is focusing on how attributes of individuals such as personality traits affect their social network (e.g., Burt, Jannotta & Mahoney, 1998; Mehra, Kilduff, & Brass, 2001; Madhavan, Caner, Prescott, & Koka, 2008), how individuals select others to engage in relationships (Kossinets & Watts, 2006; McPherson, Smith-Lovin, & Cook, 2001), and how organizations enter into alliances with other organizations (Gulati & Gargiulo, 1999). These studies offer valuable insights in potential individual and organizational attributes that may affect the pattern of social relationships in school teams.

Attributes that are especially worth investigating for their potential to shape the social structure of school teams are demographic characteristics (cf. Ely, 1995; Tsui, Egan, & O'Reilly, 1992). Demographic characteristics are more or less constant elements that typify teachers, their relationships, and schools based on socio-economic factors such as age, gender, teaching experience, and school team composition. Several network studies have suggested that

networks are at least in part shaped by demographic characteristics of individuals, their dyadic relationships, and the network (Brass, 1984; Heyl, 1996; Ibarra 1992, 1995; Lazega & Van Duijn, 1997; Veenstra et al., 2007; Zijlstra, Veenstra, & Van Duijn, 2008). For instance, several studies reported that relationships among individuals with the same gender are more likely than relationships among individuals with opposite gender (a so-called homophily effect) (Baerveldt, Van Duijn, Vermeij, & Van Hemert, 2004; McPherson, Smith-Lovin & Cook, 2001). These studies, however, seldom purposely aim to examine the impact of demographic characteristics on social networks and consequently only include few demographic variables of network members. Insights in the extent to which social relationships are formed in the light of multiple individual and organizational demographic characteristics are limited, and even more so in the context of education. We argue that such groundwork knowledge is crucial for all those who aim to optimize social networks in support of school improvement and, ultimately, student achievement.

This chapter aims to examine the extent to which social networks in school teams are shaped by individual, dyadic, and school level demographic variables, such as teachers' gender and age, school team composition and team experience, and students' socio-economic status. We conducted a study among 316 educators in 13 Dutch elementary schools. Results of this study were expected to increase insights in the constant social forces that may partly define teachers' relationships in their school teams, and discover potential tendencies around, for example, homophily and structural balance. Based on a literature review of social network studies that include demographic variables in a wide range of settings, we pose several hypotheses on the extent to which demographical variables at the individual, dyadic, and school level may affect teachers' social networks.

THEORETICAL FRAMEWORK

Individual level demographics that may shape teachers' social networks
Social network literature has suggested various individual demographic characteristics to affect their pattern of relationships, and as such social networks as a whole (Heyl, 1996; Lazega & Van Duijn, 1997; Veenstra et al., 2007; Zijlstra, Veenstra, & Van Duijn, 2008). Following these suggestions, we will first review how individual level demographic characteristics may affect teachers' social networks. We focus on the individual demographics gender, formal position, working hours, experience at school, age, and grade level for

their potential influence on teachers' patterns of social relationships and school teams' social network structure.

Gender. The likelihood of having relationships in a network may be associated with gender (Metz & Tharenou, 2001; Moore, 1990; Stoloff et al., 1999; Veenstra et al., 2007; Zijlstra, Veenstra, & Van Duijn, 2008). Previous research has indicated that gender affects network formation (Burt et al., 1998; Hughes, 1946; Ibarra, 1993, 1995, Moore, 1990; Pugliesi, 1998; Van Emmerik, 2006) and that, in general, women tend to have more relationships than men (Mehra, Kilduff, & Brass, 1998). These differences are already found in childhood (Frydenberg & Lewis, 1993) and continue to exist through life (Parker & De Vries, 1993; Van der Pompe & De Heus, 1993). In various settings and cultures, both men and women were found to use men as network routes to achieve their goals and acquire information from more distant domains (Aldrich et al., 1989; Bernard et al., 1988). Following these findings, we hypothesize that male teachers will have a higher likelihood of receiving more relationships than female teachers, and women will send more relationships than men (*Hypothesis 1a*).

Formal position. Previous research in organizations (Lazega & Van Duijn, 1997; Moore, 1990) and education (Coburn, 2005a; Coburn & Russell, 2008; Daly & Finnigan, 2009; Heyl, 1996) suggests that the formal position of individuals may be related to their relational activity and popularity. For instance, Lazega & Van Duijn (1997) found that lawyers were more often sought out for advice when they held a higher hierarchical position. Research has indicated that the network position of an organizational leader is important in terms of access and leveraging social resources through social relationships as well as brokering between teachers that are themselves unconnected (Balkundi & Harrison, 2006; Balkundi & Kilduff, 2005). In line with these studies, we expect that principals will be more sought out for work related discussions than teachers. We also expect that principals will report to be involved in more relationships than teachers, since they depend on these relationships to gather information and convey knowledge, plans, and expertise to support student learning and monitor the functioning of teachers and the school. Moreover, principals are reported to occupy a strategic position in the flow of information between the district office and teachers and relay important policy and organizational information from the district office to the teachers (Coburn, 2005a; Coburn & Russell, 2008). Therefore, we hypothesize that principals have a higher likelihood of sending and receiving relationships (*Hypothesis 1b*).

Working hours. In addition, the number of working hours that an educator spends at the school may also affect his/her opportunity to initiate and

maintain social relationships. Recent research suggests that the relationship between network embeddedness and job performance is related to working hours (Van Emmerik & Sanders, 2004). In line with this finding, it is hypothesized that educators who work full time will have a higher probability of sending and receiving relationships than educators with part time working hours (*Hypothesis 1c*).

Experience at the school. Another demographic characteristic that may affect an individual's pattern of relationships is seniority, or experience at the school. The previously mentioned law study (Lazega & Van Duijn, 1997) indicated that senior lawyers had a higher probability of being sought out for advice than junior lawyers. Besides having more work experience, a perceived network advantage of senior lawyers may be that they have built more strong, durable, and reliable relationships over time, and therefore have access to resources that are unattainable for more junior lawyers. Accordingly, we hypothesize that educators who have more experience in their school team have a higher likelihood of sending and receiving work discussion relationships than educators who have less experience in the school team (*Hypothesis 1d*).

Age. Network research in other contexts found age differences in relation to the amount of relationships that individuals maintain (Cairns, Leung, Buchanan, & Cairns, 1995; Gottlieb & Green, 1984). In general, these studies suggest that the amount of relationships that people maintain tend to decrease with age. However, with increased age, experience at the school also increases together with the amount of relationships based on seniority (Lazega & Van Duijn, 1997). In concordance with the latter, we hypothesize that age will positively affect the probability of work related ties, meaning that older teachers are more likely to send and receive work related relationships than younger teachers (*Hypothesis 1e*).

Grade Level. Within schools, formal clustering around grade level may affect the pattern of relationships among educators. The grade level may to a certain extent affect the amount of interaction among educators since grade level teams may have additional grade level meetings and professional development initiatives are often targeted at the grade level (Daly et al., in press; McLaughlin & Talbert, 1993; Newmann, King, & Youngs, 2000; Newmann & Wehlage, 1995; Wood, 2007; Stoll & Louis, 2007). Dutch elementary schools are relatively small compared to U.S. elementary schools, and are often divided into a grade level team for the lower grades (K – 2) and a grade level team for the upper grades (3 – 6). The amount of relationships that teachers have, may partly be defined by the requirements of and opportunities provided by their grade level team. We may expect that teachers that teach

upper grade levels send and receive more relationships than teachers that teach lower grade levels because of the increasingly diverse and demanding curriculum in the upper grades combined with intensified student testing and preparation for education after elementary school. These conditions may require more work related discussion of upper grade level teachers than of lower grade level teachers. As such, we expect that teachers that teach upper grade levels have a higher likelihood of sending and receiving relationships than teachers that teach lower grade levels (*Hypothesis 1f*).

Dyadic level demographics that may shape teachers' social networks

Dyadic level demographics are demographics that typify the relationship between two individuals. Dyadic level effects give insights in network homophily. Network homophily is arguably the most well-known social network concept that often explicitly focuses on demographic characteristics of network members. The concept of homophily, also known by the adage 'birds of a feather flock together', addresses similarity between two individuals in a dyadic (paired) relationship. Homophily literature builds on the notion that individuals are more likely to develop and maintain social relationships with others that are similar to them on specific attributes, such as gender, organizational unit, or educational level (Marsden, 1988; McPherson & Smith-Lovin, 1987; McPherson, Smith-Lovin, & Cook, 2001). Similarly, individuals who differ from each other on a specific attribute are less likely to initiate relationships, and when they do, heterophilous relationships also tend to dissolve at a faster pace than homophilous relationships (McPherson et al., 2001).

Homophily effects result from processes of social selection and social influence. Social selection refers to the idea that individuals tend to choose to interact with individuals that are similar to them in characteristics such as behavior and attitudes. At the same time, individuals that interact with each other influence each others' behavior and attitudes, which may increase their similarity (McPherson et al., 2001). This is a process of social influence. In addition, individuals who share a relationship also tend to share similar experiences through their relationship (Feld, 1981).

Homophily is related to the concept of structural balance. In the footsteps of cognitive balance theory, structural balance theory poses that individuals will undertake action to avoid or decrease an unbalanced network (Heider, 1958). Over time, people tend to seek balance in their network by initiating new strong relationships with friends of friends and terminate relationships with friends of enemies or enemies of friends (Wasserman & Faust, 1997). As a result

from this tendency towards structural balance, relatively homogenous and strong cliques may be formed that give the network some stability over time (Kossinets & Watts, 2006). Structural balance and network homophily may have also have a negative influence on individuals' social networks as the resulting network homogeneity and pattern of redundant relationships may limit their access to valuable information and expertise (Little, 1990; Burt, 1997, 2000). In this study we focus on two types of similarity that may define teachers' relationships, namely gender similarity and grade level similarity.

Gender similarity. A dyadic attribute that may affect teachers' patterns of social relationships is the gender similarity between two teachers. Several studies have shown that work and voluntary organizations are often highly gender segregated (Bielby & Baron, 1986, McGuire, 2000; McPherson & Smith-Lovin, 1986, 1987; Popielarz, 1999; Van Emmerik, 2006). This gender homophily effect already starts at a young age (Hartup, 1993; Cairns & Cairns, 1994; Furman & Buhrmester, 1992). In the context of education, Heyl (1996) suggested an effect of gender homophily on interactional patterns among teachers, indicating that for men and women relationships with the opposite gender are less frequent or intense than relationships among men or relationship among women. In line with this suggestion, we hypothesize a homophily effect for gender, meaning that educators will prefer same-gender relationships over relationships with teachers of the opposite gender (*Hypothesis 2a*).

Grade level similarity. Another dyadic attribute that may shape the pattern of teachers' relationships is the grade level. In the Netherlands, schools are relatively small compared to the Unitesd States, with often only one full time or two part time teachers per grade level. Commonly, Dutch school teams are formally divided into two grade level levels representing the lower ('onderbouw', often K-2 or K-3) and upper grades ('bovenbouw', often grades 3-6 or 4-6), which are often located in close physical proximity. Recent research suggests that teachers who are located closely to each another are more likely to interact with each other than with teachers that are less physically proximate (Coburn & Russell, 2008). Moreover, most schools have separate breaks for the lower and upper grades, and some schools hold additional formal meetings for the lower/upper grades to discuss issues related to these grades. Since shared experiences are argued to result in greater support among individuals (Feld, 1981; Suitor & Pillemer, 2000; Suitor, Pillemer, & Keeton, 1995), these organizational features will increase the opportunity for teachers from the same grade level to interact relative to teachers from a different grade level. Therefore, we hypothesize a homophily effect for grade level, meaning that teachers will more likely maintain relationships with teachers from their own

grade level than with teachers that teach the other grade level (e.g., lower or upper level) (*Hypothesis 2b*).

School level demographics that may shape teachers' social networks

Although teachers can often choose with whom they interact, the social structure of their school's network is partly outside their span of control (Burt, 1983a; Brass & Burkhardt, 1993; Gulati, 1995b). Just as individual relationships may constrain or support a teacher's access to and use of resources (Degenne & Forsé, 1999), the social structure surrounding the teacher may influence the extent to which teachers may shape their network so as to expect the greatest 'return on investment' (Burt, 1992; Flap & De Graaf, 1989; Ibarra, 1992, 1993, 1995; Lin & Dumin, 1986; Little, 1990). Because of the embeddedness and interdependency of individuals in their social network, relationships and attributes at a higher level will affect lower-level relationships (Burt, 2000). As such, demographic characteristics at the school level may affect teachers' patterns of relationships. We pose that the following school level demographic characteristics affect teachers' pattern of social relationships: gender ratio, average age, school team experience, school size, school team size, and socio-economic status of the schools' students.

 Gender ratio and average age. Above and beyond the influence of individual demographics on the tendency to form relationships, there may be aggregates of these individual demographics at the level of the school team that may affect teachers' tendency to form and maintain relationships. Research in a law firm demonstrated that above the influence of individual level seniority, a lawyer's position in the firm's network was in part dependent on the ratio of juniors to seniors in the team (Lazega & Van Duijn, 1997). For school teams, a compositional characteristic that may affect patterns of relationships is gender ratio, or the ratio of the number of female to male teachers. In a school team with a high ratio of female teachers (which is not unusual in Dutch elementary education) male teachers have fewer options for homophily friendships with same-sex peers than women. Therefore, male teachers in such a team may have a lower tendency to maintain relationships in general and a higher propensity towards relationships with women than men in school teams with relatively more male teachers. Research confirms that the gender composition of a team may significantly affect gender homophily, with the minority gender often having much more heterophilous networks than the majority (McPherson, Smith-Lovin, & Cook, 2001). Therefore, we expect that the gender ratio of the school team will shape teachers' social networks. In line with previous empirical work suggesting that women tend to have more relationships than

men (Mehra, Kilduff, & Brass, 1998), we expect that teachers in school teams with a high female ratio will have a higher likelihood of sending and receiving ties than individuals in teams with relatively more male teachers (*Hypothesis 3a*). Along the same lines, if we expect that age will increase the likelihood of sending and receiving relationships, then increased average age of a school team may also enhance the probability of relationships. Therefore, we hypothesize that average age is positively related to the probability of ties (*Hypothesis 3b*).

Team experience, school size, and team size. Prior research has indicated that individuals are more likely to reach out to others with whom they had previous relationships (Coburn & Russell, 2008). Given the time and shared experiences that are necessary for building relationships, we may assume that the number of years that a school team has been functioning in its current configuration, without members leaving or joining the team, may affect teachers' lilelihood of maintaining relationships. Therefore we include school team experience as a school level demographic that may positively affect teachers' patterns of relationships (*Hypothesis 3c*). Other school demographics that may affect teachers' inclinations to form relationships are school size (number of students) and team size (number of educators). Previous literature has suggested that the size of organizations and networks is directly related to the pattern of social relationships in organizations (Tsai, 2001). In general, the amount of individual relationships and the density of social networks decrease when network size increases. As such, we may expect a lower probability of relationships in schools that serve more students (*Hypothesis 3d*) and schools with larger school teams (*Hypothesis 3e*).

Students' socio-economic status. Social networks can be shaped by both endogenous and exogenous forces (Gulati, Nohria, & Zaheer, 2000). An exogenous force to the school team that has been demonstrated to affect schools' functioning is the socio-economic status (SES) of its students (Sirin, 2005; White, 1982). We argue that the socio-economic status of the children attending the school may influence the probability that teachers will form relationships. For instance, teachers' perceptions of the urgency for communication and innovation may be dependent on the community surrounding the school. Typically, schools that serve more high-needs communities are associated with greater urgency in developing new approaches (Sunderman, Kim & Orfield, 2005), which may relate to an increased probability of relationships among educators. Therefore, we hypothesize that teachers in low SES schools will have a higher probability of having relationships than teachers in high SES schools (*Hypothesis 3f*).

Table 1. Sample demographics of schools and educators (N = 13, n = 316)

<u>Individual level</u>

Gender	Male	95	(30.1 %)
	Female	221	(69.9 %)
Working hours	Part time (less than 32 hours)	143	(45.2 %)
	Full time (32 hours or more)	173	(54.8 %)
Experience at school	1-3 years	42	(13.3 %)
	4-10 years	110	(34.9 %)
	> 10 years	164	(51.8 %)
Grade level[1]	Lower grade (K - 2)	156	(49.4 %)
	Upper grade (3-6)	160	(50.6 %)

<u>School level</u>

Team experience	6 months to 2 years	5	(38.5 %)
	More than 2 years	8	(61.5 %)

Table 2. Sample demographics of schools and educators (N = 13, n = 316)

	N	M	Sd	Min.	Max.
<u>Individual level</u>					
Age	316	46.5	9.9	21	62
<u>School level</u>					
Gender ratio[2]	13	72.4	8.4	59.1	87.0
Average age	13	46.4	2.5	41.1	50.6
Number of students	13	371	79.3	287	545
Team size	13	26.0	4.0	20	31
Socio-economic status (SES) [3]	13	9.2	9.3	0.5	30.5

[1] Educators who can be considered to be a part of both lower and upper grade were asked to choose with which grade level they worked most (e.g., principal, specialist staff).
[2] Gender ratio is calculated as the percentage of female team members
[3] SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

METHOD

Context

The study took place at 13 elementary schools in south of The Netherlands. The schools were part of the Avvansa School District[1] that provided IT, financial, and administrative support to 53 schools in the south of The Netherlands. At the time of the study, the district had just initiated a program for teacher development that involved a benchmark survey for the monitoring of school improvement. We selected a subsample of all the district schools based on a team size of 20 or more team members, since trial runs of the *p2* estimation models encountered difficulties converging with smaller network sizes and more schools. The original sample consisted of 53 schools that, with the exception of school team and number of students, did not differ considerably from the 13 sample schools with regard to the described demographics.

The context of Dutch elementary schools was beneficial to the study in three ways. First, the school teams were relatively small, which facilitated the collection of whole network data. Second, school teams are social networks with clear boundaries, meaning the distinction of "who is part of the team" is unambiguous for both researchers and respondents. Third, in contrast to many organizations, school organizations are characterized by relatively flat organizational structures, in which educators perform similar tasks and job diversification is relatively small. Often, educators have had similar training backgrounds, and are receiving school wide professional development as a team. Therefore, despite natural differences in individual characteristics, teachers in Dutch elementary school teams are arguably more comparable among each other than organizational employees in many other organizations, making demographic characteristics possibly less related to differences in tasks or task-related status differences.

Sample

The sample schools served a student population ranging from 287 to 545 students in the age of 4 to 13. We collected social network data from 13 principals and 303 teachers, reflecting a response rate of 94.5 %. Of the sample, 69.9 % was female and 54.8 % worked full time (32 hours or more). Educators' age ranged from 21 to 62 years (M = 46.5, sd = 9.9 years). Additional demographic information is depicted in Table 1 and 2.

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[1] All names are pseudonyms

Instruments

Social networks. We assessed the influence of demographic variables on a network that was aimed at capturing work related communication among educators. The network of discussing work related matters was selected because it is assumed to be an important network for the exchange of work related information, knowledge, and expertise that may affect individual and group performance (Sparrowe, Liden, Wayne, & Kraimer, 2001). Moreover, according to the previous analysis into network multiplexity (see Chapter 1), this network appeared to be an instrumental network with relatively small overlap with expressive networks. We asked respondents the following question: 'Whom do you turn to in order to discuss your work?' A school-specific appendix was attached to the questionnaire comprising the names of the school team members, accompanied by a letter combination for each school team member (e.g., Ms. Yolanda Brown[1] = AB). The question could be answered by indicating a letter combination for each colleague who the respondent considered part of his/her work discussion network. The number of colleagues a respondent could indicate as part of his/her network was unlimited.

      Individual, dyadic, and school level attributes. We collected demographic variables to assess how individual, dyadic, and school level attributes shape the pattern of social relationships among educators. At the individual level, we examined the following individual attributes: gender, formal position (teacher/principal), working hours (part time/full time), number of years experience at school, age, and whether a teacher was teaching in lower grade or upper grade. At the dyadic level, we included similarity of gender and similarity of grade level (lower/upper grade). At the school level, we investigated school size, team size, gender ratio, average age, years of team experience in current formation, and students' socio-economic status (SES).

Data analysis

Analysis strategy
Since our dependent variable consisted of social network data that are by nature interdependent (relationships among individuals), the assumption of data independence that underlies 'conventional regression models is violated. Therefore, we employed multilevel *p2* models to investigate the effect of individual, dyadic, and school level demographics on having work-related

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[1] All names are pseudonyms

relationships (Van Duijn et al., 2004; Baerveldt et al., 2004; Zijlstra, 2008). The *p2* model is similar to a logistic regression model, but is developed to handle dichotomous dyadic outcomes. In contrast to a univariate logistic regression model, the *p2* model controls for the interdependency that resides in social network data. The model focuses on the individual as the unit of analysis. The *p2* model regards sender and receiver effects as latent (i.e., unobserved) random variables that can be explained by sender and receiver characteristics (Veenstra, et al., 2007). In the multilevel *p2* analyses, the dependent variable is the aggregate of all the nominations a team member sent to or received from others. A positive effect thus indicates that the independent demographic variable has a positive effect on the probability of a relationship. We used the *p2* program within the StOCNET software suite to run the *p2* models (Lazega & Van Duijn, 1997; Van Duijn, Snijders, & Zijlstra, 2004). This software has been recently modified to fit multilevel data (Zijlstra, 2008; Zijlstra, Van Duijn, & Snijders, 2006). We make use of this recent development by calculating multilevel *p2* models for our data.

The social network data in this study have a three-level structure. Network data were collected from 13 schools (Level 3) with 316 educators (Level 2) and 11.241 dyadic relationships (Level 1). To examine the influence of individual, dyadic, and school level demographics on the likelihood of having work related relationships we constructed two multilevel models. In the first multilevel model, the effects of individual and dyadic level demographics on the possibility of having relationships were examined. In the second multilevel model, school level demographic variables were added to the model in order to explain the additional effect of school level demographics on the possibility of having relationships, above and beyond the effects of individual and dyadic level demographics. For the multilevel *p2* models, we used a subsample of the 13 schools with a team size of 20 educators or more. We selected this subsample of 13 schools from a larger sample of 53 schools to reduce computing time and to examine schools that were more comparable in network size. Still, each model estimation took about six hours of computing time.

How to interpret p2 estimates

In general, effects in *p2* models can be interpreted in the following manner. Results on the variables of interest include both *sender effects* and *receiver effects*, meaning effects that signify the probability of sending or receiving a relationship nomination. A positively significant parameter estimate can be interpreted as the demographic variable having a positive effect on the probability of a relationship (Veenstra et al., 2007). For instance, a positive sender effect of

formal position with dummy coding (teacher/principal) means that the position with the upper dummy code (principal) will have a higher probability of sending relationships than the position with the lower dummy code (teacher).

To assess homophily effects, dyadic matrices were constructed based on the absolute difference between two respondents. For example, the dyadic relationship between male and female educators would be coded as a relationship between educators with a different gender because the absolute difference between male (dummy variable = 0) and female (dummy code = 1) is 1. Smaller numbers thus represent greater interpersonal similarity in gender. The same procedure was carried out for grade level differences. To facilitate the interpretation of the models, we labeled the dyadic parameters 'different gender' and 'different grade level'. A negative parameter estimate for 'different gender' would thus indicate that a difference in gender is related to a lower probability of having relationships. Meaning, teachers with different gender are less likely to report a relationship, and conversely, relationships are more likely among same-gender teachers. As such, negative parameters would provide evidence of the hypothesized homophily effects.

In *p2* models, two parameters are by default included as they 'control' for important network effects. The first default parameter is the *overall mean density effect*. A positive density effect indicates that overall, the networks are rather dense, whereas a negative density effect indicates that the networks are rather sparse. Technically phrased, when the density parameter is negative, the probability of a tie is lower than 0.50. The second default parameter is the *overall mean reciprocity effect*. A positive reciprocity effect means that symmetric relationships are more likely to occur than asymmetric relationships, while a negative reciprocity effect signifies a higher probability of asymmetric relationships in the networks. In addition, the *p2* models include information on differences in nominating (sender variance), in receiving nominations (receiver variance), and the extent to which people who send more relationships also have a higher probability of receiving relationships (sender-receiver covariance).

<center>RESULTS</center>

The effect of individual and dyadic level demographics on work discussion relationships
The results for the *p2* analyses are reported in Table 3. We will first examine model 1, in which we include individual and dyadic demographic variables in the prediction of having a work-related relationship. To recall, our first

hypothesis was that 1a) men will receive more relationships than women, and women will send more relationships than men. Subsequent hypotheses posed that the probability of being involved in relationships was higher for 1b) principals, 1c) full time employed educators, 1d) educators who had more experience working at the school, 1e) older educators, and 1f) upper grade level teachers. Moreover, we hypothesized that homophily effects would be found for 2a) gender and 2b) grade level. The results for the multilevel *p2* models are presented in Table 3.

Findings indicate a negative density effect, suggesting that the work related networks are overall rather sparse. The positive reciprocity effect signifies that on average, work related relationships have a higher probability to be reciprocated than to be unidirectional. There is considerable variation among educators in the amount of ties that they send, as signified by the sender variance effect. There is less variation among educators in the amount of relationships that they receive, as represented by the receiver variance. The model with only individual and relationship covariates has a positive sender-receiver covariance, indicating that, in general, individuals who send more ties also receive more ties. When we take school level differences in demographics into account, results signify a negative sender-receiver covariance. Meaning, when taking differences between schools into account, educators who report to send more ties have a lower probability of receiving ties.

In regard to the sender covariates, results indicate that none of the individual characteristics increased the probability of sending ties. In other words, women did not send more relationships than men, and being a principal, working full time, having more experience at the school, or being older did not affect the number of relationships that an educator sends out with regard to work related discussions. An examination of the receiver covariates rendered a positive effect for formal position and teacher experience at school, indicating that a higher score on formal position and teacher experience at school had a higher probability of sending ties than a lower score. This means that principals and those who have worked at the school for a longer time had a higher probability to be sought out for a work related discussion. As such, Hypotheses 1b and 1d could be partially supported.

Results on the effect of dyadic covariates confirmed the existence of homophily effects for gender and grade level. In general, educators tended to prefer relationships with same-gender peers and peers from their own grade-level. Thus, educators from upper grades were more likely to have relationships with colleagues that taught in upper grade as well, and the same holds among lower grade educators. These findings confirm hypotheses 2a and 2b.

Table 3. *Whom do you turn to in order to discuss your work? T*he effect of sender and receiver demo-graphic variables on the probability of having a work related relationship. Parameter estimatesof the multilevel *p2* models (n = 316).

	Model 1			Model 2		
	Posterior mean	SE	95 % CI	Posterior mean	SE	95 % CI
Overall mean						
Density	-3.03	1.45		0.35	6.43	
Reciprocity	2.27	0.19		10.68	10.98	
Sender covariates						
Gender *(male/female)*	-0.09	0.32	(-0.87/0.47)	3.86 ***	0.71	(2.11 / 4.91)
Formal position *(teacher/principal)*	0.20	0.29	(-0.34/0.90)	0.16	1.56	(-2.53 / 2.87)
Working hours *(part time/full time)*	-0.35	0.30	(-0.84 /0.21)	-0.73	1.39	(-2.58 / 1.70)
Experience at school	0.04	0.10	(-0.16/0.27)	0.13	0.27	(-0.27 / 0.60)
Age	-0.03	0.01	(-0.05/0.00)	0.09	0.06	(0.00 / 0.19)
Grade level *(lower grade/upper grade)*	0.21	0.37	(-0.52/0.81)	5.04**	1.68	(2.16 / 7.81)
Receiver covariates						
Gender *(male/female)*	0.28	0.22	(-0.08/0.68)	-4.02***	1.17	(-5.68 / -1.61)
Formal position *(teacher/principal)*	1.04 ***	0.26	(0.51/1.54)	0.96	0.67	(-0.41 / 2.07)
Working hours *(part time/full time)*	0.00	0.22	(-0.49/0.39)	-5.25***	1.25	(-7.24 / -3.47)
Experience at school	0.29 ***	0.05	(0.20/0.40)	-0.79**	0.25	(-1.29 / -0.33)
Age	-0.02	0.01	(-0.04/0.00)	-0.12***	0.04	(-0.19 / -0.06)
Grade level *(lower grade/upper grade)*	0.13	0.19	(-0.19/0.57)	-1.62	0.98	(-3.52 / -0.29)

(Table 3. Continued)

Relationship covariates						
Different gender	-0.82 ***	0.14	(-1.09/-0.53)	-0.51***	0.14	(-0.83 / -0.25)
Different grade level	-0.70 ***	0.13	(-0.99/-0.48)	-0.43*	0.21	(-0.94 / -0.09)
School covariates						
Gender ratio [1]				-0.03	0.02	(-0.08 / 0.00)
Average age				-0.03	0.10	(-0.20 / 0.11)
Team size				-0.14	0.08	(-0.26 / 0.03)
Number of students				0.10	0.06	(-0.03 / 0.19)
Team experience				0.42**	0.14	(0.09 / 0.64)
Socio-economic status *(SES)* [2]				0.01	0.02	(-0.03 / 0.03)
Random effects						
Sender variance	8.05	2.29		2.41	0.58	
Receiver variance	1.74	0.42		1.57	0.32	
Nominator-target covariance	1.30	0.82		-0.99	0.24	

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

11.241 dyadic relations from 316 educators of 13 Dutch elementary schools.

[1] Gender ratio is calculated as the percentage of female team members
[2] SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

The effect of school level demographics on work discussion relationships

While the first model examined the influence of individual demographics without taking demographic differences between schools into account, in Model 2 we added school level demographics to the equation. This analysis will provide insights in how characteristics of schools may affect the probability of ties above the influence of individual demographics. To recall, our hypotheses were that teachers have a higher likelihood to send and receive relationships in a school team with 3a) a higher female gender ratio, 3b) a higher average age, 3c) more years of shared team experience, 3d) fewer students (low number of students), 3e) fewer educators (small team size), and 3f) low SES. Given that all standard errors in Model 2 are rather high, the model appears not to have reached optimal convergence (Zijlstra & Van Duijn, 2005). Therefore, the results of model 2 should be interpreted with caution and the outcomes have to be regarded as a first exploration that requires additional tests.

        Results for the school level demographics suggest a positive effect of overall team experience on the probability of relationships in school teams. In other words, the more experience a school team had in their current formation, the more likely relationships were formed around work related discussion. Other school level demographics appeared not to affect teachers' probability of sending or receiving relationships around work discussion above and beyond the prediction of relationships from individual and dyadic demographic variables. As such, only hypothesis 3e could be confirmed. When taking school demographics into account, results indicate some changes in the significance of individual and dyadic level parameters. For instance, results suggest significant sender effects of the individual demographics grade level and gender. Since both parameters are positive, this means that the upper dummy codes for grade level and gender have a higher probability of sending ties than the lower dummy codes. In this case, findings thus suggest that educators from upper grade tend to send out more relationships than educators that teach lower grade. However, they do not receive more relationships, as evidenced by a non-significant receiver effect. Also, female educators appear to send more relationships than male educators, but mail educators receive more relationships than female educators, signified by the significant negative receiver parameter for gender. These findings partially support Hypotheses 1a and 1f when taking school level network differences into account. Surprisingly, findings also indicate negative receiver effects for educators that work fulltime, educators with more experience at the school, and older educators. Meaning, educators with these demographics were less likely to receive work-related relationships. Also, principals were not more likely to send or receive

relationships than teachers. As such, these findings contradict respectively Hypotheses 1b, 1c, 1d, and 1e.

The change of a positive effect of teacher experience at school in Model 1 into a negative effect in Model 2 may be evidence of a suppression effect due to the inclusion of school demographics, and in particular, the significant effect of team experience. Team experience and teacher experience at school may be correlated, which may explain why team experience would suppress an individual level effect of experience. When taking team experience into account, the amount of (individual) experience at school decreases teachers' likelihood of receiving relationships. Moreover, the significant receiver effect for principals disappears under the influence of school demographics, but this may occur due to an overestimation of the standard errors, since the absolute value of the parameter estimate is similar in both models. At the dyadic level, again homophily effects could be confirmed for gender and grade level, thus supporting Hypotheses 2a and 2b when taking school level network differences into account.

CONCLUSIONS AND DISCUSSION

The field of educational research into social networks among educators is expanding rapidly. While studies are focusing on the potential effects of social networks for a variety of school outcomes, insights in the social forces that shape social network structure are limited. Especially in the field of education, where teachers play such a vital role in achieving school outcomes and where the expectations and stakes for collaborative initiatives are high, we need to understand how efforts to optimize these collaborative initiatives may be supported or constrained by inflexible factors, such as demographic variables. In support of this goal, this study examined 316 teachers of 13 schools in a large district in The Netherlands. We explored probability of sending and receiving work discussion relationships was shaped by several plausible demographic variables at the level of the individual, the dyad, and the school. Our findings give rise to the discussion of multiple general themes. Implications for practice are woven into the themes, as they relate directly to the findings that are discussed. We end with the limitations of our study and directions for further research.

Chapter 2

Individual demographics shape the probability of relationships in line with educational practice

The findings of this study, although not always in the way we expected, make sense in an educational context. For instance, results indicated that teachers from upper grade tend to send more relationships around work discussion than teachers from lower grade. It may well be that the teacher practice and lesson planning of upper grade levels require more coordination and interaction among these grade level members than among lower grade level members. Recall that we also found a homophily effect for grade level, which means that the ties that are sent out by upper grade teachers, would have had a higher probability of being targeted towards same-grade level peers. In other words, communication is more likely *within* grade levels than *between* grade levels. In addition, upper grade levels in The Netherlands receive additional lessons for half a day per week compared to lower grades, which may also explain the increased probability of upper level relational activity. In combination with physical proximity for teachers within grade levels and physical distance for teachers from different grade levels, educational practice offers ample explanations for our findings. Therefore, in creating and strengthening professional communities, it may be useful to attend to this grade level gap as a means to increase overall teacher interaction and the exchange of experience and expertise in support of continuing paths of learning throughout elementary education.

In line with research in other settings (Aldrich et al., 1989; Mehra, Kilduff, & Brass, 1998), female teachers tended to send more relationships, and male teachers were found to receive more relationships. In addition, against our expectation, full time employed teachers receive fewer relationships than part time employees. Again, this may be related to the amount of coordination that is needed to effectively 'share' teaching responsibility among two teachers. Although full time teachers probably spend more time at school, the work related discussion network is mainly dominated by relationships among part time educators. Part time teachers, as they spend less time at the school, may have to work 'harder' and send out more ties to find the information they need to perform their tasks. When aiming to increase teacher interaction in support of teacher professional development or school improvement, scholars and practitioners should be aware of the already increased burden of work related interaction on part time teachers.

It is striking that principals were not found to send more relationships than teachers. Especially with a general purpose network such as 'work related discussion', we would expect that principals would engage in more

relationships than teachers, especially given that the networks were on average rather scarce. One explanation could be that principals perceive interaction with teachers as such an integral part of their task, that they interpreted work related discussion differently than teachers. Principals in these schools may also have developed additional strategies that lower their burden of having to maintain too many relationships and draining their resources (Balkundi & Harrison, 2006), such as transferring leadership tasks to senior teachers or assistant principals. Another explanation may lie in the dual leadership role that principals have as general administrative manager and leading educational professional (Hughes, 1985). According to school leadership research, many principals are mainly occupied with performing their administrational role, even while they consider the educational role to be more desirable (Cuban, 1988; Lee, Smith, & Cioci, 1993; Leithwood, Begley, & Cousins, 1990; Stoel, 1994). It may well be that principals in the sample schools were more focused on their administrative roles than on leading content related discussions on instructional strategies and exchanging work related expertise. This finding points to the realization that principals do not per definition have a higher probability of sending or receiving relationships in a school team, which implies that there may be teachers who are 'better positioned' to convey information through the school team's social network than the principal. Conversely, professional development initiatives aimed at increasing teacher interaction are advised to attend to both teacher interactions and the principal position in the school's social network in raising awareness for the importance of having a solid structure of social relationships in place.

Findings suggest that older teachers, and teachers with more experience, receive fewer relationships around work related discussion than younger and 'newer' teachers. This finding contradicts our expectations. This study further suggests that years of experience at school is a stronger predictor of the probability of having relationships than age. Yet, age and experience at the school are likely correlated, just as team experience and average age may be related to their individual level counterparts. The same may also hold for gender ratio, gender similarity, and gender at the individual level. A suppression effect caused by adding similar parameters may explain the sign change of the parameter estimate of 'experience at the school' between models 1 and 2. Moreover, the difficulty at model convergence for model 2 may be in part due to this empirical overlap. Future research is therefore needed, and in following studies, scholars are advised to carefully select their demographics of interest.

Individual and dyadic demographics shape networks to a larger extent than school level characteristics

Results further suggest that the demographics especially influence the reception of relationships, more than the sending of relationships. This finding implies that a social network is defined by certain 'regularities' that affect the flow of resources such as information, knowledge, and support. Two of these regularities are homophily effects for gender and grade level; educators clearly prefer same-gender work relationships over different gender relationships and they tend to maintain relationships within their grade level over relationships with teachers from other grade levels. This given is already used by some intervention programs that target teacher interaction at the grade level (Newmann, King, & Youngs, 2000). Yet, practitioners should be careful not to focus too much on solely building relationships at the grade level, since this may increase the potential of homogenous cliques that may consist of many strong but redundant ties, which inhibit the flow of new, complex knowledge in the network through weak ties that span grade levels and gender segregation lines (Burt, 1997, 2000; Hansen, 1999).

School level demographics were found to be much less important for the pattern of social relationships among teachers than were individual and dyadic characteristics. The only school level characteristic that affected the probability of individual relationships is school team experience. What has to be noted, however, is that the employed statistical models (p2) are only designed to examine dyadic network characteristics as dependent variables (Snijders, 2002). Yet, the included school demographic variables may also affect social network structure at a higher level than the dyad, for instance network centralization or the number and shape of triadic relationships. Recently, scholars have developed p* (ERGM) models, that may be used to examine these more complex social network questions. Since this study was aimed to provide a first exploration of the influence of demographics on social networks in school teams, such a complex approach did not fall within the scope of this study. Moreover, we did not use p* modeling as its estimation properties are limited (Snijders, 2002). There is a dearth of work examining the influence of 'natural and inflexible' demographics and other antecedents that may affect the probability of social relationships in school teams.

Limitations

While we see the potential of this study to guide social network research and intervention programs aimed at teacher interaction, we acknowledge its limitations. One limitation that may affect our findings is the role of network

perception in the self-report of social relationships. For instance, Baerveldt et al. (2004) found that the number of relationships that an individual reports is associated with the importance that an individual attaches to having relationships. Students who find it important to have friends at school, tend to report more relationships than those who attach less importance to having friends at school. This may potentially have biased the findings with regard to the sender effects of grade level and gender; upper grades and women may just find relationships more important, and that is why they report having more relationships. To counter this bias, it would be interesting to include the relative importance of having relationships as an individual attribute in subsequent studies into the influence of demographic variables on network structure.

Another limitation pertains to the level of generalization that is possible from our findings. Since the findings of this study contradict some findings in other settings, it is questionable whether our findings are generalizable to other contexts than Dutch elementary education. As mentioned before, Dutch schools are much smaller than U.S. elementary schools. Although we did not find effects of school size and team size on the probability of relationships in school teams, it may be possible that this is due to the relative homogeneous school and team sizes in our sample compared to potential differences in team size in other countries, such as the U.S. Therefore, this study should be valued as a first exploration of the influence of demographics on social network structure, specifically in regard to the school level demographics.

Social forces in school teams

This chapter emphasizes the importance of attending to demographic variables at multiple levels of analysis (individual, dyadic, and school) in efforts to further social network research and the implementation of collaborative initiatives in support of school improvement. These demographic variables represent the social forces upon which social network initiatives are layered. As such, insights in these demographics are vital to guide our expectations of networked interventions. Knowledge of the social forces that affect social networks enable practitioners to find ways to target social networks in school teams in such a way, that they are optimally equipped to transfer valuable resources through the school team in order to facilitate collective teacher action. One important clue to optimizing social network structure is that an unraveling network is not conducive to creating organizational benefits or supporting organizational change. Practitioners, educators, educational leaders, and scholars should first and foremost orchestrate the necessary conditions that promote network stability (Dhanaraj & Parkhe, 2006; Ebers & Grandori, 1999;

Kenis & Knoke, 2002; Madhavan, Koka, & Prescott, 1998). This study shows that a potential route through which this can be achieved is to minimize school team turnover and increase school team experience. Since change experts and scholars can hardly intervene in any of the other demographic characteristics, they will have to design interventions and research that take into account these social forces that shape social networks in school teams. It is through the individuals behind these social forces, eventually, that change efforts optimize the potential of ties to affect teachers' instructional practice and ultimately, student achievement.

PART II

Antecedents
of social networks
in school teams

CHAPTER 3

Helping to Build Bridges?
Teachers' Organizational Citizenship Behavior
as a Catalyst for Social Relationships [1]

ABSTRACT

Background. An important assumption in social network literature is that the shape and size of a social network may be affected by individual behavior and action. A potential behavioral element that is suggested to affect the pattern of social relationships is organizational citizenship behavior, or behavior that goes beyond the line of duty. Yet, the empirical evidence base to support this suggestion is small.

Purpose. The goal of the current study was to explore whether teachers' helping behavior, as a key component of organizational citizenship behavior, increased teachers' likelihood of having work related and friendship relationships with colleagues in their school team.

Method. Data were collected from 316 educators in 13 elementary schools in a large educational system in the Netherlands. A quantitative survey using Likert-type scales and social network questions on work discussion and friendship relationships was analyzed using multilevel *p2* modeling. This is an advanced social network technique specifically designed to handle interdependent multilevel social network data.

Conclusions. Results demonstrated that teachers that display more helping behavior are slightly more likely to be sought out for a discussion on work related matters than teachers that show less helping behavior. High helpers also had a slightly higher likelihood of having friendships than low helpers. While significant, the effects were weak and leave to question whether there are other mechanisms that may shape social relationships more strongly than helping behavior. Evidently, more research is indicated to substantiate and build on the findings from this study.

INTRODUCTION

In educational practice and research, relational linkages among educators are increasingly acknowledged as an important source of teacher development and school improvement. Studies that examine the potential of relational linkages build on the notion that a strong informal community benefits from the know-how that is shared among the community members (Borgatti & Foster, 2003). The more information, knowledge, and expertise is shared, the more easy it is to retain (Kelly, 2004). Since educational research has emphasized the importance of strong professional communities for teachers' professional development, student learning, and educational change (Lee & Smith, 1996; Louis & Marks, 1998; Newmann, King, & Youngs 2000; Vescio, Ross, & Adams, 2008), the need to understand the potential of relational linkages among educators is evident.

Educational scholars have recently started to embrace social capital theory as a valuable lens to study social relationships among educators (Coburn & Russell, 2008; Daly & Finnigan, 2009; Penuel, Riel, Krause, & Frank, 2009). Social capital theory is concerned with the social embeddedness of individuals in social networks and posits that this embeddedness may support or constrain an individual's opportunity to achieve desired goals (Degenne & Forsé, 1999). Studies have emphasized the importance of relational linkages among educators for the spread and depth of policy and reform implementation, trust among educators, teachers' shared decision-making, schools' innovative climate and teachers' perceptions of collective efficacy (Coburn & Russell, 2008; Daly et al., in press; Moolenaar, Karsten, Sleegers, & Zijlstra, 2009; Moolenaar, Daly, & Sleegers, in press). While social network research quickly advances in the discovery of potential benefits of relational linkages, attention to possible antecedents that shape social network structure is limited.

A behavioral component that is suggested to affect educators' relationships is organizational citizenship behavior (Bolino, Turnley, & Bloodgood, 2002). Organizational citizenship behavior refers to behavior that goes beyond role requirements, that is not directly or explicitly recognized by the formal reward system, and that facilitates organizational functioning (Organ, 1988, 1997; Podsakoff, MacKenzie, Paine, & Bachrach, 2000). This extra-role behavior supports the social and psychological environment in which task performance takes place (Organ, 1997) and contributes to organizational functioning by facilitating the management of interdependencies between team members (Organ, 1988, 1990, 1997; Smith, Organ, & Near, 1983). Recent literature has pointed at the potential of examining organizational citizenship

behavior in support of interpersonal relationships in social networks (Koster & Sanders, 2006; Penner, Dovidio, Piliavin, & Schroeder, 2005).

In an effort to understand how individual behavior shapes social relationships among teachers, and to explore ways to target and optimize the potential of these ties, this study examines how teachers' OCB affects their pattern of relationships in the social network of their school team. The extent to which teachers help their colleagues may support or constrain their pattern of social relationships and as such, their potential to access and leverage resources from the school's social network. The research question guiding this chapter is: To what extent does teachers' organizational citizenship behavior affect their pattern of social relationships in Dutch elementary school teams?

This study focuses on the influence of organizational citizenship behavior on the probability of having work discussion and friendship relationships using data from 316 educators from 13 Dutch elementary schools. To answer our research question, we employ an advanced social network technique that accounts for the interdependency of social network data, namely multilevel *p2* modeling. By examining organizational citizenship behavior as an antecedent of social relationships, this study provides valuable insights in a potential behavioral mechanism that may be targeted to optimize relational linkages among teachers in support of teachers' professional development and school improvement. As such, the study offers a unique contribution to research on the interplay of organizational behavior and social networks.

THEORETICAL FRAMEWORK

Organizational Citizenship Behavior

Organizational citizenship behavior (OCB) is defined as employees' extra-role behavior that is voluntary, goes beyond routine requirements of the job and that is (explicitly or not) aimed at benefiting organizational functioning (Allison et al., 2001; Organ, 1988). Research on OCB was instigated by the idea that there are certain behaviors by employees that are contributing to organizational performance, but that are difficult for managers enforce because these behaviors are not directly rewarded by salary or imposed by a job description (Organ, 1988). Examples of such behaviors are helping others voluntarily, offering suggestions for improvement without apparent need or gain, tolerating inconveniences, and being loyal to the organization even in difficult times (Organ, Podsakoff, & MacKenzie, 2006). Indeed, empirical studies have found OCB to contribute to organizational performance (Podsakoff, Ahearne, &

MacKenzie, 1997; Podsakoff & MacKenzie, 1994, 1997). In the profit-sector, employees' OCB is associated with higher sales, higher production, and better product quality (Podsakoff et al., 2000), as well as employees' organizational commitment and job satisfaction (Podsakoff, MacKenzie, & Bommer, 1996; Organ & Ryan, 1995). Nowadays, the willingness of employees to exert effort beyond the formal obligations of their job is recognized as an essential component of effective organizational performance in a variety of work contexts (e.g., Podsakoff & MacKenzie, 1997; Van Dick & Wagner, 2002; DiPaola & Hoy, 2005a, 2005b).

In the context of education, organizational citizenship behaviors are believed to be important since the nature of educators' work cannot be comprehensively prescribed in job descriptions, and the increasing pressure to meet new standards for school performance urges educators to go well beyond their formal role to accomplish their goals (DiPaola & Tschannen-Moran, 2001; Tschannen-Moran, 2003). The interest in extra-role behavior as antecedent of organizational performance has been reflected by a growing number of studies positively linking educators' OCB to various school outcomes (Belogolovsky & Somech, in press; Bogler & Somech, 2005; Somech & Drach-Zahavy, 2000, 2004; Somech & Ron, 2007). Recently, teachers' OCB has also been related to (cognitive) student achievement (DiPaola & Hoy, 2005b).

We focus our investigation on a specific component of OCB, namely helping behavior (LePine & Van Dyne, 2001; Van Dyne & LePine, 1998). Summarizing definitions of many OCB scholars, Organ et al. (2006) define helping behavior as involving 'voluntarily helping others with, or preventing the occurrence of, work-related problems' (p. 308). As such, helping behavior resembles concepts such as Interpersonal Citizenship Behavior (ICB) (Settoon & Mossholder, 2002), altruism (Organ et al., 2006), prosocial (organizational) behavior (Borman & Motowidlo, 1993; Brief & Motowidlo, 1986; De Dreu & Nauta, 2009; George & Brief, 1992), OCB-I (Williams & Anderson, 1991), willingness to cooperate (Katz, 1964), and extra-role behavior or contextual performance (Motowidlo, Borman, & Schmitt, 1997; Motowidlo & Van Scotter, 1994; Organ, 1997; Organ & Lingl, 1995; Van Dyne, Graham, & Richard, 1995). We concentrated on helping behavior because it is arguably the most frequently studied component within the construct of organizational citizenship behavior (Organ et al., 2006), and because research has not unequivocally supported the interrelatedness of various components that fall within the conceptual frame of OCB (Bowler & Brass, 2006; LePine, Erez, & Johnson, 2002; Organ, 1997; Organ et al., 2006; Podsakoff et al., 2000; Settoon & Mossholder, 2002). The motive for helping other individuals is often a mixture of incentives (Clary & Snyder,

1999). Individuals may help others because they "simply can", because of genuine concern with the person in need of help, or because they feel morally compelled to contribute to the common good ('philanthropy', De Dreu & Nauta, 2009). Another argument for helping others is that helping behavior may distract the helper from one's own troubles, enhance a sense of value and self-esteem, increase positive moods and facilitate social integration (Midlarsky, 1991).

Several scholars have emphasized the importance of OCB and related behaviors for its social context. For instance, Organ (1997) defines OCB as 'performance that supports the social and psychological environment in which task performance takes place' (p. 95). Moreover, Borman and Motowidlo (1993) argue that helping behavior benefits organizational effectiveness because it shapes the organizational social context that supports the main task activities required to achieve organizational goals. As such, OCB is said to 'lubricate the social machinery of the organization' (Bateman & Organ, 1983).

Social capital theory

To explain the relationship between organizational citizenship behavior and organizational performance, Bolino, Turnley, and Bloodgood (2002) posed a theoretical framework in which organizational citizenship behavior influences organizational performance through the development of social capital. As defined by its principal theorists (Coleman, 1990; Putnam, 1993a), social capital refers to 'features of social organization, such as trust, norms and networks, which act as resources for individuals and facilitate collective action' (Lochner, Kawachi & Kennedy, 1999). The general idea underlying social capital theory is that the pattern of relational linkages among organizational members may provide them with the opportunity to access, borrow, or leverage social resources that reside in their social network. In contrast to previous research that conceptualized OCB as a dependent variable (Organ & Ryan, 1995; Podsakoff et al., 2000), Bolino et al. (2002) argued that OCB may serve as an antecedent of social relationships and social capital.

According to Bolino, Turnley, and Bloodgood (2002), OCB contributes to organizational social capital by facilitating the formation and nurturing of structural ties between organizational members, and by 'infusing the connections among employees with an affective component' (p. 511). In turn, social capital is believed to contribute to organizational functioning by facilitating the flow of information between individuals; helping to solve problems of coordination; increasing the potential costs to defectors; and thus reducing transaction costs (Putnam, 1993a; Lazega & Pattison, 2001; Lin, 2001).

Indeed, organizational social capital, in the form of tight and stable networks of communication and mutual trust, has been proven to contribute to organizational functioning (Katzenbach & Smith, 1993b; Lawler, 1992).

Literature outside education has associated the act of helping others (for instance conceptualized as organizational solidarity, OCB, or co-worker assistance) with concepts that relate to social relationships in some form, such as group cohesiveness (Flache, 2002; Frenkel & Sanders, 2007; George & Bettenhausen, 1990; Kidwell, Mossholder, & Bennett, 1997; Podsakoff et al., 1996; Sanders, 2004), distance to others in the organization (Organ et al., 2006), and social embeddedness (Hodson, 1997; Koster, Sanders, & Van Emmerik, 2003; Raub & Weesie, 1990; Van Emmerik, Lambooij, & Sanders, 2002; Van Emmerik & Sanders, 2004). Also, scholars have suggested that individuals in strong advice relationships are characterized by similarity in organizational citizenship behavior, indicating that strong relationships form when helping behavior is reciprocated by similar helping behavior (Zagenczyk, Gibney, Murrell, & Boss, 2008).

One route through which helping behavior may affect an individual's pattern of relationships is that the act of helping others may simply increase the amount of contact among individuals and therefore enlarge the opportunities for them to build relationships (Bolino, Turnley, & Bloodgood, 2002). Individuals who display more helping behavior will not only be in contact with others through their helping behavior, it may also make them more likable (e.g. Coie & Kupersmidt, 1983; Denham & Holt, 1993; Dodge, 1983). Another route through which helping behavior may affect social relationships thus involves positive feelings that may arise from giving and receiving help, which may facilitate creating new relationships and deepening existing contacts (George, 1991).

An explanation for the development of social relationships through helping behavior may be found in social exchange theory (Podsakoff et al., 2000). Social exchange theory (Blau, 1964; Homans, 1961) suggests that individuals help others because they expect that the favor will be reciprocated to them in the future (Clary & Snyder, 1999; Gouldner, 1960). This norm of reciprocity or social obligation to return a favor that is associated with helping behavior may become apparent in the relational patterns of individuals. Meaning, by helping others, individuals do not only invest more in social relationships, they will also receive more relational contact as a return on their investment. Until now, research has not examined whether individuals who enact more helping behavior are more likely to be engaged in social

relationships than individuals who enact less helping behavior. Moreover, this assumption has yet to be validated in the context of education.

Guided by this literature base, we pose that helping behavior will positively affect social relationships among school team members because teachers who display higher levels of helping behavior are inclined to voluntarily step in or assist when a colleague needs help, thereby initiating or strengthening a relationship with this colleague. In other words, teachers with more helping behavior will reach out more often, and thus report more social relationships than teachers with less helping behavior (*Hypothesis 1a*). Moreover, we pose that helpers will be sought out for relationships more often than people who display less helping behavior, because the colleagues that have been helped will be inclined to return the favor based on the norm of reciprocity. In addition, high helpers may be known for their inclination to help others and as such may also be sought out for social relationships more than low helpers. Teachers with a high tendency to help will thus have a higher likelihood of receiving relationships than teachers who display less helping behavior (*Hypothesis 1b*).

Besides the amount of relationships, another important characteristic of the pattern of social relationships is the content that typifies the social network. Previous research has indicated that social networks in school teams can be categorized in instrumental and expressive relationships (Ibarra, 1993, 1995; see also Chapter 1). Instrumental relationships are primarily directed at work. Central to these work related networks is the exchange of information, knowledge, and expertise related to educators' core task, which have been suggested to affect individual and group performance (Sparrowe, Liden, Wayne, & Kraimer, 2001). Expressive relationships are more affect-laden and not directly aimed at fulfilling organizational goals. Expressive ties, such as friendship, are believed to be more durable and stronger than instrumental ties (Marsden, 1988; Uzzi, 1997).

Research has indicated that the type of relationship may elicit differential effects of OCB on the pattern of relationships (Zagenczyk, Gibney, Murrell, & Boss, 2008). Studies have suggested that there are lower perceived costs associated with seeking help from someone with whom one has a close relationship (Anderson & Williams, 1996; Shapiro, 1983; Wills, 1991). Since scholars emphasized the importance of including multiple networks in the study of cooperative behavior (Koster et al., 2007), we will examine the effect of helping behavior on both work related and friendship relationships. In line with previous findings outside education, we argue that helping behavior

affects friendship relationships to a stronger extent than work related relationships (*Hypothesis 2*).

METHOD

Sample

The data for this study were gathered at 13 elementary schools of the Avvansa School District[1] in the Netherlands. Data were collected on the schools' advice network structure and teachers' helping behavior. A total of 316 educators (teachers and principals) participated in the study by responding to a questionnaire, reflecting a response rate of 94.5 %. Of the sample, 69.9 % was female and 54.8 % worked full-time (32 hours or more). The age of the respondents varied between 21 and 62 years (M = 46.5, sd = 9.9). Each school team had a minimum six months of experience in their current configuration. Additional sample demographics are presented in Table 1 and 2.

Instruments

Social networks. The patterns of social relationships among teachers were delineated using social network questions. Following earlier research (Monge & Contractor, 2003; see also Chapter 1), we focused on two networks that were assumed to vary as to the content of the network. To examine work-related communication among school team members, we asked respondents: 'Whom do you turn to in order to discuss your work?'. Following Ibarra (1993), we will refer to this network as the *instrumental* social network. Friendship relationships were examined by posing the question: 'Whom do you regard as a friend?'. This network will be referred to as the *expressive* social network. Respondents received a school-specific appendix that included the names of all the school's team members and a corresponding letter combination (e.g. Mr. Guy Miller[1] = AB). This letter combination could be used to nominate colleague(s). The number of nominations that respondents could make was unlimited.

   Helping behavior. To assess teachers' helping behavior, we used 4 items from a questionnaire developed for organizational research by Podsakoff, MacKenzie, Moorman, and Fetter (1990). They assessed helping behavior as an important component of organizational citizenship behavior (OCB) (Organ,

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[1] All names are pseudonyms

Table 1. Sample demographics of schools and educators (N = 13, n = 316)

Individual level			
Gender	Male	95	(30.1 %)
	Female	221	(69.9 %)
Working hours	Part time (less than 32 hours)	143	(45.2 %)
	Full time (32 hours or more)	173	(54.8 %)
Experience at school	1-3 years	42	(13.3 %)
	4-10 years	110	(34.9 %)
	> 10 years	164	(51.8 %)
Grade level[1]	Lower grade (K - 2)	156	(49.4 %)
	Upper grade (3-6)	160	(50.6 %)
School level			
Team experience	6 months to 2 years	5	(38.5 %)
	More than 2 years	8	(61.5 %)

Table 2. Sample demographics of schools and educators (N = 13, n = 316)

	N	M	Sd	Min.	Max.
Individual level					
Age	316	46.5	9.9	21	62
School level					
Gender ratio[2]	13	72.4	8.4	59.1	87.0
Average age	13	46.4	2.5	41.1	50.6
Number of students	13	371	79.3	287	545
Team size	13	26.0	4.0	20	31
Socio-economic status (SES) [3]	13	9.2	9.3	0.5	30.5

[1] Educators who can be considered to be a part of both lower and upper grade were asked to choose with which grade level they worked most (e.g., principal, specialist staff).

[2] Gender ratio is calculated as the percentage of female team members

[3] SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

1988; Organ et al., 2006). Few adjustments were made to the original scale. We adapted the items to fit the organizational context of Dutch elementary education. Also, the items were reformulated to accommodate self-report. The original OCB questionnaire was composed to measure supervisor ratings of their employees' OCB (Podsakoff et al., 1990). As we needed to collect data on whole teams for the social network analyses, it would be too time-consuming for the principal to rate the helping behavior of all school team members. To stimulate recall of actual helping behavior, the items were composed as to ask about concrete behavior that may have taken place in the two months prior to the study (e.g., 'In the past two months, I helped a coworker who had a heavy workload'). The period of two months was chosen because that was approximately the time that had passed since the last (fall) break. Respondents could rate the items on a Likert-type scale, ranging from 1 (never) to 5 (very often). The internal consistency of the scale was sufficient (4 items, α= .70). Principal component analysis with varimax rotation yielded a single factor solution that explained 51.7 % of the variance. The items and factor loadings of this principal component analysis are summarized in Table 3.

 Demographic variables. Several demographic variables were included to examine the influence of teacher and school variables on the variables under study. The following individual variables were included: tenure (part time/full time), gender, and years of experience at the school. Earlier findings on social networks in elementary education indicate that these demographic variables may affect the structure of social networks in school teams (see Chapter 2).

Table 3. Items and factor loadings of the scales used in the study (n = 316)

	Factor loading
Helping behavior (α = .70)	
1. In the past two months, I helped a colleague who had a heavy workload	.75
2. In the past two months, I helped a colleague who had work-related problems	.74
3. In the past two months, I was ready to lend a help helping hand whenever it was needed	.73
4. In the past two months, I have helped to orient a new colleague even though it is not required	.55

Educators who are tenured full time tended to receive fewer nominations than educators who are tenured part time. Also, results of the same study suggest that female educators are more likely to turn to others for a work related discussion, but are less likely to receive nominations than male educators. Relationships were found to be more likely between same-gender educators than opposite-gender relationships, suggesting a homophily effect of gender. In addition, educators who have worked at the school longer are less likely to be approached for a work related discussion than educators with fewer years of experience at the school, even when controlled for educators' age.

Data Analysis

Social networks. To describe the work related and friendship networks, we calculated various network measures using the UCINET 6.0 software package (Borgatti, Everett, & Freeman, 2002). For each educator, we calculated out-degree, in-degree, and ego-reciprocity. The social network measure of *out-degree* corresponds to the number of colleagues nominated by the respondent and can be interpreted as an indication of individual activity. The measure of *in-degree* reflects the number of colleagues from whom the respondent received relationship nominations, and can thus be regarded as an indication of individual popularity.

The *raw scores* of in- and out-degree encompassed the actual number of educators that were named by the respondents. The average in-degree is the same as the average out-degree, since each out-going relationship for one educator also implies an in-coming relationship for another educator. The standard deviations of the out- and in-degrees reflect the variability among educators in the amount of out-going and in-coming relationships, and can therefore be different for the out-degrees and in-degrees. The range of the average raw scores varies from 0 to 26.0 which is the average team size of the sample schools. In addition to the raw scores, we also calculated normalized scores for out-degree and in-degree to facilitate comparisons among schools.

The *normalized scores* can be interpreted as the percentage of relationships of the whole network that an educator maintains. The normalized out- and in-degrees range from 0 (the educator has no relationships) to 100 (the educator has a relationship with all of his/her team members). Again, the average percentage of out-going relationships is the same as the average percentage of in-coming relationships. The standard deviations of the normalized out- and in-degrees reflect the variability among educators in the percentage of relationships that are sent (out-going) or received (in-coming). *Ego-reciprocity* reflects the percentage of ties of an educator that is reciprocated and is

calculated as the ratio of reciprocated relationships to the total number of relationships an individual is involved in. Ego-reciprocity ranges from 0 (none of the educator's relationships are reciprocated) to 100 (all of the educator's relationships are reciprocated).

Helping behavior. We calculated inferential and descriptive statistics for the helping behavior scale.

Analysis strategy

Because of the interdependency of the data of the dependent variable (relationships among individuals), the assumption of data independence that underlies 'conventional' regression models is violated. Therefore, we conducted *p2* modeling to test the hypotheses (Van Duijn, Snijders, & Zijlstra, 2004; Baerveldt, Van Duijn, Vermeij, & Van Hemert, 2004). Since the data had a multilevel structure, we used a multilevel expansion of the *p2* model (Zijlstra, Van Duijn, & Snijders, 2006; Zijlstra, 2008; Zijlstra, Veenstra, & Van Duijn, 2008). The multilevel *p2* model is designed to estimate the probability of having a relationship (the dependent variable) as a function of individual, dyadic (relational), and group level covariates (Veenstra, et al., 2007). As such, the *p2* model can be regarded as a variation on a logistic regression model that accounts for the interdependency of social network data. We used the *p2* program within the StOCNET software suite to run the *p2* models (Lazega & Van Duijn, 1997; Van Duijn, Snijders, & Zijlstra, 2004). This software has been recently modified to fit multilevel data (Zijlstra, 2008; Zijlstra, Van Duijn, & Snijders, 2006). The current study addressed three levels of analysis; the dyadic (relational) level, the individual level, and the school level, represented by respectively 11.241 dyadic relationships (Level 1), 316 respondents (Level 2), and 13 schools (Level 3).

Separate multilevel *p2* models were estimated for the work discussion and friendship networks. Both models were built to assess the effect of teachers' helping behavior on the possibility of having (work discussion or friendship) relationships while controlling for demographic individual and relationship covariates. Individual covariates are characteristics of individuals that may influence the amount of ties that an actor sends or receives, such as gender or the number of working hours. Individual covariates can be included for the sender of a relationship (sender covariates) and/or the receiver of a relationship (receiver covariates). A relationship covariate renders information on the similarity of two individuals on a given (demographic) characteristic, such as gender. Relational covariates are included to assess homophily effects (as discussed in Chapter 2).

How to interpret p2 estimates

The parameter estimates in *p2* models can be interpreted in the following way. The main parameters of interest concern the *sender effects* and *receiver effects*, meaning effects that signify the probability of sending or receiving a relationship nomination. A positively parameter estimate signifies a positive effect on the probability of a relationship (Veenstra et al., 2007). For example, a positive sender effect of gender with dummy coding (male/female) indicates that female educators (represented by the highest dummy code) will have a higher probability of sending relationships than male educators (represented by the lowest dummy code).

For the relationship covariate of gender, dyadic matrices were constructed based on the absolute difference between two respondents' gender. The relationship between male and female educators would be coded as a relationship between educators with a different gender because the absolute difference between male (dummy variable = 0) and female (dummy code = 1) is 1. Greater interpersonal similarity in gender is thus reflected by smaller numbers. To facilitate the interpretation of the models, we labeled the dyadic (relationship) parameter 'different gender'. A negative estimate for 'different gender' would thus mean that gender difference between educators is associated with a lower probability of having relationships. As such, teachers with different gender are less likely to report a relationship, and conversely, relationships are more likely among same-gender teachers. A negative parameter for the relationship covariate would therefore provide evidence of a homophily effect of gender.

In *p2* models, two parameters are by default included as they 'control' for important network effects. The first default parameter is the *overall mean density effect*. A positive estimate for the density effect indicates that in general, the sample networks are rather dense, while a negative density effect reflects that the networks are rather sparse. The second default parameter is the *overall mean reciprocity effect*. A positive estimate for the reciprocity effect suggests that symmetric relationships are more likely to occur than asymmetric relationships, whereas a negative reciprocity effect signifies a higher probability of asymmetric relationships in the networks. Furthermore, *p2* models include information on differences in nominating (sender variance), in receiving nominations (receiver variance), and the extent to which people who send more relationships also have a higher probability of receiving relationships (sender-receiver covariance).

Table 4. Descriptive statistics, intercorrelations [1], and reliability (Cronbach's alpha) for the individual level variables (n = 316)

	Raw scores		Normalized scores		1b	1c	2a	2b	2c	3
	M	Sd	M	Sd						
1. Instrumental network										
a. Out-degree	5.41	4.21	24.8	18.2	.15**	.17**	.34**	.12*	-.07	.09
b. In-degree	5.41	3.60	24.8	15.0	1.00	.32**	.14*	.53**	.03	.20**
c. Ego-reciprocity	- [2]	- [2]	31.5	21.1		1.00	.10	.28**	.27**	-.01
2. Expressive network										
a. Out-degree	1.72	3.11	7.8	13.3			1.00	.19**	.06	.07
b. In-degree	1.72	1.65	7.8	7.0				1.00	.23**	.15*
c. Ego-reciprocity	- [2]	- [2]	28.0	30.8					1.00	.05
3. Helping behavior	3.50	.64								(.70)

Notes: * p < 0.05, ** p < 0.01

[1] Intercorrelations are calculated with normalized degree scores

[2] Ego-reciprocity is only calculated as a percentage score

RESULTS

Social network descriptives and correlations
In Table 4, descriptives and intercorrelations of the social network properties and helping behavior are summarized. Results from the descriptive analyses suggest that on average, educators have work related discussions with about 24.8 % of the total number of educators, which is consistent with on average 5.4 colleagues. Friendship relationships occur less often; in general, educators have friendship relations with about 7.8 % of their colleagues, corresponding to about 1.7 friends It is important to note that the standard deviations of the normalized network scores are high, indicating that there is great variability among educators in the number of relationship nominations that they report and receive. Findings with regard to ego-reciprocity show that only less than a third of the educators' relationships are reciprocated for both the instrumental and expressive network, respectively 31.5 % and 28.0 %. Results further show small to moderate positive correlations among the social network properties (between r = .12, p < .05 and r = .53, p < .01) with the highest correlation between the in-degree scores of both networks. This indicates that educators who receive many work related relationship nominations also tend to receive relatively many friendship nominations. Positive relationships between in-degree scores and helping behavior was confirmed for the instrumental network (r = .20, p < .01) and the expressive network (r = .15, p < .05), indicating that helping behavior is positively associated with the receipt of work discussion and friendship relationships. In other words, it appears that educators who report more helping behavior, are also sought out more for work related discussion and friendship.

General network tendencies
To study the extent to which helping behavior affects the probability of having work-related relationships, we conducted two multilevel *p2* analyses. Results of these analyses are depicted in Table 5. Findings for both networks indicate a negative overall mean density effect, indicating that the networks tended to be sparse. In comparison, the general probability of a friendship tie was lower than a work related discussion tie. In both networks, relationships have a higher tendency to be mutual than uni-directional, as evidenced by the positive overall mean reciprocity effect. In the friendship network, this overall tendency to reciprocate relationships is stronger than in the work related network.

Table 5. The effect of helping behavior the probability of having work related or friendship relationships. Parameter estimates of the multilevel *p2* model (n = 316).

	Work-related relationships			Friendship relationships		
	Posterior mean	SE	95 % CI	Posterior mean	SE	95 % CI
Overall mean						
Density	-3.94	0.56		-6.83	0.83	
Reciprocity	2.52	0.16		4.37	0.29	
Sender covariates						
Gender *(male/female)*	-0.12	0.18	(-0.44 / 0.31)	-0.22	0.27	-(0.74 / 0.28)
Working hours *(part time/full time)*	0.15	0.19	(-0.18 / 0.51)	-0.04	0.25	(-0.56 / 0.47)
Experience at school	-0.09 *	0.04	(-0.18 / -0.01)	0.07	0.08	(-0.07 / 0.21)
Helping behavior	0.01	0.01	(-0.02 / 0.03)	0.03 *	0.01	(-0.01 / 0.07)
Receiver covariates						
Gender *(male/female)*	0.07	0.15	(-0.27 / 0.32)	0.30	0.20	(-0.08 / 0.69)
Working hours *(part time/full time)*	0.31	0.16	(-0.02 / 0.61)	0.33	0.18	(-0.04 / 0.67)
Experience at school	0.08 *	0.04	(0.01 / 0.16)	0.09	0.05	(-0.01 / 0.20)
Helping behavior	0.04 **	0.01	(0.01 / 0.06)	0.01	0.01	(-0.02 / 0.04)
Relationship covariates						
Different gender *(male/female)*	-0.66 ***	0.12	(-0.89 / -0.45)	-0.68 ***	0.12	(-0.94 / -0.46)
Random effects						
Sender variance	1.51	0.18		2.81	0.36	
Receiver variance	1.07	0.13		0.93	0.18	
Sender-receiver covariance	-0.87	0.13		-1.31	0.22	

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

11.241 dyadic relations from 316 educators from 13 Dutch elementary schools.

In both networks, there is considerable variation among educators in the amount of ties that they send and receive, as signified by the sender and receiver variance effects. In general, both networks are characterized by negative sender-receiver covariance, meaning that individuals who report to send more relationships have a lower probability of receiving ties, which especially applies to the friendship network. In general, these findings reflect and add to results that were derived from the network descriptive statistics.

The influence of demographics
Findings in regard to the work related social network indicate a negative sender effect of school experience. This means that on average, educators with more experience at the school are less likely to send relationships around work discussion than less experienced educators. In contrast, more experienced educators are more likely to receive relationships around work discussion. These findings imply a circular flow of work related discussion relationships in which less experienced teachers appear too seek out more experienced teachers for work related discussion. This circular flow of work discussion within the school teams based on experience at the school reflects earlier findings by Lazega and Van Duijn (1997). For the friendship networks, none of the demographic variables affect the probability of relationships. Demographic variables thus appear to minimally affect the likelihood of being involved in work discussion and friendship relationships.

In regard to the relationship covariate, results for both networks show a strong homophily effect of gender, suggesting that on average, female educators tend to prefer work discussion and friendship relationships with female colleagues, and male educators tend to prefer work and friendship relationships with male colleagues.

The influence of helping behavior on educators' pattern of relationships
Results indicate that helping behavior does not increase teachers' likelihood of sending work discussion relationships. Yet, helping behavior has a minimal, though significant effect of helping behavior on the probability of sending friendship ties. Meaning, individuals that reported more helping behavior were also likely to report more friendship relationships. As such, hypothesis 1a is rejected for the instrumental network, but supported for the expressive network.

Findings also suggest that helping behavior slightly increases teachers' likelihood of receiving work discussion relationships. In contrast, helping behavior does not significantly affect of the probability of receiving friendship

ties. In other words, the more helping behavior an educator reported, the more this person was sought out for a discussion about work related matters, but not for friendship. Therefore, hypothesis 1b is supported for the instrumental network, but rejected for the expressive network.

Finally, a comparison between the effects of helping behavior on both networks yields that effects were not stronger in the friendship network than in the work related network and therefore, hypothesis 2 is rejected.

CONCLUSIONS AND DISCUSSION

The study of social linkages among educators is receiving increased prominence in educational literature for its potential to affect a wide range of school outcomes (Daly, in press, McCormick, Fox, Carmichael, & Procter, in press; Penuel et al., 2010). While research is mainly focusing on the extent to which social networks support or constrain educational outcomes such as reform implementation and teachers' attitudes (Coburn & Russell, 2008; Cole & Weinbaum, 2007), there is a paucity of knowledge on potential antecedents of social relationships among educators. Insights in such antecedents are crucial since they may provide valuable leads as to the extent to which social networks may be targeted to optimally support teaching practice. This chapter contributes to social network research by focusing on helping behavior as a behavioral antecedent of social relationships in the context of education.

Apparent from the findings is that educators' general helping behavior only slightly increases their probability of having social relationships. Does this imply that helping behavior is not the 'lubricant of the social machinery of an organization' that Bateman and Organ (1983) pose it is? We believe that there is more to the story that deserves scholarly attention. One factor that may potentially explain the findings is that this study examined whether helping behavior affected the number of relationships of educators. It may be that helping behavior has a greater impact on the quality of relationships than on the quantity (e.g., Settoon & Mossholder, 2002, Venkataramani & Dalal, 2007). Anderson and Williams (1996) suggested that helping behavior is linked to relationship quality, in that people who have close relationships are more likely to help one another. Individuals that share a strong advice tie were also found to be typified by similarity in organizational citizenship behavior, thus indicating that strong relationships are fostered when helping behavior is reciprocated by similar helping behavior (Zagenczyk, Gibney, Murrell, & Boss, 2008). Following this line of reasoning, besides creating new (weak) ties,

helping behavior may play a more important role in fostering strong ties. Helping behavior may thus lubricate the social relationships among teachers by strengthening existing relationships through reinforcing norms of reciprocity, increasing the exchange of resources, and expanding one type of relationship (e.g., work related discussion) into another, more strong and durable type of relationship (e.g., friendship). As such, helping behavior may be an important catalyst for network multiplexity, or networks that serve multiple interests (see Chapter 1).

Another explanation may entail that helping behavior is mostly targeted at specific others. We defined helping behavior as voluntarily helping (undefined) others in the school team. We argued that educators' helping behavior would affect their likelihood of having social relationships because of the increased contact, the positive effects that may result from helping, and the norm of reciprocity (Bolino, Turnley, & Bloodgood, 2002; Clary & Snyder, 1999; Coie & Kuperschmidt, 1983; Dodge, 1983; George, 1991; Gouldner, 1960). Yet, helping behavior may be more specifically targeted at colleagues with whom educators are already involved in work related or friendship relationships. Helping behavior may thus be more focused on strengthening specific relationships through bonding than engaging in new relationships through bridging.

While we posed that helping behavior may affect social relationships based on suggestions firmly grounded in organizational literature (Bolino, Turnley, & Bloodgood, 2002; Organ, 1988; 1997; Smith, Organ, & Near, 1983), it is conceivable that social relationships in turn give rise to increased levels of helping behavior, thereby creating a 'feedback loop' of social interaction and helping behavior (Bolino, Turnley, & Bloodgood, 2002). For instance, Sanders, Flache, Van der Vegt and Van de Vliert (2006) argue that network cohesion may foster OCB in the from of employee solidarity towards collective goals. Venkataramani and Dalal (2007) found that social network characteristics of affective networks partly explain helping behavior. It may even be that a continuous feedback loop of helping behavior and social interaction may support or constrain the extent to which educators are willing to help others, with whom they are unconnected. Future research into this feedback loop between (targeted) helping behavior and social relationships is clearly indicated.

Delimiters and areas for future research

All studies involving some measure of extra-role behavior have to cope with the fuzzy line between extra-role behavior and role-prescribed behavior, or

behavior that is inherent to the job (Organ et al., 2006; MacKenzie, Podsakoff, & Fetter, 1991; Morrison, 1994; Orr, Sackett, & Mercer, 1989). This is reflected in the considerable variance with which employees rate their manager's helping behavior (MacKenzie, Podsakoff, & Paine, 1999). Teachers' roles may also lack clear definition as to the difference between extra-role and in-role behavior (Belogolovsky & Somech, in press), especially in times of high accountability pressure (Valli & Buese, 2007). While the variation of individuals' self-reported OCB in this study was not exceptionally high, variation among respondents in the interpretation of 'helping' cannot be ruled out.

There may also be limits as to the generalizability of this study. Research has indicated that there are cross-cultural differences in the meaning and interpretation of 'helping' (Farh, Earley, & Lin, 1997; Farh, Zhong, & Organ, 2002). In addition, Dutch school teams are relatively small compared to US elementary school teams, which may sort differences in social network structure (Tsai, 2001). Clearly, studies in a variety of organizational and culturally diverse settings are indicated to increase our insights of potential cross-cultural differences and similarities.

The findings also offer fruitful directions for future research. Besides the already mentioned potential of studying the potential feedback loop of social relationships and helping behavior, research on helping and social structure at multiple levels of analysis is also much needed. For instance, knowledge on the cross-level relationships between school teams' social network structure, collective and individual norms of reciprocity, and helping behavior at the school and individual level is scarce. Also, longitudinal and mixed method research may increase our insights in the complex interplay between concepts such as helping behavior, reciprocity, social networks, and individual and collective action.

A catalyst for social relationships

In sum, this study suggests that the conceptual and empirical linkage between helping behavior and social relationships is theoretically and empirically more complex than hypothesized in this chapter. While general helping behavior of teachers may not help them to build bridges in their school team, it may certainly serve as a catalyst for social relationships. Yet, we would first and foremost urge researchers and practitioners to ponder other behavioral mechanisms through which individuals may create and nurture social relationships. Insights in such mechanisms may provide valuable clues as to methods to facilitate and kindle the exchange of knowledge, information, and expertise that is so vital to strong professional teacher communities.

CHAPTER 4

Occupying the Principal Position:
Examining Relationships between Transformational Leadership, Social Network Position, and Schools' Innovative Climate [1]

ABSTRACT

Background. Around the world, educational policy-makers, practitioners and scholars have acknowledged the importance of principal leadership in the generation and implementation of innovations. In many studies, transformational leadership has emerged as a promising approach in response to increasing demands to develop and implement innovations in schools. While research has also suggested that having access to leaders with expertise can significantly stimulate innovation, the relationship between transformational leadership and principals' social network position has not yet been extensively studied.

Purpose. The goal of the study was to investigate the impact of principals' positions in their schools' social networks in combination with transformational leadership on schools' innovative climate.

Method. This study was conducted among 702 teachers and 51 principals in 51 elementary schools in a large educational system in the Netherlands. Using social network analysis and multilevel analysis, we analyzed a survey with social network questions on work related and personal advice and Likert-type scales for transformational leadership and innovative climate.

Conclusions. Findings indicated that transformational leadership was positively predictive of schools' innovative climate. Principals' social network position, in terms of centrality, was also predictive of schools' innovative climate. The more principals were sought for professional and personal advice, and the more closely connected they were to their teachers, the more willing teachers were to invest in change and the creation of new knowledge and practices. Moreover, work related closeness centrality was found to mediate the relationship between transformational leadership and innovative climate.

INTRODUCTION

Across the globe there is an increasing demand and allocation of resources for developing and implementing innovations that will improve public education. For example, the American Recovery and Reinvestment of Act of 2009 devoted $650 million dollars to its Investing in Innovation fund (i3), with the stated purpose of supporting the rapid development and adoption of effective solutions. Despite the call for more innovation, there is much debate as to what constitutes 'innovation'. Moreover, largely absent in the discourse is how leaders create and support the necessary conditions in which these innovations may be developed. This lack of clarity has spawned significant discussion in the academic and practitioner communities as to a course of action. Although there are multiple disparate voices in the discussion there is some long standing general agreement that 'leadership' is important in both developing and sustaining the climate and condition for innovation to occur (Bass & Riggio, 2006; Burns, 1978). One of the most referenced types of leadership that may hold potential in reforming systems through innovative practice is transformational leadership (Bass, 1985).

Despite a variety of perspectives, what undergirds most definitions of transformational leadership (TL) is a leader's ability to increase organizational member's commitment, capacity, and engagement in meeting goals (Leithwood & Jantzi, 2006; Marks & Printy, 2003). Transformational leadership motivates followers to do more than they originally expected and often even more than they thought possible, resulting in extra effort and greater productivity (Bass, 1985; Bass & Avolio, 1994). Research around transformational leadership in education has been associated with stimulation of innovation (Day et al., 2000; Geijsel, Sleegers, Van den Berg, & Kelchtermans, 2001; Leithwood, Harris, & Hopkins, 2008); changed teacher practices (Geijsel, Sleegers, Stoel, & Krüger, 2009; Leithwood et al., 2004); organizational learning (Silins, Mulford & Zarins, 2002); organizational commitment and extra effort for change (Geijsel, Sleegers, Leithwood, & Jantzi, 2003; Nguni, Sleegers & Denessen, 2006; Yu, Leithwood & Jantzi, 2002); and collective teacher efficacy (Ross & Gray, 2006) in a variety of international settings.

Given that TL involves mobilizing social interactions in support of goals, scholars have further suggested that the potential of TL may well be as an organizational attribute that is distributed throughout the organization as well as residing 'within' a formal leader (Hallinger, 2003; Leithwood et al., 2004). This implies that while a leader is important in the process of 'leadership', the interactions between and among others within that system and how leadership

is distributed may be equally essential. For that reason, the study of 'distributed leadership' has become a very active line of inquiry (Harris et al., 2007; Mayrowetz, 2008; Scribner, Sawyer, Watson, & Myers, 2008; Spillane, 2006). Despite a growing body of evidence to suggest the importance of distributing leadership, there is limited empirical evidence as to the extent to which leaders can mobilize the social resources that reside within their organization's social network in support of innovation.

Although a schools' social network structure has been identified as an important vehicle through which leadership may exercise influence (Hallinger & Heck, 1998), studies on the interplay between transformational leadership, social network structure, and innovations are scarce. Emerging studies are addressing this absence by taking a social network approach to study innovations in organizations (Obstfeld, 2005), and the uptake of reforms in schools (Coburn & Russell, 2008; Daly & Finnigan, 2009; Daly, Moolenaar, Bolivar & Burke, in press). Research in this area suggests that relationships between educators within a school are important to foster a climate in which innovations can develop and new knowledge can be created (Moolenaar, Daly & Sleegers, in press). This study extends the current literature by investigating the extent to which a principal's position in the school's social network may support or constrain the effects of transformational leadership behavior on an innovative climate. In doing so, we contribute to a deeper understanding of the mechanisms that interact with transformational leadership to benefit innovation and ultimately, school improvement and increased student achievement.

In this chapter we present the results of a study into the potential of transformational leadership behavior and principal social network position for fostering an innovative school climate in 51 Dutch elementary schools within a large educational system. The study was guided by the following research questions:

1. To what extent does transformational leadership behavior affect a school's innovative climate?
2. To what extent does principals' social network position mediate the effect of transformational leadership behavior on a school's innovative climate?

In the next section we will provide an overview of literature on innovation-supportive climates in organizations. We will then focus on transformational leadership behavior and principals' network positions as two different aspects of leadership, and continue with an empirical investigation designed to answer our research question.

THEORETICAL FRAMEWORK

Innovative climate

The subject of organizational innovation has been studied extensively in management and organizational research (Hage, 1999). Innovation, in general, has been defined as the development and use of new ideas, behaviors, or practices (Daft & Becker, 1978; Damanpour & Evan, 1984). In an organizational sense, innovation is not merely transmitting, diffusing, or recycling existing knowledge between members; it is also concerned with the transformation of prevailing knowledge and practices of actors as a means to organizational change (Nonaka & Takeuchi, 1995).

Organizational innovation often occurs in an iterative and cyclic process that is established and maintained through social interaction (Kanter, 1983). As such, innovation is regarded as a social process in which social interaction provides multiple opportunities for input and refinement (Calantone, Garcia & Droge, 2003; Nohari & Gulati, 1996). Communication, sharing information and ideas, and opportunities to engage in discussion and decision-making are critical for an open orientation towards innovation (Frank, Zhao & Borman, 2004; Monge, Cozzens, & Contractor, 1992). This suggests that a social learning process underlies the development of organizational innovation (Paavola, Lipponen & Hakkarainen, 2004), in which the combination of different people, knowledge, and resources triggers the generation of new ideas and practices (Kogut & Zander, 1992).

In this study, we examine the degree to which a school is characterized by a climate for innovation, rather than study the development or implementation of specific innovations. We have selected to move in this direction as scholars have emphasized the importance of a pro-innovation climate to foster innovative behavior and the generation, adoption, and implementation of new practices (Amabile, 1998; Van der Vegt, Van de Vliert, & Huang, 2005). Focusing on innovative climate, instead of innovations per se, also helps to transcend the contextual aspect of studying innovations. Whereas innovations are often context specific, given the fact that one school's innovation may be another school's daily practice, studying an innovative climate provides the opportunity to make better comparisons between schools. Following Van der Vegt et al. (2005), we define Innovative Climate as the shared perceptions of organizational members concerning the practices, procedures, and behaviors that promote the generation of new knowledge and practices. Central to this definition are educators' perceptions of the collective willingness to adopt an open orientation toward new practices and change, and

to collectively develop new knowledge, practices, and refinements to meet organizational goals (Moolenaar et al., in press). Next, we will elaborate on how an innovative climate may be affected by leadership behavior, in the form of transformational leadership, as well as leaders' social network position.

Leadership behavior in relation to innovative climate

An increasing number of studies suggest that innovation-supportive climates that foster creativity may be facilitated or constrained by leadership behavior (Mumford, Scott, Gaddis, & Strange, 2002). Creativity is key to the innovation process as it is often referred to as 'the first step in innovation' (Amabile, 1998, p. 80). A leader's ability to support the fertile ground of creativity involves combining knowledge, expertise, and motivation in a risk tolerant climate (Oldham & Cummings, 1996; Perry-Smith & Shalley, 2003; Storey & Salaman, 2005; Jung, 2001). Moreover, leaders can create opportunities for actors to interact and test out creative ideas in a supportive environment (Drazin, Glynn, & Kazanjian, 1999; Mumford et al., 2002). In order to foster a school's innovative climate, leaders may direct their behavior towards encouragement and support, as well as develop nurturing relationships (Shalley & Gilson, 2004).

Although there are multiple leadership theories in the literature that provide a theoretical lens for understanding change and innovation, transformational leadership (TL) is one of the most prominent contemporary approaches to leadership in relation to innovation. TL has been well studied both outside and within education and provides an empirically grounded theory on the role of leadership in supporting organizational change (Bass & Avolio, 1994). Drawing on the work of Burns (1978) concerning political leadership, Bass (1985) developed a model of transformational leadership that conceptualized transactional and transformational forms as separate but interdependent dimensions.

Whereas transactional leadership is generally sufficient for maintaining the status quo, transformational leadership focuses on capacity building for the purpose of change. Such leadership motivates followers to do more than they originally expected and often even more than they thought possible (Bass & Avolio, 1994). Transformational leaders aim to motivate followers to accomplish and even exceed their initial achievement expectations (Jung & Avolio, 2000). The success of a transformational leader is demonstrated both by increased performance outcomes and the degree to which followers develop their own leadership potential and skills. What is more, transformational leadership has been found to significantly enhance satisfaction with, and

perceived effectiveness of, leadership beyond levels achieved with transactional leadership (Bass & Avolio, 1994).

Research on transformational leadership in educational settings was initiated by Leithwood and his colleagues in the late 1980s and early 1990s (Leithwood, 1994). Since then, numerous studies on transformational leadership have demonstrated positive relationships between transformational leadership and various school and teacher organizational conditions. For example, studies have found increases in teachers' perceptions of leader effectiveness, successful implementation of innovations, boost in teachers' behaviors, emotions, and job satisfaction, increased participation in decision-making and commitment to change, and teachers' motivation to implement accountability policies (Geijsel et al., 2003; Leithwood & Jantzi, 2005; Leithwood, Steinbach, & Jantzi, 2002). Transformational leaders were found to be able to influence organizational members to move beyond self-interest in support of larger organizational goals (Marks & Printy, 2003). Moreover, transformational leadership has been associated with student outcomes, both directly and indirectly through these conditions (Leithwood et al., 2004; Leithwood & Jantzi, 2006).

Studies on transformational leadership within the educational context have distinguished three specific dimensions of transformational school leadership: *Vision building* which refers to the development of a shared vision, goals and priorities; i*ndividual consideration* which includes attending to the feelings and needs of individual teachers, and providing i*ntellectual stimulation* which entails the support of teacher professional development and the constant challenging of teachers to readdress their knowledge and daily practice (Geijsel, Van den Berg, & Sleegers, 1999; Geijsel et al., 2009).

While the balance of this literature associates transformational leadership with innovation and change in education, few studies have empirically examined the role of transformational leadership in supporting an innovative climate. However, a conceptual link between the three transformational leadership dimensions (vision building, individual consideration and intellectual stimulation) and schools' innovative climates seems plausible. For example, transformational leaders may increase a team's orientation towards innovation by providing a vision for school improvement through supporting a risk tolerant climate, providing opportunities for learning and professional development, and challenging team members to invent new solutions to old problems by thinking 'out of the box' (Shalley & Gilson, 2004; Sosik, Avolio, & Kahai, 1997). Transformational leaders that set and share a clear vision may boost followers' innovativeness by serving as role models in the development and implementation of innovations (Shalley & Perry-Smith, 2001; Tierney &

Farmer, 2002), clarifying the challenges for the school's future and the importance of developing new knowledge and practice, pointing out opportunities for school improvement through innovation, and motivating team members by envisioning an attractive future for the school (e.g., Amabile, 1996). In addition, setting clear goals toward outcomes can help transformational leaders manage timeframes of complex innovation projects, which represents a critical competency of leaders of innovative organizations (Halbesleben, Novicevic, Buckley, & Harvey, 2003).

Transformational leaders that provide individual consideration demonstrate confidence in individuals' innovative capacities, share the responsibilities and risks with team members when adopting new strategies, and recognize individual contributions to the team (Leithwood & Jantzi, 2005). Individual consideration creates and sustains a climate in which innovations can grow and public criticism of followers' mistakes is minimized (Bass & Avolio, 1994). By providing meaning and understanding to followers' tasks, leaders can increase organizational members' intrinsic motivation and address their individual needs, which are basic sources of creativity (Tierney, Farmer, & Graen, 1999). In this way, leaders encourage followers to innovate by providing a psychologically 'safe' workplace environment without the fear of being punished or ridiculed (Amabile et al., 1996). Innovative and creative behaviors involve risk-taking (Tesluk, Farr, & Klein, 1997) and an acceptance of the possibility of failure. In order to motivate teachers to share creative new ideas and practices, for example, by inviting colleagues in their classroom, leaders have to establish and maintain a 'safe' climate that is conducive to innovation.

Through intellectual stimulation, transformational leaders may for instance encourage teacher to spend more time on training and professional development. This in turn may stimulate an innovation-oriented climate, as training may increase teachers' knowledge and skills, broaden their horizon with a variety of experiences and perspectives, teach teachers how to make the development of innovative teaching strategies an integral part of their job, and increase their confidence and comfort with the implementation of new ideas (Feldhusen & Goh, 1995). In order to be innovative as a team, it is vital that individual team members are stimulated to share and discuss creative ideas and different views with each other (Amabile et al., 1996). Moreover, in order to support the development of new ideas, organizations need to foster an open orientation towards innovation in a climate in which creative efforts and the distribution of new knowledge and practices are encouraged (Bain, Mann, & Pirola-Merlo, 2001; Scott & Bruce, 1994).

Given this robust literature base and our expectations about the theoretical connection between transformational leadership practices and innovation we hypothesize that principals' transformational leadership behavior (TL) will have a positive effect on teachers' perceptions of their school's innovative climate (IC) (*Hypothesis 1*).

Leadership position in relation to innovative climate

The research around Transformational Leadership (TL) as referenced in the previous section is robust in terms of its support for organizational change and innovation. The theoretical underpinnings and empirical work around TL also suggest the importance of social relations and the distribution of tasks over formal and informal leaders. Recent educational studies suggest that having access to leaders who possess expertise may significantly affect teachers' of innovation use (Penuel, Fishman, Yamaguchi, & Gallagher, 2007a; Penuel, Frank, & Krause, 2007b). However, there remains an empirical gap in the TL literature in regard to the social network position of formal leaders in relation to organizational members (Daly & Finnigan, 2009; Moolenaar et al., in press).

Complementary to traditional leadership behavior research, organizational literature is now starting to focus on leadership effectiveness in terms of a leaders' position in a social network (Balkundi & Harrison, 2006; Balkundi & Kilduff, 2005). The balance of this literature underscores the importance of a leader's informal position in the social network in terms of access and leveraging social capital as well as brokering between parts of a system. Moreover, studies suggest that a leader's social network position is related to group performance and leader reputation (Mehra, Dixon, Brass, & Robertson, 2006; Sparrowe & Liden, 1997). The social network structure of interpersonal relationships often supports or constrains the distribution of resources and information. Typically, the structural position of an individual in a social network is associated with similar constraint and potential (Burt, 1983b). Connections and access, or a lack thereof, to available resources presents some structural positions with more or less power and influence than other positions in the social network. However, this assertion has received limited attention in the context of educational leadership (Daly & Finnigan, 2009; Moolenaar et al, in press).

A key determinant of the structural advantage of an individual's position in a social network is an actor's centrality in the network. Centrality is defined in terms of the relative number of connections that an individual has to others in the network. The more connections, or ties, a leader has to the team members, the more central the leader is positioned in the network. Central

actors play a major role in their social network (Baker & Iyer, 1992). A meta-analysis by Balkundi & Harrison (2006) indicated that groups with leaders who occupy a central position in the group's social network, tended to show higher group performance than groups with less central leaders.

By occupying a more central position, a leader is more often sought for resources (friendship, expertise, etc.), and has easier access to resources, information or support from the social network (Adler & Kwon, 2002). Moreover, having more relationships increases a leader's opportunities to access novel information (Balkundi & Kilduff, 2005; Krackhardt, 1996). This access to diverse resources provides a central leader with the possibility to guide, control, and even broker the flow of information and resources within the team (Burt, 2005). A leader may use the power and status attained through occupying a central position to direct certain knowledge and information to the right people who might need it most. In contrast, a leader may also decide to 'block' certain flows of resources, such as information, that might negatively affect team performance.

Different types of centrality can be inferred from an individual's position relative to others in the social network. While most studies on individual position in networks only include a single centrality measure, we examine three types of centrality that each may offer a different perspective on leadership; degree centrality, closeness centrality, and betweenness centrality. *Degree centrality* is perhaps the most familiar form of centrality, and refers to the popularity of the leader. (In-) degree centrality is assessed simply as the number of people who seek out the principal for, for instance, advice, information, expertise, friendship or social support. In other words, the higher the principal's degree centrality, the more s/he is nominated as a valuable resource in the network.

Closeness centrality indicates how 'close' a principal is to the team members, or how quickly a principal can reach all team members through the social network. Closeness centrality can thus be interpreted as a measure of "reachability" by the principal. The higher a principal's closeness centrality, the quicker information that is dispensed by the principal will reach all team members. In contrast to degree centrality, closeness centrality includes principals' indirect relationships to all team members. Uzzi (1996) suggests that not only direct, but also indirect connections are important as these relationships may dampen or enhance leader effectiveness.

Betweenness centrality refers to the potential of an individual to 'broker' his/her relationships, thereby in effect controlling the flow of resources between two actors. Betweenness is assessed as the number of times an actor is

positioned 'in between' two people in the network that are themselves unconnected. Actors with high betweenness are often perceived by others as leaders as they link otherwise disconnected parts of the networks. Individuals with high betweeness may benefit an organization by connecting unconnected groups, or cliques, but also have a very strategic and influential position as they can 'choose' whether or not to diffuse resources such as information and knowledge between separate (groups of) individuals. High betweeness has also been conceptualized as being in a 'power' position in the network given this ability to control the flow and content of resources (Burt, 1992). Because of the potential misuse of high betweenness centrality, this 'power' position has been suggested to negatively affect the distribution of information, knowledge, and innovation (Balkundi & Kilduff 2005).

While a principal's structural position may influence his/her ability to achieve goals, the content of the resources flowing through the ties in a social network is equally important (Hite, Williams, & Baugh, 2005). In social network research, studies often concentrate on two types of social networks that reflect different content flowing through the ties; instrumental and expressive networks (Ibarra, 1993). Instrumental social networks are conduits for the circulation of information and resources that pertain to organizational goals. These networks often initially tend to follow patterns of formal hierarchical relationships. Expressive social networks reflect patterns of more affect-laden relationships, such as friendships, that are believed to transport and diffuse resources such as social support, trust, and values (Ibarra, 1993, 1995). These two types of networks tend to overlap and are not mutually exclusive, with one type of relationship possibly even leading to another (Borgatti & Foster, 2003; Cross & Parker, 2004). Recent research in education indicates that there can be different outcomes associated with each type of relation (Daly, et al., in press; Moolenaar, Daly, & Sleegers, 2009).

Occupying a central position offers potential in the form of status, power, and influence (Brass, 1984; Friedkin, 1993), but may also burden the leader with having to maintain and/or broker too many relationships. In general, having to maintain too many ties may be disadvantageous, as these relationships may drain a leader's own resources (Balkundi & Harrison, 2006). This may especially be the case in friendship relationships that require more effort to maintain, and may distract from work related matters (Boyd & Taylor, 1998). It may be difficult for leaders to burden, disadvantage or reprimand team members with whom they are closely connected, or make difficult decisions that might have negative consequences for the team (Hughes, Ginnett, & Curphy, 1999; Taylor, Hanlon, & Boyd, 1992). Moreover, relationship patterns may also constrain

leadership behavior to a distinct leadership role as defined by those relationships (Krackhardt, 1999). Along the same lines, it might be very hard for a leader, who is embedded in a network of many friendship relationships, to oppose general opinions and interpretations of core organizational values and resist the social pressure resulting from these relationships (Krackhardt & Kilduff, 1990).

Given the substantive literature around the importance of the structural position of a leader in a network and how network position is related to power and the movement of resources within a network, we hypothesize that the principals': (a) in-degree centrality and (b) closeness centrality in the instrumental and expressive social networks will have a positive effect on teachers' perceptions of schools' innovative climate (IC), whereas the (c) betweenness centrality of the principal in the instrumental and expressive social networks will have a negative effect on teachers' perceptions of schools' innovative climate (IC) (*Hypotheses 2a, 2b, and 2c* respectively).

Relationship between TL behavior, position, and innovative climate
Through this literature review we have related the conditions necessary for innovation, leadership behavior through transformational leadership (TL), and the influence of a leaders' network position on the movement of resources. As reflected in our first two hypotheses we will be examining the relationships between innovative climate and leadership behavior, in the form of TL, as well as between innovative climate and a principals' position in the social network of the school. These examinations will begin to fill the gap in the literature surrounding leadership behavior, network position, and innovative climate.

In addition, we are interested in potential mediators (such as network position) that bring together all three areas as a way to potentially clarify the relationship between transformational leadership and innovation (Avolio & Yammarino, 2002; Kark, Shamir, & Chen, 2003). Although there are indications in the literature about the interrelatedness of all three areas: Bass, Avolio, Jung, and Berson (2003) who found the level of network cohesion in a US army unit partially mediated the relationship between transformational leadership and performance; and Ibarra and Andrews (1993) who suggested that central actors played a more prominent role in innovation, there is a dearth of empirical work. Examining the interactions among all three areas independently as well as through interactions and mediation offers a unique contribution to the literature. Therefore, we offer two additional hypotheses. Transformational leadership will (a) have a positive effect on principals' in-degree centrality and (b) closeness centrality; and (c) a negative effect on principals' betweenness

Table 1. Sample characteristics of schools (N = 51), principals (N = 51) and teachers (N = 702)

	N	Min.	Max.	M	Sd
Teachers					
Age	702	21	63	45.5	10.8
Fte	702	0.20	1.00	0.73	0.24
Administrative tasks	702	0	1	0.19	0.39
Principals					
Age	50	27	61	48.96	8.96
Fte	50	0.33	1.00	0.77	0.25
School					
Gender ratio [1]	51	59.0	100.0	77.1	10.5
Number of students	50	53	545	213.0	120.1
Team size	51	6	31	14.8	6.9
SES [2]	51	0.4	47.3	7.9	9.7

		Principals (%)		Teachers (%)	
Gender	Male	39	(76.5 %)	166	(23.6 %)
	Female	12	(23.5 %)	536	(74.6 %)
Experience	6 months - 3 years	27	(52.9 %)	122	(17.4 %)
at the school	4-10 years	10	(19.6 %)	243	(34.6 %)
	> 10 years	14	(27.5 %)	337	(48.0 %)
Experience	6 months - 3 years	18	(35.3 %)		
as a principal	4-10 years	18	(35.3 %)		
	> 10 years	14	(27.5 %)		
	Unknown	1	(1.9 %)		

[1] Gender ratio is calculated as the ratio of female to male team members with 100 % referring to a team with only female team members

[2] SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

centrality (*Hypotheses 3a, 3b, and 3c* respectively). The relationship between transformational leadership (TL) and schools' innovative climate (IC) will be positively mediated by principals' in-degree and closeness centrality, but negatively mediated by betweenness centrality (*Hypothesis 4*).

METHOD

Context

Strengthening principal expertise and fostering innovations are two major foci in educational policy in the United States as evidenced by recent federal government initiatives such as Investing in Innovation (i3). This same level of federal emphasis is also true in the Netherlands where this study took place (Netherlands Ministry of Education, 2009a, 2009b). Our inquiry was conducted in 51 Dutch elementary schools located in the south of the Netherlands, and were all served by the Avvansa School District[1] that provided administrative, financial, and instructional technology support. The schools participated in the study as part of a large-scale reform effort around professional development that was designed, implemented, and supported by the district.

Sample

A total of 51 principals and 702 teachers participated in the study by completing a survey on transformational leadership, social networks, and innovative climate, with a response rate of 100.0 % and 96.7 % respectively. While the majority of the principals was male (76.5 %), the majority of the teachers was female (74.6 %). This gender ratio is approximately reflective of elementary education across the Netherlands. Principals' age varied between 27 and 61 (M = 49.0, Sd = 9.0). School team size varied between 6 and 31, with an average of 15 teachers per team. Additional sample demographics are presented in Table 1.

Instruments

Social network position. We employed social network analysis to obtain information about principals' structural position in their schools' instrumental and expressive network. All teachers and principals in the sample schools were asked to respond to a social network survey. The following question was posed to examine the social network around work related advice; 'Whom do you go to for (work related) advice?'. In line with Ibarra (1993), we will refer to this social network as the *instrumental* network. The social network around personal

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[1] All names are pseudonyms

advice was obtained by asking the question; 'Whom do you go to for guidance on more personal matters?'. This social network is referred to as the *expressive* network.

Guided by previous studies on social networks and innovation (Copeland, Reynolds, & Burton, 2008; Obstfeld, 2005), we focused on the network structure around advice. Advice relationships are important in the diffusion of new knowledge and information and the development of innovations as advice relationships are arguably the primary channel for principals to guide and support teachers in their practice. As such, the act of giving advice presents the principal with a powerful tool to assert social control and to steer activities and opinions about innovation and change. The act of asking advice conveys information about the advice-seeker, who may be in a position of vulnerability thereby taking a risk in asking for support. In turn, the advice-giver has the potential to create a safe psychological space for the exchange and may be able to actively influence the advice-seeker's perceptions, actions, and behavior.

The survey was complemented with a school-specific appendix, which included the names of all the team members in combination with a letter code (e.g. Mr. Mike Wolf[1] = AB). Teachers and principals answered the questions by writing down the letter codes of the colleagues with whom they have the relationship described in the social network questions. The respondents could indicate a relationship with as many colleagues as they preferred.

Transformational Leadership (TL). We assessed teachers' perceptions of their principal's transformational leadership with a questionnaire based on the work of Geijsel and colleagues (2001, 2009). Following prior research on transformational leadership, the scale evaluated teachers' perceptions of principals' vision building, individualized consideration, and intellectual stimulation. An example of an item designed to assess principals' *vision building* is: 'The principal of my school refers explicitly at our school's goals during decision-making processes'. A sample item from the *individualized consideration* included asking teachers to evaluate the following statement: 'The principal of my school takes opinions of individual teachers seriously'. To measure the extent to which principals provide *intellectual stimulation* to their team members, we asked a series of questions typified by the following: 'The principal of my school encourages teachers to experiment with new didactic strategies'. Principal component analysis was conducted on the 18 items, rendered a three factor solution that explained 73.7 % of the variance. However, because all items loaded highly on the first component, and the three components were

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[1] All names are pseudonyms

highly interrelated, we combined the three scales into a single higher-order component that explained 58.4 % of the variance (α = .96). This procedure is in line with previous research on transformational leadership (Avolio, Bass, & Jung, 1999; Bono & Judge, 2003; Jung & Sosik, 2002; Kark, Shamir, & Chen, 2003).

While transformational leadership was assessed at the individual level, we interpreted TL as a school level variable, as we were interested in school leadership as perceived by the teacher team as a whole. In order to justify the aggregation of individual teacher perceptions of transformational leadership into a school-level aggregate, we calculated interrater agreement (r wg[j]; James, Demaree, & Wolf, 1984) and interrater reliability (ICC[1] and ICC[2]; cf. Bliese, 2000; LeBreton & Senter, 2008). The three measures were found to be sufficiently supportive of aggregation (r wg[j] = .95, ICC[1] = .09, ICC[2] = .73). Following previous research, we therefore aggregated individual teacher perceptions of transformational leadership to a school-level variable (Avolio, Zhu, Koh & Bhatia, 2004).

Innovative Climate (IC). We measured teachers' perceptions of their schools' climate in support of innovation with six items that were developed to assess schools' orientation to improve (Bryk, Camburn, & Louis, 1999; Consortium on Chicago School Research, 2004). The items were translated and adapted to fit the context of Dutch elementary education. The scale was designed to measure the extent to which teachers have a positive attitude towards developing and trying new ideas. A sample item is: 'In my school, teachers are generally willing try new ideas'. Principal component analysis provided evidence that the six items contributed to a single factor solution explaining 59.8 % of the variance (α = .86).

The scales on transformational leadership and innovative climate used a Likert-type scale, ranging from 1 (disagree) to 4 (agree). While the social network survey was presented to principals and teachers to assess principals' structural position in the networks, the scales on transformational leadership and innovative climate were given to teachers only. To assess whether the latter scales measured separate constructs, the TL and IC items were both entered in a single principal component analysis with varimax rotation. This analysis resulted in a four-factor solution that accounted for 70.6 % of the variance. The first three factors referred to the Transformational Leadership scales, whereas the fourth component comprised the items of the Innovative Climate scale, indicating that the two scales assessed separate constructs. The items and factor loadings of this principal component analysis are summarized in Table 2.

Table 2. Items and factor loadings of the scales used in the study (n = 702)

Factor	I	II	III	IV
<u>Transformational Leadership</u> (α = .96)				
The principal of my school…				
Vision Building				
1. Refers explicitly at our school's goals during decision-making processes	.24	.16	.77	.18
2. Explains the relationship between the schools' vision and initiatives of the school district, collaborative projects, or the government	.25	.29	.77	.17
3. Discusses the consequences of the school's vision for everyday practice	.29	.24	.76	.19
4. Uses all possible moments to share the school's vision with the team, students, parents and others	.29	.26	.75	.17
5. Incorporates the school's vision and goals for the future to talk about the current issues and problems facing the school	.29	.38	.72	.14
Individualized Consideration				
6. Takes opinions of individual teachers seriously	.28	.81	.24	
7. Listens carefully to team members' ideas and suggestions	.27	.80	.28	
8. Is attentive to problems that teachers encounter when implementing innovations	.33	.78	.24	.11
9. Shows appreciation when a teacher takes initiatives to improve the education	.36	.76	.21	
10. Helps teachers talk about their feelings	.33	.75	.24	
Intellectual Stimulation				
11. Encourages teachers to experiment with new didactic strategies	.79	.10	.23	.13
12. Involves teachers in a constant discussion about their own professional personal goals	.77	.29	.19	.11
13. Encourages teachers to try new strategies that match their personal interests	.74	.33	.21	.11
14. Helps teachers to reflect on new experiences	.72	.40	.16	.20
15. Motivates teachers to look for and discuss new information and ideas that are relevant to the school's development	.72	.27	.34	.13
16. Stimulates teachers to constantly think about how to improve the school	.70	.29	.34	.15
17. Offers enough possibilities for teachers' professional development	.62	.33	.19	.18
18. Helps teachers talk about and explain their personal views on education	.61	.53	.22	.10

(Table 2. Continued)

Factor	I	II	III	IV
Innovative Climate (α = .86)				
1. Teachers are generally willing to try new ideas		.12		.84
2. Teachers are continuously learning and developing new ideas	.11		.22	.80
3. Teachers have a positive 'can-do' attitude		.14		.78
4. Teachers are willing to take risks to make this school better		.14		.76
5. Teachers are constantly trying to improve their teaching	.12		.19	.73
6. Teachers are encouraged to go as far as they can	.24		.26	.61

Demographics. Several demographic characteristics were collected in the questionnaire to assess their relationship with demographics, principals' social network position, TL, and IC (see Table 1). As background variables regarding the principal, we included age, gender, and years of experience as a principal as they have been indicated as potential predictors of transformational leadership and innovative climate (Geijsel, 2001). We also included number of working hours (FTE) and years of experience at the school since both may affect the extent to which teachers are able to, and comfortable with, asking the principal for work related advice and advice regarding personal matters. At the teacher level, we added teacher age, gender, number of working hours (FTE) and years of experience at the school for similar reasons. We also included whether teachers had additional administrative tasks in support of the principal, which would potentially involve increased contact with the principal and could therefore explain an advice relationship. As school level demographics, we entered gender ratio (the percentage of female to male teachers in the team), school size (as represented by the number of students) and team size (total number of school staff with teaching and/or administrative tasks) in the models, because these demographics may be related to structural characteristics of social networks (Tsai, 2001). Finally, schools' socio-economic status (SES; based on a governmental weighing factor for additional financial support) was added as a demographic school level variable. Typically, schools that serve more high-needs communities, and schools that are under pressure to improve, are associated with greater urgency in developing new approaches (Sunderman, Kim & Orfield, 2005).

Data analysis

Social network position. For each principal, we calculated three measures that reflected the centrality of his/her position in the schools' instrumental (advice) and expressive (spending breaks) social network: in-degree centrality, closeness centrality, and betweenness centrality (cf. Borgatti, Jones, & Everett, 1998; Burt, 1983b). These social network characteristics were calculated using both teachers' and principals' answers to the social network survey, and analyzed using UCINET 6.0 (Borgatti, Everett, & Freeman, 2002). The three types of centrality, discussed below, were assessed as they each offer a different perspective on principals' centrality position in the team.

A principal's *in-degree centrality* reflects the number of people who indicated the principal as a source of work related or personal advice. In-degree centrality scores are normalized to facilitate between-school comparisons, and can therefore be interpreted as a proportional measure of principals' popularity for advice in the network. In-degree centrality is an asymmetric measure in which the direction of the tie (who nominates who) is taken into account. In contrast, closeness centrality and betweenness centrality are calculated using symmetrized networks, in which the direction and reciprocity of the tie is ignored. *Closeness centrality* is calculated as one minus the sum of the shortest paths between the principal and the teachers in the network. As such, closeness centrality can be interpreted as a measure of how much effort it will take for the principal to reach all teachers in the network. The higher a principal's closeness centrality in the network, the quicker the principal's advice or information will spread through the social network because the principal is close to many teachers. Closeness centrality is then also normalized to facilitate comparisons among individuals (Hanneman & Riddle, 2005). A principal's *betweenness centrality* assesses the degree to which a principal occupies a position 'in between' the teachers in the network. A principal who has a central betweenness position has the capacity to broker contacts between actors in the organization, and as such the power to control the flow of information and resources in the network. Betweenness centrality is calculated as the proportion of times an individual occupies a position between two other actors that are themselves unconnected. This measure is then normalized as a percentage of the maximum possible betweenness position that an individual could possibly reach in the network, in order to facilitate comparisons among principals (Hanneman & Riddle, 2005).

The centrality measures of the principals' position in their schools' social networks range from 0 (the principal is not central at all) to 1 (the principal occupies a very central position in the network). The centrality measures are to

be interpreted as school-level variables, because we were interested in the centrality of the principal to all teachers in the network as a proxy for the principals' influence on the school's innovative climate.

Transformational Leadership and Innovative Climate. We calculated descriptive and inferential statistics including correlations and internal consistencies for the scales assessing Transformational Leadership (TL) and Innovative Climate (IC), as well as correlations with the social network measures regarding the centrality of principals' positions in their schools' networks.

Analysis strategy

Four steps were taken to test our hypotheses (see Figure 1 for a path diagram of the hypothesized relationships). First, we conducted correlation analyses to examine the relationships among principals' structural position, transformational leadership (TL), and schools' innovative climate (IC) as perceived by teachers. Second, we analyzed the influence of demographic variables on the proposed relationships to identify potential control variables that must be taken into account. Third, we conducted multilevel regression analyses to test the direct effects of TL on IC (Path c) and principals' centrality in the instrumental and expressive social networks on IC (Path b). Finally, we tested whether principals' network position mediated the relationship between TL and IC following procedures as described by Baron and Kenny (1986).

Figure 1. Path diagram of hypothesized multilevel mediation
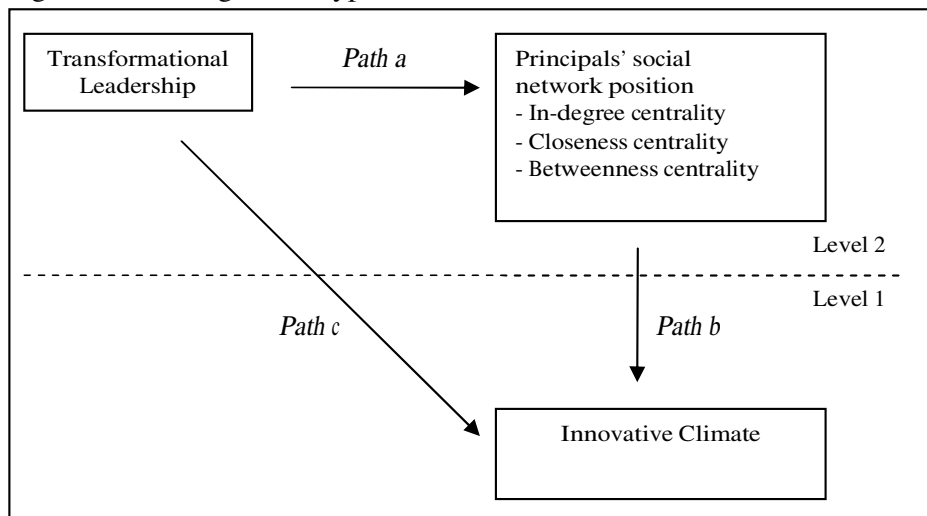
An important methodological concern when conducting social network analyses is that the basic assumption of independence of observations, that underlie regression analyses techniques, does not hold, as actors in bounded social networks are constrained by the same relationship opportunities (see Kenny, Kashy, & Bolger, 1998). Therefore, principals' centrality in the advice network is not entirely independent of their centrality in the social network of personal guidance. Moreover, since all three types of centrality are calculated using the same source (the number of relationships between the principal and the other team members), the observations of different types of principals' centrality cannot be considered independent. Because of this interdependency, there is a considerable risk of multicollinearity. Previous research has demonstrated that often in-degree, closeness and betweenness centrality are characterized by medium to high correlations (Brass & Burkhardt, 1993). This is also reflected in our sample for both the instrumental and expressive network ($r = .61$, $p < .01$, and $r = .64$, $p < .01$ respectively). While multicollinearity does not affect the predictive power of the model as a whole, it may inflate the standard errors of the individual predictors. To address this methodological concern, we ran separate models for all types of centrality (in-degree, closeness, and betweenness) and for both network types (instrumental and expressive). Given this strategy and the substantial size of our dataset, we may assume that multicollinearity did not create a significant threat to the robustness of our findings.

Table 3. Descriptive statistics for transformational leadership, principals' social network position, and schools' innovative climate at school level (N = 51) and the teacher level (n = 702)

	N	M	Sd	Min.	Max.
Instrumental network					
Principal in-degree centrality	51	0.35	0.18	0.03	0.89
Principal closeness centrality	51	0.59	0.18	0.22	1.00
Principal betweenness centrality	51	0.08	0.11	0.00	0.55
Principal number of nominations (in-degree)	51	4.8	3.5	1	17
Expressive network					
Principal in-degree centrality	51	0.32	0.18	0.00	0.78
Principal closeness centrality	51	0.62	0.18	0.19	1.00
Principal betweenness centrality	51	0.06	0.08	0.00	0.33
Principal number of nominations (in-degree)	51	4.1	3.2	0	18
Transformational leadership	51	3.06	0.38	2.12	3.87
Innovative Climate	702	2.96	0.55	1.00	4.00

<div align="center">RESULTS</div>

Descriptive analyses

We calculated descriptive statistics for transformational leadership, principals' social network position, and schools' innovative climate (see Table 3). Findings indicate that principals' position in both social networks (work related advice and personal guidance) is very similar. Teachers in the sample schools nominate their principals as much as a person from whom they seek work related advice, as a person by whom they seek guidance on more personal matters (in-degree centrality for the work related network is .35, and for the expressive network .32). In general, principals thus receive work related advice nominations from about 35 % of the teachers, and 32 % of the teachers indicate the principal to be a valuable source of advice related to personal matters. In both networks, principals are similarly close to teachers, respectively 59 % and 62%. On average, principals' betweenness centrality is 8 % in the work related advice network, and 6 % in the personal advice network. This implies that principals in general seldom occupy a brokerage position in the advice networks in their school. Results thus suggest that principals occupy similar positions in both the social network of work related advice and the social network of personal guidance.

Relationships between transformational leadership, principals' structural position, and innovative climate

Results from the correlation analyses (see Table 4) indicate that transformational leadership is positively and significantly related to teachers' perceptions of their schools' innovative climate. Transformational leadership is also positively related to principals' popularity (in-degree) in both the instrumental (work advice) and expressive (personal advice) network. The more teachers perceive their principal as a transformational leader, the more the principal was nominated as a source of work related advice and as a person whom teachers approach for guidance on more personal matters. Moreover, the more transformational a principal is perceived, the more close s/he is to all teachers in both the instrumental and expressive networks, as illustrated by positive correlations between transformational leadership and closeness centrality. Transformational leadership was not significantly related to betweenness centrality, which reflects the degree to which a principal occupies a brokerage position.

Results also suggest that principals' structural position within the social network is related to their schools' innovative climate. The more teachers rely

on the principal for work related and personal advice, the more teachers' perceive the school's climate as supportive of innovation. Interestingly, the higher principals' betweenness in the schools' instrumental networks, the lower the perception of innovative climate within the school. This finding suggests that the more a principal occupies a brokerage role in the advice relationships between teachers, the less the team is characterized by a willingness to develop new knowledge, create novel practices and try innovative teaching strategies. Principals' betweenness centrality in the expressive social network was not significantly related to schools' innovative climate.

The effect of demographic variables on principals' structural position and innovative climate

To examine whether demographic characteristics of teachers, principals, and schools played a role in the relationships under study, we tested the influence of demographics on principals' structural position and schools' innovative climate. We found that teachers, who performed administrative tasks in support of the principal besides their teaching task, perceived their school's climate slightly less innovative than teachers without additional administrative tasks. Moreover, teachers that have more than one year of experience at the school perceive their school's climate to be slightly more innovative than teachers who just started working at the school. In regard to principals, we

Table 4. Correlations and internal consistencies (Cronbach's alpha) at the school level (N = 51).

	1	2a	2b	2c	3a	3b	3c	4
1. Transformational Leadership	(.96)	.58**	.50**	.05	.49**	.35*	.11	.52**
2. Position in instrumental network								
a. In-degree Centrality		1.00	.61**	.26	.61**	.52**	.30*	.39**
b. Closeness Centrality			1.00	.06	.47**	.36*	.23	.38**
c. Betweenness Centrality				1.00	.18	-.14	.08	-.32*
3. Position in expressive network								
a. In-degree Centrality					1.00	.64**	.30*	.41**
b. Closeness Centrality						1.00	.58**	.38**
c. Betweenness Centrality							1.00	.01
4. Innovative Climate [1]								(.86)

Notes: *** p < .001, ** p < .01, * p < .05

[1] Aggregated at the school level for this table only

found that teachers with older principals perceive their schools' climate on average less supportive of innovation than teachers that work with younger principals. Principals' gender and years of experience at the school were not significantly related to their schools' innovative climate (see Table 5). Demographic variables that had a significant effect on the relationships under study were included in further analyses.

The effect of transformational leadership on innovative climate

The first hypothesis addressed the impact of principals' transformational leadership on their schools' innovative climate (see Table 5). Results from multilevel analyses indicated that the more principals display transformational leadership behavior in the form of building a shared vision, considering individual teachers' feelings and needs, and intellectually stimulating the teachers, the more their team was characterized by a willingness to take risks to improve the school by developing and implementing new knowledge and

Table 5. Multilevel analysis results of the prediction of perceived Innovative Climate (IC) by Transformational Leadership (TL) (N = 51, n = 702) (*Path c*)

	Model 1		Model 2	
	Est.	S.E.	Est.	S.E.
Intercept	2.971 ***	.040	2.974 ***	.035
Individual level				
Administrative tasks (dummy)	-.046 *	.019	-.046 *	.019
Experience at school (dummy)	.038 *	.019	.037 †	.019
School level				
Principal age	-.095 *	.038	-.063 †	.034
Principal gender	.054	.040	.006	.037
Principal experience at the school (dummy)	.025	.043	.014	.037
Transformational Leadership			.146 ***	.038
-2*log likelihood	1047.181		1034.130	
(Null model χ²(3) = 1064.449)	χ² DIFF. (5)= 17.268 ***		χ² DIFF. (6)= 30.319 ***	
Explained variance (total variance)				
School (23.8 %)	4.9 %		11.0 %	
Teacher (76.2 %)	13.1 %		34.3 %	

Notes: † p < .10, * p < .05, ** p < .01, *** p < .001

Table 6. Multilevel analysis results of the prediction of perceived Innovative Climate (IC) by principals' social network position (N = 51, n = 702) (*Path b*)

	β	S.E.		School variance	Teacher variance
Instrumental Network Position					
In-degree Centrality	.098 *	.046	1042.845, χ^2_D (6) = 21.604 **	7,3 %	21,8 %
Closeness Centrality	.147 ***	.042	1035.819, χ^2_D (6) = 28.630 ***	9,7 %	29,3 %
Betweenness Centrality	-.090 *	.039	1042.027, χ^2_D (6) = 22.422 **	7,2 %	20,7 %
Expressive Network Position					
In-degree Centrality	.125 **	.041	1038.582, χ^2_D (6) = 25.867 ***	8,9 %	26,8 %
Closeness Centrality	.102 *	.042	1041.715, χ^2_D (6) = 22.734 ***	7,7 %	22,9 %
Betweenness Centrality	-.015	.041	1047.049, χ^2_D (6) = 17.440 **	4,9 %	13,0 %

Notes: Null model for IC: χ^2_{Null} (3) = 1064.449

ICC $_{IC}$ = .238, $\chi2$ (1) = 85.212, p < .001

† p < .10, * p < .05, , ** p < .01, *** p < .001

All models include the following demographic control variables; *Teacher level*; administrative tasks (dummy), experience at school (dummy); *School level*; principal age, principal gender, principal experience at school (dummy).

practices. (β = .146, p < .001). Transformational leadership accounted for 11.0 % of the variance in teacher perceptions of Innovative Climate (IC) between schools, while 34.3 % of the variance in teacher perceptions of IC was explained at teacher level. As such, this finding offers support for Hypothesis 1.

The effect of the principal's position on innovative climate
Hypothesis 2 concerned the effect of principals' structural position on schools' innovative climate (see Table 6). Results indicate that principals' in-degree centrality was significantly predictive of schools' innovative climate (β = .098, p < .05). Meaning, the more a principal is sought for work related advice, the more teachers perceived their schools' climate to be open to innovation and supportive of change. This finding is even stronger in regard to the expressive relationships (β = .125, p < .01). The more the principal is regarded as a person from whom teachers seek personal guidance, the more the team is oriented towards the development of novel teaching strategies and implementation of innovations. This finding provides evidence in support of Hypothesis 2a.
The extent to which principals are closely connected to all teachers through work related advice, as indicated by high closeness centrality in the instrumental network, was also positively predictive of schools' innovative climate (β = .147, p < .001) . This finding holds as well for the expressive network, but to a lesser extent (β = .102, p < .05). In other words, the more the principal is embedded in the network as a central 'hub' of work related and personal advice, the more the team is willing to try new practices and take risks in improving the school. As such, this finding corroborates hypothesis 2b.

In line with our expectation, we found that schools' innovative climate was negatively impacted by principals' betweenness centrality in the instrumental network (β = -.090, p < .05). The more a principal occupied a 'brokerage' position in the work related advice network, thereby controlling the flow of information, the less a team was open to innovation and willing to collectively invent new teaching strategies and ideas. This finding could not be confirmed for the expressive network (β = -.015, n.s.). This result provides partial evidence for hypothesis 2c. Principals seem to play an important role in facilitating innovations in a school as they have potential to stimulate, but also to interrupt and inhibit development of new ideas and risk taking behavior by controlling the dissemination of work related advice.

The effect of transformational leadership on principals' structural position
Findings from the third set of hypotheses regarding the influence of principals' transformational leadership and principals' structural position are reported in

Table 7. Multiple regression analysis results of the prediction of principals' social network position by Transformational Leadership (TL) (N = 51) *(Path a)*

	Instrumental In-degree Centrality			Instrumental Closeness Centrality			Instrumental Betweenness Centrality		
	B	S.E.	β	B	S.E.	β	B	S.E.	β
(intercept)	-.276	.176		-.087	.187		-.021	.141	
Principal age	-.061	.021	-.328 **	-.018	.022	-.101	.016	.017	.146
Principal gender	.041	.021	.222 †	-.005	.023	.027	-.011	.017	-.106
Principal experience at the school (dummy)	.033	.021	.179 †	.056	.022	.320 *	.000	.016	-.002
Transformational Leadership	.205	.057	.417 ***	.222	.061	.476 ***	.034	.046	.118
R^2	.483			.358			.031		
Adjusted R²	.437			.301			.000		
F	10.519 ***			6.267 ***			.354		

	Expressive In-degree Centrality			Expressive Closeness Centrality			Expressive Betweenness Centrality		
(intercept)	-.273	.198		.259	.209		.025	.098	
Principal age	-.024	.024	-.132	-.035	.025	-.194	-.010	.012	-.128
Principal gender	.020	.024	.112	.025	.025	.136	.005	.012	.064
Principal experience at the school (dummy)	.031	.023	.172	.049	.024	.269 †	.010	.011	.136
Transformational Leadership	.193	.064	.410**	.119	.068	.248 †	.011	.032	.055
R^2	.289			.235			.045		
Adjusted R²	.226			.167			.000		
F	4.576 **			3.454 *			.527		

Notes: † p < .10, * p < .05, , ** p < .01, *** p < .001

Table 7. Since both variables are school level variables, we conducted multiple regression analysis (N = 51) to test our hypotheses. We found that transformational leadership had a positive predictive relationship with principals' popularity in the instrumental and the expressive network (respectively β = .417, p < .001 and β = .410, p < .01). The more a principal displays transformational leadership by disseminating the school's vision, considering teachers' individual needs and stimulating the professional development of teachers, the more s/he is sought out for work related and personal advice. This finding confirms Hypothesis 3a.

Principals' transformational leadership also has a positive predictive relationship with the extent to which they are close to all teachers in the network. The more teachers perceive their principal as a transformational leader, the closer the principal is to all teachers in the team with regard to work related advice. This result suggests that transformational leaders have an increased ability to reach all teachers with work related advice than principals who display less transformational leadership behavior. This finding was stronger for the instrumental network than for the expressive network (respectively β = .476, p < .001 and β = .248, p < .10), indicating the importance of transformational leadership particularly for the dissemination of knowledge and information through work related advice ties, thus partially supporting hypothesis 3b. Finally, we found that transformational leadership was unrelated to betweenness centrality in the instrumental and expressive network (respectively β = .118, n.s., and β = .055, n.s.) As such, hypothesis 3c was rejected.

Results from hypotheses 2 and 3 can also be illustrated graphically. In Figure 2 and 3 we provide two typical instrumental social networks of similar size sample schools (schools 39 and 19 respectively) that represent principals with high and low scores on perceived Transformational Leadership (TL) and Innovative Climate (IC) coupled with centrality scores. In these social network visualizations, teachers are represented by black circles, principals by white triangles (sized by in-degree), and relationships between actors indicated by arrowed lines representing the directional flow of work related advice. Teachers from school 39 (Figure 2) reported significantly higher levels of TL and IC in comparison to school 19 (Figure 3) (TL, *t*(34) = 2.02, p < .05; and IC, *t*(34) = 4.98, p < .001). In addition to significantly 'more' TL and IC for school 39 (Figure 2), the principal's position in this school was also characterized by higher in-degree and closeness centrality and lower betweenness centrality than the principal in school 19 (Figure 3).

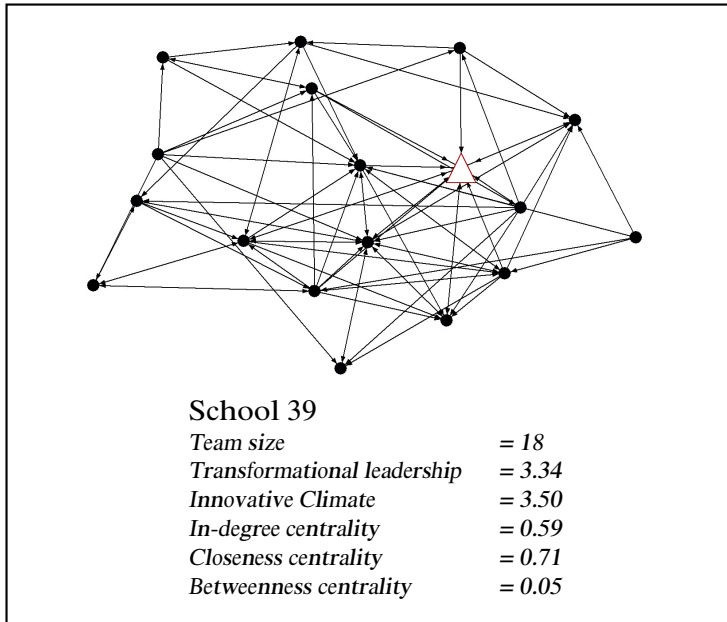Figure 2. Example of principal's position in a school's work related advice network: high innovative climate

School 39

Team size	*= 18*
Transformational leadership	*= 3.34*
Innovative Climate	*= 3.50*
In-degree centrality	*= 0.59*
Closeness centrality	*= 0.71*
Betweenness centrality	*= 0.05*

Figure 3. Example of principal's position in a school's work related advice network: low innovative climate

School 19

Team size	*= 18*
Transformational leadership	*= 3.12*
Innovative Climate	*= 2.84*
In-degree centrality	*= 0.47*
Closeness centrality	*= 0.61*
Betweenness centrality	*= 0.17*
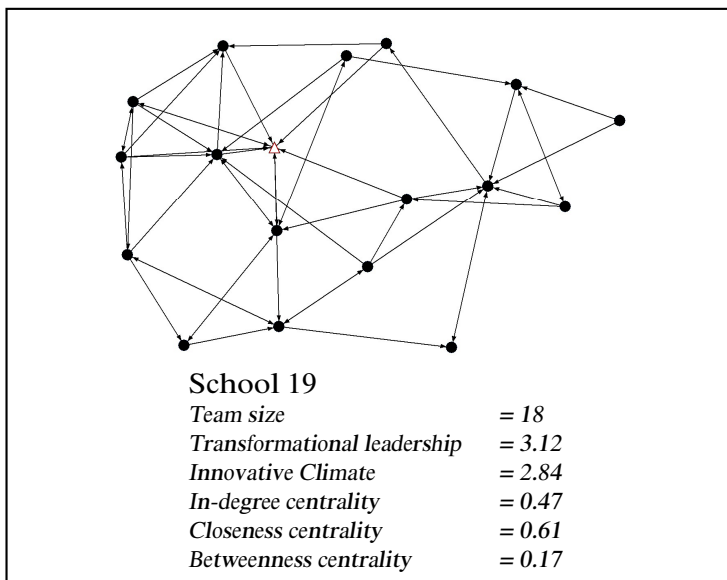
Mediating role of principals' structural position in predicting innovative climate by transformational leadership

Additional analyses were conducted to examine whether principals' structural position played a mediating role in the relationship between transformational leadership and innovation orientation (Hypothesis 4). To test for mediation, we followed a procedure suggested by Baron and Kenny (1986). Step 1 involved confirmation of a positive predictive relationship between transformational leadership and schools' innovative climate (path c in Figure 1, confirmed by Hypothesis 1).

The second step in testing mediation, required the confirmation of relationships between transformational leadership and principals' structural position (path a, partially confirmed by Hypotheses 3). Since transformational leadership was found to be unrelated to betweenness centrality in both networks, preconditions for mediation by betweenness centrality were not met. In addition, transformational leadership failed to significantly explain closeness centrality in the expressive network. Therefore, a test of mediation was limited to in-degree centrality in both networks, and closeness centrality in the expressive network as possible mediators.

In order to confirm mediation, it must be shown that the mediator is related to the dependent variable while 'fixing' the independent variable (Pearl, 2000). Therefore, we conducted three additional multilevel analyses in which transformational leadership was added to the prediction of IC by principals' structural position. This way, we examined whether transformational leadership accounted for any additional explained variance above the effect of principals' structural position on IC. Mediation by principals' structural position is evidenced when the direct effect of transformational leadership on IC in this model is either zero (full mediation), or decreases significantly in absolute size (partial mediation). Confirmation of mediation is then provided by a test of the significance of the indirect effect as examined by Sobel's test (1982). Results of this multilevel analysis are reported in Table 8.

Previous analyses (see Table 5) already indicated that transformational leadership (TL) had a significant predictive relationship with innovative climate (IC) ($\beta = .146$, $p < .001$). Including both TL and principals' in-degree centrality in the instrumental network in the regression equation did not reduce the direct effect of TL on IC significantly ($\beta = .134$, $p < .01$). A similar result was obtained for TL in combination with principals' in-degree centrality in the expressive network ($\beta = .116$, $p < .01$). Moreover, both effects of principals' structural position in the instrumental network were not significant when TL was

Table 8. Testing mediation: multilevel analysis results of the prediction of perceived Innovative Climate (IC) by principals' social network position and TL (N = 51, n = 702)

	β	S.E.		School variance	Teacher variance
Instrumental Network Position					
In-degree Centrality	.027	.048	1033.807	11,2 %	35,0 %
Transformational Leadership	.134 **	.043	χ^2_D (7) = 30.642 ***		
Closeness Centrality	.094 *	.040	1029.734	12,3 %	38,5 %
Transformational Leadership	.106 *	.041	χ^2_D (7) 34.715 ***		
Betweenness Centrality	-.092 **	.033	1026.853	13,4 %	42,5 %
Transformational Leadership	.149 ***	.036	χ^2_D (7) = 37.596 ***		
Expressive Network Position					
In-degree Centrality	.075 †	.041	1030.906	12,1 %	38,1 %
Transformational Leadership	.116 **	.040	χ^2_D (7) = 33.543 ***		
Closeness Centrality	.064	.040	1031.587	11,9 %	37,5 %
Transformational Leadership	.128 **	.039	χ^2_D (7) = 32.862 ***		
Betweenness Centrality	-.024	.036	1033.698	11,1 %	34,6 %
Transformational Leadership	.148 **	.038	χ^2_D (7) = 30.751 ***		

Notes: Null model for IC: χ^2_{Null} (3) = 1064.449

ICC $_{IC}$ = .238, χ2 (1) = 85.212, p < .001

† p < .10, * p < .05, , ** p < .01, *** p < .001

All models include the following demographic control variables; *Teacher level*; administrative tasks (dummy), experience at school (dummy); *School level*; principal age, principal gender, principal experience at school (dummy).

included in the equation. Sobel's test confirmed that both proposed mediator effects were non-significant (for instrumental in-degree centrality, Sobel test statistic = 0.56, n.s.; for expressive in-degree centrality, Sobel test statistic = 1.56, n.s.). The inclusion of TL and principals' closeness centrality in the instrumental network reduced the effect of TL on IC considerably (from β = .146, p < .001 to β = .106, p < .05) and rendered a significant effect of expressive closeness centrality on innovative climate (β = .094, p < .05). The mediating effect was found to be just significant as evidenced by Sobel's test (Sobel test statistic = 1.97, p <.05). As such, partial mediation could be confirmed in the case of instrumental closeness centrality, but has to be rejected for other forms of centrality. This finding suggests that the effect of transformational leadership on schools' innovative climate can be partially explained by increased closeness of the principal in the work related social network. Interestingly, above and beyond the positive effect of transformational leadership on schools' innovative climate, occupying a brokerage position (high betweenness centrality) negatively affected the extent to which teachers were willing to innovate and support school change.

CONCLUSIONS AND DISCUSSION

In this chapter we examined the effects of transformational leadership behavior and principals' network position on innovative climate in 51 Dutch elementary schools. Results indicate that the more a principal engaged in transformational leadership the more likely teachers were to take risks in developing and implementing new knowledge and practices. Also, transformational principals were more sought out for advice, and were significantly closer to teachers in their school than principals that showed less transformational leadership behavior. Moreover, the more connected and the closer a principal was to the teachers the more teachers perceived the schools' climate to be supportive of innovative practices and risk taking. Conversely, we also found that when principals were positioned 'in between' others in the network, thus having the potential to control the flow of work related knowledge and information, the less their schools' climates were perceived as oriented towards innovation. Although one of the earliest attempts to examine both leadership behavior and social position around innovative climate, our study offers several themes related to leadership practice and research.

The role of leadership behavior in fostering innovative climates

With increasing pressure and incentives to innovate, educational systems are seeking new ideas and practices to improve performance. This study contributes to previous literature by underlining that leadership behaviors matter for innovation by creating risk-tolerant environments. Our work suggests that by enacting transformational leadership behavior, principals foster a school climate that is more oriented towards innovation and provides opportunities to challenge the status quo. As such, leadership behavior is important for creating and nurturing a climate in which teachers are more likely to engage in risk taking and the development of novel solutions. Those leaders who are able to develop shared vision and goals; attend to the social needs of individuals; and provide intellectual stimulation are perceived to support the fertile ground for innovation to develop.

This finding, while maybe not overly surprising, is important for educational systems that are attempting to improve. While change efforts are more likely to succeed in innovation-supportive climates, the need for leadership behaviors that foster such climates is often overlooked. Most policy related to improvement is focused on technical elements of reform and therefore many change efforts in underperforming system focus on program fidelity, rigid curriculum, and prescriptive approaches (Daly, 2009; Mintrop & Trujillo, 2007). In response, many leaders in these systems also tend to become more focused on the technical elements of the reform and thus perhaps engage less in vision building and creating opportunities to enact novel solutions that may lead to the new approaches necessary to improve performance. Although our research did not examine these more transactional behaviors and their effect on creating an innovative climate, our work does suggest that principals, through transformational leadership, have the potential to foster such innovation-oriented climates that in turn may strengthen change efforts.

The role of leadership behavior in occupying the principal position

The results of the study suggests that principals who are recognized as transformational leaders occupy more central positions in their schools' social network. Teachers with transformational principal seek out their principal more often for work related and personal advice, thus enabling principals to exert control over the (new) knowledge that gets disseminated within teams. Through sharing and developing a school's vision, providing personalized attention, and intellectually stimulating organizational members, transformational leaders may have something to offer above and beyond non-transformational leaders, making them more actively sought as a source of

advice. It may also be possible that in addition to being sought for advice, transformational leaders themselves actively seek to obtain a more central position in their network, thus enabling them to provide more targeted individualized attention. Examining the agency of transformational principals in this regard may be an important future area of inquiry. Additionally, our results suggest that highly transformational principals are also, in terms of work related network position, closer to their teachers, meaning that they may reach their teachers more quickly with professional information and knowledge that may support efforts at innovation. A principal who is close to staff has the opportunity to share and develop the school's vision as well as provide timely access to the resources necessary in realizing that vision.

Combining leadership behavior and position for innovative climates

The combination of speed, ease, and consistency of resource flow (information, knowledge, etc.) throughout the network are important as sharing information, ideas, and opportunities to interact are critical for innovative climates (Moolenaar et al., in press; Mumford, et al., 2002). The significant contribution of this work is that, in addition to leadership behavior, the principal's network position plays an important role in stimulating or inhibiting the flow of resources within the work and personal advice networks and occupying such a position is associated with supporting or constraining an innovative climate. We will now discuss the facilitating and inhibiting roles of principals' network positions in support of innovative climates.

The facilitating role of closeness

Our work suggests that teachers who perceive their school's climate as innovative are often guided by leaders that both display transformational behavior *and* occupy a close position to these teachers. Hence, at least one of the mechanisms through which transformational leaders succeed in creating an innovative climate is by occupying a position 'close' to their teachers. The greater a principal's closeness centrality, the quicker and with more ease information that is provided by the principal will reach all team members. Moreover, this closeness also implies that the information that does flow from the principal will have less chance of being modified as it passes from person to person. Being close to their team members may thus be of strategic advantage for transformational leaders as increased connections with team members may enable them to maximize the skills and knowledge that reside within the network.

As the work of a transformational leader is often done 'through' others, a leader who has close access to others may be better positioned to leverage social resources in meeting organizational goals. By sharing a clear vision for the school's future and attending to teachers' needs for professional development and intellectual growth, transformational leaders also become more valuable as a 'hub' of advice. What is clear from this study is that both transformational leadership behavior *and* closeness centrality are important facilitators in fostering risk tolerant and climates supportive of innovation.

It appears that this risk taking behavior is also demonstrated in teachers' search for personal advice from transformational leaders. In addition to cultivating climates in which innovation can occur, it seems these transformational leaders also supported a psychologically safe environment for personal vulnerabilities to be shared. This openness in communication and the ability to take risks in a psychologically safe environment suggests the importance of trust in these interactions (Tschannen-Moran, 2009; Daly & Chrispeels, 2008; Moolenaar, Karsten, Sleegers, & Zijlstra, 2009). This suggests the importance of individual consideration by transformational leaders as one of the elements in fostering innovation-oriented and change-supportive school climates.

The inhibiting role of betweenness

An important finding of this study is that even if a principal is enacting transformational leadership, which is associated with increased perception of innovative climate, occupying a go-between position in a network will inhibit the extent to which teachers are willing to innovate. In some cases, occupying a brokerage position may offer the potential for leaders to connect otherwise disconnected individuals or groups within a network. However, the networks in our sample were relatively small (network size between 6 and 31), thus increasing the chance of teachers interacting. As such, the small teams decreased the possibility for principals to be 'in between' teachers that are themselves unconnected. Therefore, in our sample, principals rarely occupied moderate to extreme brokerage roles and as such suggests an area of further examination.

Previous research has suggested that leaders who occupy a brokerage position may reduce the opportunities for combining people, knowledge, and resources interacting throughout the network, thus constraining the generation of new ideas and practices (Hargadon, 2003; Obstfeld, 2005). As such, principals that occupied an 'in between' position in the sample schools may inhibit the social learning process that underlies the development of innovation (Paavola et

al., 2004), which may have resulted in a reduction in teachers' perceptions of opportunities for, and openness to, innovation and change. In this sense, the position of a principal in a network has as much influence on the fertile grounds for innovation as leadership behavior. The important message from this work is the enactment and benefits of transformational leadership behaviors can be enhanced or diminished based on principal position in the social network.

Delimiters and directions for future research

Our study is at the forefront of research into the interplay of leadership behavior and leadership position. As an early study into this emerging area, there are several limitations to our work. First off, our work suggests interrelations between behavior and network position, but does not imply directionality or chronology. While it is plausible that transformational leadership behavior 'makes' principals more sought as a resource, and these leaders may themselves seek a more central position, which in turn shapes teachers' orientation towards innovation, the opposite may also hold. For instance, in schools with an urgent need for innovation, teachers may be more oriented towards change. As a consequence, teachers may seek more advice from principals, which in turn may increase principals' behavior in terms of setting goals, giving individualized attention, and offering intellectual stimulation.

Another limitation to the study concerns the generalizability of findings. Although we have adequate sample size for the analysis, our results only reflect the Dutch context and therefore caution is warranted in generalizing the findings to other settings. In addition, while we have attempted to control for a variety of demographic features of principals and teachers, there may be various other variables in play that may partially explain our findings. For instance, it may be interesting to study other principal leadership behavior in relation to principals' position, as well as how leadership may be shared throughout an organization. We foresee a valuable link to another emerging field in leadership, namely distributed leadership. A distributive perspective on leadership focuses on leadership activities that emerge from the interaction of "all individuals who contribute to leadership practice, whether or not they are formally designated or defined as leaders" (Harris & Spillane, 2008, p. 31). Leadership from this perspective is therefore concerned with both the leadership behavior and the social context in which organizational members interact in support of organizational goals. From this perspective, teachers' leadership actions may also be studied for their relation to network position and effect on the implementation of innovations and reform.

Finally, this study only included teachers' perceptions of the climate around innovation, not the actual innovations themselves. While we strongly subscribe the need for a fertile climate as perhaps even a pre-condition for successful change, we acknowledge that the study of conditions for successful change need to be supported by insights in the success of actual innovations. The limitations of this early work also offer great potential for future research. Additional samples from a variety of international perspectives would add to our understanding and perhaps provide opportunity for comparisons across contexts. Moreover, longitudinal studies that examine networks over time may broaden our knowledge of network dynamics in school teams and changes in principals' network positions, related to for instance the multi-phased implementation of reform. In addition, creating matched sets of schools in regard to teacher population would provide for more control in the study and thus more comparable results. We view future research as best done through a combination of both quantitative and qualitative methods, as the network methods provide a snapshot of the structure, while the quality and nuanced exchanges that can be captured through more qualitative means.

With regard to leadership education and practice, our results suggest that leaders would be advised to not only focus on developing vision, considering individuals, and supporting intellectual stimulation, but to also be aware of the importance of location in a social network, as that position can either enhance or detract from leadership efforts. This research suggests the importance of combining the fields of leadership with network theory in creating a robust picture of future educational leadership.

Occupying the Principal Position

The work of the contemporary principal in any setting is complex, fraught with decisions, and replete with pressures for performance. In the Dutch context as well as in the US there is increasing pressure to 'innovate'. What is less clear is what comprises an 'innovation' as one systems' novel idea may be another's' common practice. Therefore, we have focused our attention on innovation-supportive climates as the fertile ground for innovations to flourish. Our work suggests that the well studied area of transformational leadership holds promise in supporting innovative climates. However, the behaviors themselves can either be enhanced or diminished based on the social position the leader occupies. This combination of purposeful action and position in the social milieu we believe holds promise for leaders enacting change and supporting innovation in 21st century educational settings.

PART III

Consequences
of social networks
in school teams

CHAPTER 5

Linking Social Networks and Trust:
A Social Capital Perspective on
Professional Learning Communities [1]

ABSTRACT

Background. The study of schools as professional communities has recently gained popularity among policy makers and educational researchers around the world. Yet, large-scale studies on teachers' professional relationships that shape professional communities are scarce. Moreover, while literature associates strong social networks with trust, the relationship between social networks in school teams and teacher trust has received limited scholarly attention.

Purpose. This chapter adopts a social capital perspective to investigate teachers' professional relationships in Dutch elementary schools and its influence on teacher trust as elements that characterize professional communities.

Method. Data were collected from 751 teachers and principals from 49 Dutch elementary schools using a survey with a social network question on work related discussions and a Likert-type scale to assess teacher trust. We analyzed the data using social network analysis and multilevel (HLM) analysis.

Conclusions. Results show that the pattern of social relationships in the school team as a whole is as important to teacher trust as individual relationships. Interestingly, teacher teams that show great reliance on one-to-one reciprocal relationships are characterized by lower trust in comparison to teams with fewer reciprocal relationships. This implies that certain social network configurations may be unfavorable for the development of professional learning communities.

INTRODUCTION

Fostering the professional development of teachers in schools seems to be a key challenge for governments, school districts and principals to improve the quality of education. Since teachers' professional development mostly takes place within schools, researchers have started to examine teacher learning in its social context, using a professional learning community perspective (Hord, 1997; Mitchell & Sackney, 2000; Sleegers, Bolhuis, & Geijsel, 2005; Stoll et al., 2006; Toole & Louis, 2002). Professional learning communities are generally conceptualized as communities of educators that are characterized by elements such as a focus on student learning, shared values and vision, collaboration, trust and collective learning (Louis & Marks, 1998; Louis, Marks, & Kruse, 1996; McLaughlin & Talbert, 1993, 2006; Mitchell & Sackney, 2000; Sackney, Walker, Mitchell & Duncan, 2005; Stoll et al., 2006; Toole & Louis, 2002).

There are indications that schools with strong professional communities indeed promote teachers' professional development, produce increased student learning, and manage educational change more easily than schools lacking these elements (Lee & Smith, 1996; Louis & Marks, 1998; Newmann, King, & Youngs, 2000; Vescio, Ross, & Adams, 2008; Wiley, 2001). Although research on professional communities underlines the relevance of teachers' social interactions to support teachers' professional development and instructional change, scholars have long overlooked what lies at the fundament of professional communities; teachers' social networks in schools (Coburn & Russell, 2008; Smylie & Hart, 1999). As a consequence, we know little about the social fabric that signifies the 'community' of a professional learning community. This weak conceptual elaboration of one of the key concepts underlying professional learning communities is considered as a main problem that demands attention in future research (Westheimer, 1999; Toole & Louis, 2002).

Recently, researchers have suggested using social capital theory to elaborate on teachers social interactions by examining teachers' social networks and trust (Coburn & Russell, 2008; Daly & Finnigan, 2009; Penuel, Riel, Krause, & Frank, 2009). Social capital theory conceptualizes how social relationships enable individuals to have access to, and make use of, the resources that reside in their social networks. Social capital theory is seen as a promising theory to increase our understanding of the crucial role of social networks among teachers for a number of valuable elements related to professional communities, including transfer of knowledge, joint problem solving, collective orientation

towards innovation, and reform implementation (Coburn & Russell, 2008; Daly & Finnigan, 2009; Penuel, Frank, & Krause, 2007b).

Two major concepts that represent social resources in social capital theory are social networks and trust. While previous research suggested that teachers' professional relationships foster a climate of trust and a 'safe' environment to engage in innovative behavior and risk-taking in reform efforts (Bryk & Schneider, 2002; Louis, Marks, & Kruse, 1996; Moolenaar, Daly, & Sleegers, 2009; Penuel, Fishman, Yamaguchi, & Gallagher, 2007a), empirical evidence on the interrelatedness of the two major constituents of social capital in school organizations, social networks and trust, is missing.

This chapter examines the extent to which the structure of teachers' social networks underlying professional communities affects teacher trust in elementary schools in the Netherlands. We will present social capital theory as a useful theoretical foundation to describe the way in which professional communities take shape in social interactions that can foster trust among teachers, setting the stage for beneficial school and student level outcomes that are associated with strong professional communities in schools. Then, using data from 751 teachers and principals from 49 Dutch schools, we will conduct a multilevel test of the influence of individual and school level social network configurations on teacher trust. By doing so, we provide a unique contribution to the empirical validation of the sociological concept of social capital in the context of education. Finally, we offer a discussion of the findings and limitations of the study, together with implications for practice in order to maximize the potential of professional learning communities and social capital for the field of education.

THEORETICAL FRAMEWORK

Professional learning communities from a social capital perspective

To better understand how the pattern of social interactions among teachers may shape the valuable outcomes associated with strong professional communities, we draw on the concept of social capital. The leading notion behind social capital theory is that individuals are situated in networks of social relationships that provide access to resources residing in these social networks (Bourdieu, 1986; Putnam, 1995). The popularity of social capital is reflected in the myriad of definitions used to describe the concept. As defined by its principal theorists (Coleman, 1990; Putnam, 1993a, 1993b), social capital refers to 'the sum of the actual and potential resources embedded within, available through, and

derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network' (Bourdieu, 1986; Burt, 1992; Lin,, 1999; in Nahapiet & Ghoshal, 1998, p. 243).

Until now, social capital theory has mainly gained interest among educational researchers with regard to students, for instance, to explain the impact of family or peer social capital on educational outcomes, such as student attainment and achievement (Goddard, 2003a; Horvat, Weininger, & Lareau, 2003; Lareau & Horvat, 1999; Morgan & Sorensen, 1999; Ream & Rumberger, 2008; Stanton-Salazar & Dornbusch, 1995; see Dika & Singh, 2002 for a review of educational research on social capital). However, organizational literature points to the value of social capital in organizational contexts (Leana & Van Buren, 1999; Nahapiet & Ghoshal, 1998). These studies argue that social capital contributes to organizational goals by facilitating the flow of information between individuals and overcoming problems of coordination (Adler & Kwon, 2002; Lazega & Pattison, 2001; Lin, 2001; Tsai & Ghoshal, 1998; Walker, Kogut, & Shah, 1997).

With many debates on the dimensions of social capital still ongoing (Dika & Singh, 2002; Halpern, 2005; Portes, 1998), two components can be found throughout most social capital literature (e.g., Bourdieu, 1986; Coleman, 1990; Halpern, 2005). The first component of social capital addresses the pattern of social relationships, and is referred to as the *structural dimension* (Nahapiet & Ghoshal, 1998). The pattern of social relationships can be visualized as a social network that provides individuals with the opportunities to obtain resources through the formation of ties or links between people. The use of social networks to study collaboration among teachers is growing rapidly (Coburn & Russell, 2008; Daly & Finnigan, 2009; Moolenaar, Daly & Sleegers, 2009; Penuel, Frank, & Krause, 2007b; Penuel, Riel, Krause, & Frank, 2009; Spillane, 2005). These studies suggest that strong teacher networks benefit the dissemination of information on school-wide reform efforts, an open orientation towards innovation and overall school functioning, as well as counteract negative phenomena such as absenteeism and low job satisfaction due to teacher isolation (Bakkenes, De Brabander & Imants, 1999; Imants, 2002).

A second component of social capital, the *relational dimension*, addresses the quality of the relationships in social networks. This quality is often described in terms of the norms, values, and expectancies that are shared by group members (Bourdieu, 1986; Halpern, 2005; Portes, 1998). In social capital literature, trust among organizational members is identified as the most important affective norm characterizing a community (Nahapiet & Ghoshal,

1998). Trust can be defined as an individual's or group's willingness to be vulnerable to another party based on the confidence that the latter party is benevolent, reliable, competent, honest and open (Cummings & Bromiley, 1996; Hoy & Tschannen-Moran, 2003). Trust is a central element in the debate about professional learning communities as it is believed to be the critical ingredient of all human learning (Rotter, 1967). Moreover, trust is important for the development of open school cultures, increasing the quality of schooling, and student achievement (Goddard, Tschannen-Moran & Hoy, 2001; Hoy, 2002; Hoy & Sabo, 1998; Tschannen-Moran, 2004). Trust, according to Bryk and Schneider (2002), allows teachers to be vulnerable and open to new learning experiences that are central to ongoing teacher development in schools. As a consequence, improving the quality of education and student learning becomes both an individual and collective enterprise, which motivates teachers to engage in instructional change and willing to take more risk. Research has indeed shown that trust has positive effects on teacher professionalism (Tschannen-Moran, 2009; Tschannen-Moran & Hoy, 1998) and teachers' motivation (Smylie, 1999).

Social networks and trust are important elements in social capital theory (Nahapiet & Ghoshal, 1998; Fukuyama, 1995; Putnam, 1993a) and literature on professional learning communities (Bryk & Schneider, 2002; Bryk, Camburn, & Louis, 1999; Coburn & Russell, 2008). However, only few studies have addressed the relationship between social networks and trust. Therefore, the research question guiding this study is: To what extent are the individual and school characteristics of teachers' networks predictive of teacher trust? In the next section, we will explore the link between social network characteristics and trust among teachers in the context of professional communities, which can benefit teacher professional development and, in turn, promote student achievement.

Linking social networks and trust

In literature on professional communities and social capital, trust and social interaction often go hand in hand as interrelated elements. Trust is based on interpersonal interdependence (Rousseau, Sitkin, Burt, & Camerer, 1998) and embedded in relationships (Hoy & Tschannen-Moran, 2003), and often associated with cooperation (Deutsch, 1958; Tschannen-Moran, 2001; Hoy & Tschannen-Moran, 2003) and group cohesiveness (Zand, 1972, 1997). Several scholars argue that trust, as a key element of professional communities, is prompted by a social context that creates vulnerability and the need for individuals to rely on each other to achieve individual or common goals (Bryk

& Schneider, 2002; Hoy & Tschannen-Moran, 2003). Trust is suggested to contribute to the efficiency of collective action because it allows collaboration to occur in the absence of sanctions and rewards (Onyx & Bullen, 2000; Deutsch, 1958; Tschannen-Moran, 2001). Positive experiences from prior social interactions may foster trust by reducing uncertainty about the engagement and involvement of the other party and decreases vulnerability between individuals (Larson, 1992; Uzzi, 1997). As such, social interactions among teachers in professional communities may shape the context in which trust can flourish by providing a blueprint for future interactions, shaping expectations and conveying information about the norms and values of social interaction within the community. While the relationship between social interaction and trust seems commonsensical, the interrelatedness of patterns of social interaction and levels of trust in teams has, to our knowledge, not yet been the subject of extensive study.

In this study, we investigate whether the social network configuration of individuals is predictive of their trust in their colleagues within the school team. Moreover, we examine whether schools with high levels of social interaction are also characterized by higher levels of trust than schools with low levels of social interaction, as indicated by the schools' social network configurations. We acknowledge that causality may be an issue of debate. A circular relationship between social interactions and trust may also be defendable, in which interactions provide opportunities for trust to develop, be nurtured, or terminated, but in which trust in turn also shapes the conditions for interactions to occur (Coburn & Russell, 2008). However, in this first large-scale exploration on the relationship between social network characteristics and teacher trust, we argue that social interactions, as an inevitable precondition for the formation of professional learning communities, precede the formation of trust by providing opportunities for trust to develop, nurture, grow, and decline.

Recently, scholars have started to voice the importance of studying social capital at multiple levels of analysis, for instance the individual teacher and the school level (Halpern, 2005; Ibarra, Kilduff, & Tsai, 2005). Multilevel research is imperative since studies have suggested that the size and direction of a relationship between variables at individual level may vary from the size and direction of the relationship between the variables at the school level (Chen & Bliese, 2002). In reality, the configurations of teacher interactions at the individual level (e.g., individual activity in the maintenance of social relationships) may have a considerable different meaning than the configurations of teacher interactions at the team level (e.g., the density of social relationships in a team). Therefore, we may expect that the effect of having

multiple professional relationships is different for teachers and for schools. Considered at the school level, professional communities may benefit from a dense social network structure in which all teachers are tightly connected to one another. However, having to maintain a high number of relationships may be less beneficial to individual teachers because of the constraints that multiple relationships can pose with regard to time, attention span, and possibly conflicting interests between various connections. Therefore, it is crucial that studies on professional learning communities adopt a multilevel framework to assess relationships at multiple levels of analysis. Research on professional learning communities, too, can be criticized for a lack of attention for the multiple level character of studying individuals in teams (Smylie & Hart, 1999; Coburn & Russell, 2008; Geijsel, Sleegers, Stoel, Krüger, 2009). Therefore, this study addresses the patterns of teachers' social interactions in professional school communities and its capacity to foster trust among teachers at multiple levels of analysis.

In social network analysis, two approaches can be discerned that are related to the level of analysis. The 'egocentric network approach' employs a micro-level perspective by focusing on the patterns of relationships of individuals. The social relationships of an individual ('ego') are examined by, for instance, the amount of ego's incoming and outgoing relationships, and the extent to which these relationships are mutual (also called 'reciprocal'). Reciprocal relationships are often indicated to be stronger relationships that reflect mutual interest, shared experiences, and risk-taking in the relationship. The idea behind an egocentric approach is that an individual's position in a social network can push or inhibit certain behaviors and/or attitudes, for example, a relationship between students' peer relationships and achievement (Lubbers, Van der Werf, Kuyper, & Offringa, 2006), a teacher's isolated position and his/her job satisfaction (Bakkenes, De Brabander & Imants, 1999) or the position of a teacher in a social network and teachers' attitude to innovation (Cole & Weinbaum, 2007).

The 'whole network approach' examines the social network of a collective, group, organization, or community as a whole (Wasserman & Faust, 1997). Whole social networks encompass a finite number of individuals and relationships between these individuals within a bounded community of people (e.g., a class, a school team, or a district office) . Studies using this approach argue that collective level characteristics of a social network as a whole (e.g., overall density and reciprocity) are related to individual and collective variables, such as individuals' behavior and attitudes and organizational outcomes. Putnam's rationale, that the presence of stable social

networks in a community facilitates coordination and communication, and thus allows dilemmas of collective action to be resolved, is an example of a collective-level approach to social networks and social capital (Putnam, 1993a).

Since multilevel social network studies are scarce, we pose similar expectations at multiple levels of analysis for the relationships under study, based on the limited evidence available. Earlier work on social interactions in teams (Coburn & Russell, 2008; Hodson, 2005) suggests that having more relationships is beneficial to positive experiences and teacher trust. We therefore assume that teachers who maintain more relationships, as well as experience more mutual relationships, will foster higher levels of trust in their colleagues.

As collaborative experiences and the exchange of knowledge and ideas are at the core of professional learning communities, adopting a social capital framework to study the way teachers are situated in the social contexts of their school community can provide valuable insights in the social fabric that signifies the 'community' of schools as professional learning communities. Moreover, by focusing on trust, social capital attends to shared norms among community members that may foster or inhibit the development and valuable outcomes of strong professional communities. As mentioned earlier, professional community literature lacks studies conducted at multiple levels of analysis. We believe that insights in the relationships between teachers' social networks and teacher trust at multiple levels of analysis will contribute to a more nuanced perspective on the individual and school-wide fundaments of professional communities. In the next section, we will describe a large-scale empirical study among teachers and principals of 49 Dutch elementary schools, designed to address our research question.

METHOD

Context

Similar to the United States, educational policies in the Netherlands are introducing the concept of professional learning communities within schools as a way to incorporate life-long learning and professional development, with the ultimate goal to improve teacher practice and, in turn, student achievement. We conducted a survey study at 49 elementary schools in the south of the Netherlands, representing 751 educators. The schools resided under a single school board in the Avvansa School District[1], which coordinated collective

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[1] All names are pseudonyms

resources such as financial, IT and personnel support. The sample schools were selected as the school board had initiated a district-wide ongoing school and teacher monitoring process around school improvement.

Sample

In total, 751 educators (principals and teachers) participated in the study by filling in a questionnaire, reflecting a response rate of 93.8 %. Of the respondents, 72.5 % was female, 46.8 % worked full-time (32 hours or more) and 51.0 % was 50 years or older. All respondents had been working at the school for at least 6 months, and the school teams were functioning in the same team composition for at least 6 months. Additional sample demographics are presented in Table 1.

Instruments

Social networks. In order to study the social network characteristics among educators in professional school communities, we used social network analysis. Social network analysis provides researchers with an approach to systematically map patterns of interpersonal interaction in order to understand how individual action is situated in structural configurations (Valente, 1995). Insights in organizational social networks can help to 'explain how organizational knowledge is accumulated and applied' (Kilduff & Tsai, 2003, p.

Table 1. School demographics (N = 49, n = 751)

	M	Sd	Min.	Max.
Socio-economic status (SES)[1]	8.2	10.1	0.4	47.3
Number of students	226	117	61	545
Average age	45.9	10.6	21	63
Average FTE [2]	0.54	0.49	0.23	1
Team size	18.1	6.7	7	31
Gender ratio [3]	72.4	9.6	50.0	90.9

[1] SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

[2] FTE represents the percentage of working hours. For example, a teacher with 0.40 fte is employed at the school for (a total of) two days per week.

[3] Gender ratio is calculated as the ratio of female to male team members with 100 % referring to a team with only female team members

63) and may therefore be useful in the study of schools as professional communities. To map social interactions that would contribute to building organizational knowledge and professional communities, we examined the social network of work communication within schools. We asked the respondents to answer to the question 'Whom do you turn to in order to discuss your work?'. Respondents were asked to name the people in their school team whom they turn to in order to discuss their work (e.g. Flap & Völker, 2001). A school specific appendix was added to each questionnaire, in which the names of all school team members were represented by a letter combination (e.g., Mr. Eric McEwen[1] = AB). Respondents could indicate a relationship by answering the letter combination of the intended colleague(s), and they could name as many colleagues as they wanted (free choice).

Trust. We measured trust by a Dutch translation of the 'trust in colleagues' scale of Hoy and Tschannen-Moran (2003). The items were scored on a four point scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). The scale for trust was composed of five items, for instance 'I trust my colleagues' (α = .87). Scale scores were composed using the mean score of all trust items. When an individual missed more than one item from the scale, the trust scale score was not computed and considered missing. Principal component analysis confirmed that the five items loaded highly on a single factor that explained 65.6 % of the variance. The items and factor loadings are presented in Table 2.

Table 2. Items and factor loadings of the Trust Scale (N = 751)

	Factor loading
Trust (α = .87)	
1. I trust my coworkers	.66
2. Even in difficult situations, I can depend on my coworkers	.71
3. I find that my coworkers are open to me	.72
4. I share personal information with my coworkers	.52
5. I find that my coworkers are honest to me	.68

[1] All names are pseudonyms

   Demographic variables. The survey for teachers and principals also included questions on background demographics, such as age, gender, and number of working hours (fte). Information on team size, number of students served, and socio-economic status (SES) was collected from the district main office. Additional school level demographics were calculated by aggregating individual level demographics, such as average age, gender ratio (percentage of female educators in the team), and average number of working hours (fte). All demographic variables were standardized to facilitate interpretation of the multilevel models.

Data analysis

Social networks. Social network analysis is a technique to systematically examine patterns of relationships in order to understand how individual action is situated in structural configurations (Valente, 1995). We calculated several social network measures at both the individual and collective (whole network) level (cf. Borgatti, Jones & Everett, 1998; Burt, 1983b). As indicators of an individual's social network, we included in-degree, out-degree, and ego-network reciprocity. Indicators of the schools' social networks were density, reciprocity, and centralization. All social network characteristics were calculated and analyzed by means of UCINET 6.0 (Borgatti, Everett, & Freeman, 2002). Moreover, all predictors were standardized to facilitate interpretation of the multilevel models. We will now describe these network characteristics in detail.

   Individual level social network measures. We included three characteristics of the social network of individuals. Both in- and out-degree provide information on the relationships of an individual. *Out-degree* refers to the number of people chosen by the respondent. In other words, a respondent will have a high out-degree, if s/he indicates to turn to many (different) colleagues in the school team to discuss work. As such, out-degree can be interpreted as an indicator of relational activity. *In-degree* refers to the number of people by whom the respondent is chosen. A respondent will have a high in-degree, if s/he is chosen by many (different) colleagues as a person with whom they discuss work. In-degree can therefore be interpreted as an indication of an individual's popularity, or influence over a network (a higher in-degree means being chosen by many team members). Both measures were divided by the team size of the individual's school (normalization) in order to facilitate comparisons between schools. The social network characteristic of reciprocity mirrors the two-way nature of the relationships in the network. A relationship between two people is reciprocal when both respondents indicated to have a relationship with the each other. We calculated ego-network reciprocity *(ego-reciprocity)* as each

individual's proportion of reciprocal ties to the total amount of ties in which the individual is involved. Ego-reciprocity thus reflects the extent to which the network surrounding an individual (ego-network) consists of reciprocal relationships.

School level social network measures. At the school level, we included three indicators that provided information on the patterns of social relationships within the school teams. For each of the schools' social networks as a whole, we calculated *density* as the proportion of existing relationships to the maximum number of relationships possible in the network. The value of density varies between 0 (no relations in the network) and 1 (all actors are connected to each other). Density can be used to indicate group cohesion (Blau, 1977; Wasserman & Faust, 1997). *Reciprocity* was calculated as the ratio of the number of observed reciprocated relationships to the total number of relationships in the team (see Zeggelink, 1993). A network with a high centralization depicts a large difference between one or a few highly central person(s) and other (more peripheral) people in the network (Wasserman & Faust, 1997). *Centralization* represents the variability in the in-degree scores of the individuals in a network. The value of in-degree centralization will reach the maximum of 1 if a single respondent occupies a very central position in the network (is chosen by others as a valuable person to discuss work with) and other actors are not central at all, whereas the lowest value of 0 indicates that all actors in the network have the same in-degree. In other words, a team with high in-degree centralization is typified by only one or a few central (popular) persons, who are frequently selected by other team members, and more peripheral team members.

Analysis strategy

First, we will provide a description of social network characteristics of work-related discussions among educators as the 'social fabric' within schools. Second, in order to account for the nested structure of our data (teachers in schools), we applied multilevel analysis (HLM) to examine our research question. Several multilevel models were analyzed. We started with a random intercept model (the baseline model) to decompose the variance of the dependent variable 'teacher trust' into an individual level component and a school level component. After including significant individual level demographic variables, we added the individual level predictors to the model to account for the influence of individual level social network characteristics on trust (Model 1). Next, after adding school level demographics to the equation (Model 2), we tested whether school level social network characteristics added to the prediction of trust in school teams (Model 3). As such, these hierarchical

multilevel models tested whether the schools' social network as a whole contributed to the prediction of trust above the social network characteristics of individual educators and individual and school level demographics. This way, we were able to test whether between-school relationships differed from within-school relationships between social network characteristics and trust.[1]

RESULTS

Describing individual and school-level social networks
On average, an individual in a sample school indicated to discuss work-related matters with roughly a third of their colleagues (average out- and in-degree is 34.6 %). In general, about a third of all relationships in which an individual is involved, is reciprocated. These numbers are reproduced at the school level, where we can notice an average density of 32.0 %. This means that of all possible relationships that could exist in a school team around work-related discussions, almost a third of these relationships is actually confirmed to exist by the respondents. Of all existing relationships, 36.5 % were mutual relationships in which individuals turn to each other to discuss their work. The sample school teams were on average rather decentralized, which means that mostly, discussion relationships are dispersed among many team members with few educators being more popular as discussion partners than others. Table 3 contains the social network characteristics at both the individual and school level.

Correlation analyses
Our research question focused on the relationships between individual and school level social network characteristics on trust. Correlations are presented in Table 4 (individual level relationships) and Table 5 (school-level relationships).

At the individual level, the correlations between trust and social network characteristics were found to be statistically significant and in the expected direction. Moreover, the social network characteristics correlated moderately with each other, reflecting the interdependence of the network data; per definition, the denser a social network gets, the higher the mere chance that relationships will be reciprocal. At the school level, correlation analyses did not show significant relationships between patterns of social relationships and trust

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[1] In addition, random slopes were tested, as well as school-level univariate regression models to test the impact of the schools' social network structure on trust (n = 49). None of these tests provided additional insights and are therefore not reported here.

Table 3. Descriptives of social network characteristics and trust at the school
(N = 49) and individual level (n = 751)

	N	M	Sd	Min	Max
Individual level social network characteristics					
Out-degree	749	.35	.24	.00	1.00
In-degree	749	.35	.21	.00	1.00
Ego-reciprocity	746	.37	.23	.00	1.00
School level social network characteristics					
Team density	49	.35	.09	.15	.52
Team reciprocity	49	.38	.09	.17	.57
In-centralization	49	.34	.11	.14	.64
Trust	737	3.22	.56	1.00	4.00

Table 4. Correlations between individual level social
network characteristics and trust (N = 732)

	1	2	3	4
Out-degree	1.00	.35**	.40**	.23**
In-degree		1.00	.42**	.13**
Ego-reciprocity			1.00	.12**
Trust				1.00

Note: ** $p < .01$

Table 5. Correlations between school level social
network characteristics and aggregated trust (N = 49)

	1	2	3	4
Density	1.00	.43**	.10	.17
Reciprocity		1.00	.10	-.27
Centralization			1.00	.01
Trust				1.00

Note: ** $p < .01$

among school team members. Moreover, density and reciprocity were moderately correlated, again reflecting the interdependence of the social network data. Both density and reciprocity were unrelated to centralization in the sample schools. Next, we will consider the multilevel analyses conducted to provide additional insight in the effect of individual and school level social networks on trust in professional communities.

Multilevel analyses

The first multilevel model, the baseline model, showed that a statistically significant amount of variance in individual trust scores can be attributed to the school level. The intraclass correlation coefficient for trust was .134 (p < .001), thus indicating the need to use multilevel analysis techniques to examine the relationship between social network characteristics and trust. In other words, 13.4 % of the variability in individual trust of school team members in their colleagues occurs between schools, and the remaining 86.6 % of the variance occurs within schools at the individual level. Results for the multilevel models are depicted in Table 6.

The importance of work related discussion for teacher trust at multiple levels

To address our research question, we first consider the effect of individual level demographics on trust. As demographics, we included educators' age, gender, number of working hours (fte), tenure, years of experience in education, years of experience in their current school, and whether they fulfilled additional administrative tasks in support of the principal. All individual level demographics were found to be unrelated to trust and were thus excluded from further analyses.

In Model 1, we examined the effect of individual level social network characteristics on teachers' trust in their colleagues. Results indicated that the number of people with whom an individual discusses work had a positive predictive relationship with the individual's trust in his colleagues. A teacher who displayed high relational activity by indicating to have work-related discussions with many colleagues (high out-degree), showed greater trust in these colleagues than teachers with lower out-degree. Moreover, the more a teacher was chosen, or the more popular a teacher was as a colleague to discuss work with (high in-degree), the more trusting he reported to be of his colleagues. Surprisingly, the amount of reciprocal relationships in which an individual was involved did not affect the individual's trust. The individual level model added significantly to the random intercept model (χ^2_D (3) = 57.55, p < .001).

Table 6. Multilevel regression analyses of the effect of individual level and school level social network characteristics on trust (N = 49, n = 732)

	Baseline model		Model 1		Model 2		Model 3	
	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Intercept	3.21	.03	3.18	.04	3.22	.03	3.22	.03
Individual level								
In-Degree			.05 *	.02	.07 *	.02	.05 *	.02
Out-Degree			.13 *	.02	.15 *	.02	.14 *	.02
Ego-Reciprocity			.03	.02	.02	.02	.03	.02
School level								
Team size					.13 *	.03	.17 *	.05
Team density							.11 *	.05
Team reciprocity							-.08 *	.03
Centralization							-.01	.03
-2*log likelihood	1166.06		1108.51		1096.92		1089.03	
			χ^2 DIFF. (3) = 57.55, p < .001		χ^2 DIFF. (4) = 69.14, p < .001		χ^2 DIFF. (7) = 77.03, p < .001	
Explained (total)								
School	(13.4 %)		5.0 %		9.7 %		11.7 %	
Individual	(86.6 %)		0.0 %		17.7 %		27.7 %	

Note: * p < .05

Next, we added school-level demographics to the multilevel equation. We included average age, gender ratio, average tenure, team size, average years of experience in education, average years of experience in the current school, and average percentage of additional administrative tasks in support of the principal. Of these demographic variables, only team size showed a statistically significant positive relationship with teachers' trust in their colleagues. The larger the school team, the more trust individuals reported in relation to their colleagues. Apparently, smaller school teams are characterized by lower trust than larger teams. Therefore, only team size was included in Model 2 as a school-level demographic covariate. The addition of team-size added significantly to the prediction of trust (χ^2_D (1) = 11.59, p < .001).

Finally, Model 3 included the school level social network characteristics. With this model, we tested whether the social configurations of the schools' social networks had any additional affect on trust among teachers above the effect of individuals' own social network characteristics. The addition of school level social network predictors added significantly to the prediction of trust (χ^2_D (3) = 7.89, p < .05), indicating that school social network characteristics contributed to the prediction of teacher trust on top of the prediction by the pattern of relationships that an individual maintained. Results suggest that the density of the social configurations in a team is a strong indicator of trust among school team members, above and beyond the relational activity of individuals (the number of out- and ingoing relationships). That is, the more densely connected a school team was, the more trusting the individual school team members were of each other. Density of a team is thus at least as important for fostering trust in schools as the maintenance of individual relationships. Interestingly, while the amount of individual level reciprocal relationships did not affect trust-levels of the individual, school level reciprocity had a *negative* predictive relationship with trust among educators. A teacher's trust in his colleagues did not appear to be affected by the amount of mutual relationships in which s/he was involved, but this teacher's trust in colleagues was negatively influenced by an abundance of reciprocal relationships at the school level. The higher the school level reciprocity, the lower the level of trust among school team members. Conversely, schools with few reciprocal relationships were characterized by higher trust than schools with more reciprocal relationships. Both effects of density and reciprocity were found to be highly significant (p < .001). The centralization of the work-related network did not affect teacher trust significantly. The significant school level effects of density and reciprocity on individuals' trust in their co-workers above individual level effects of in- and out-degree suggest the importance of the

overall social configurations in a school team as a whole for important elements of professional communities such as trust.

Summarized, the relationships between social network properties and trust tell a compelling story about teacher interactions that make up the social fabric underlying professional school communities. Not only the amount of individual relationships defines an individual's trust in his/her coworkers, but this trust is also influenced by the social network configurations of the professional community as a whole. Moreover, it appears that while certain social network characteristics nurture the growth of trust, such as density and individual social activity, other social network configurations may be less favorable to the development of school-wide trust, such as work-related reciprocity. In the next section, we will discuss our findings, provide limitations to the study and offer implications for research and practice.

CONCLUSIONS AND DISCUSSION

Professional communities are increasingly studied as the key to strengthening teachers' professional development and schools' capacity to address ongoing changes in educational policy and practice. Several scholars have suggested that the theory of social capital would provide a valuable lens to describe collaborative structures, such as professional communities (Coburn & Russell, 2008; Daly & Finnigan, 2009). Social capital theory provides a framework of elements that revisit characteristics of strong professional communities, such as social interaction in social networks, trust, a focus on both the individual and the collective, and beneficial outcomes. However, both social capital theory and literature around professional communities lack insights in the interplay of elements that form the concept. Also, large-scale empirical studies on social capital in educational organizations are scarce, and most empirical research only focuses on a single level of analysis. This chapter adds to the existing literature on social capital and professional communities by describing an empirical examination of the relationship between two main elements that social capital and professional communities have in common, namely social networks and trust. In addition, it offers a unique contribution by testing the relationship between teacher trust and social network characteristics at multiple levels of analysis.

The aim of this chapter was to deepen our understanding of schools as professional communities by examining social networks as the social fabric of which professional communities are woven. Building on social capital theory,

we hypothesized that social interactions would provide communities with the opportunity to build trust among teachers. Moreover, we argued that social networks in professional communities need to be studied at two levels of analysis: the school level and the individual (teacher) level. We analyzed the relationship between social networks and trust in 49 Dutch elementary schools among 751 educators, using multilevel analysis. To assess social interactions that lie at the core of professional learning communities and may support school-wide capacity for school improvement, we focused on social interactions around the discussion of work-related matters. Findings indicated that several characteristics of social networks predict trust among teachers. For instance, teams with a dense pattern of work-related social interaction reported higher trust than teams with more sparse work-related interaction. Also, the more a teacher discusses work-related issues with different team members, the more the teacher indicated to trust his/her school team members. These results support the notion that patterns of social interaction at both individual and school level may strengthen or diminish school-wide trust among educators in support of individual and collective teacher learning and, ultimately, student achievement and school improvement. We guide this section by the key themes from our findings, limitations and future directions for research, and implications for educational policy and practice.

Strengthening trust through social interaction

The current educational focus on professional communities urges the need to examine collaborative structures among teachers across schools, and revisit how educators capitalize on their social relationships (Honig, 2009). While recently emerged studies point at the importance of teacher social networks underlying professional learning communities for the dissemination of reform and innovations (Coburn & Russell, 2008; Cole & Weinbaum, 2007; Daly & Finnigan, 2009; Daly, Moolenaar, Bolivar, & Burke, in press) and the generation of new knowledge and practice (Moolenaar, Daly, & Sleegers, 2009), the interplay of social network characteristics and other key elements of professional communities, until now, has a limited empirical base. Our work suggests that social network characteristics have a predictive relationship with trust among educators, and underlines the importance of studying the relationship between elements of professional communities at multiple levels of analysis. To illustrate, we discuss the influence of the amount of relationships at both individual and school level on teacher trust.

At the individual level, the amount of individual relationships appeared to positively influence teacher trust; the more teachers indicated to have work-

related discussions with other team members, the higher the trust they reported in their colleagues. When we took a more nuanced perspective and added school-level network characteristics, we found that the density and reciprocity of the overall school social network of work discussion had an additional, and as important, effect on individual teachers' trust. In sum, the more relationships, the more trust, and this assumption holds at both levels of analysis. This result corroborates and extends earlier findings in a single-level smaller scale qualitative study (Coburn & Russell, 2008). Our finding implies that stimulating the individual bonding and recognition of relationships between individual teachers will enhance their trust, as well as enlarge the density of relationships within the organization, which will in turn raise individual levels of trust as well. While it pays to start building relationships one by one, this study shows that it is at least as important to attend to the social configurations of the team as a whole for the fostering of beneficial elements of professional communities, such as trust. Being embedded in a strong social network of work-related relationships is as important as maintaining individual relationships. This finding clearly emphasizes the need for policymakers and principals to attend to the value of strong social networks as a power base for building professional communities. In this case, multilevel analysis offered a more detailed picture of the relationships under study, and therefore we argue that multilevel analysis should be employed in large-scale educational research involving social network analysis as much as possible.

The dark side of social network configurations
Results from our large-scale study suggest that while individual and collective social activity nurture the growth of trust, other social network configurations may be less favorable to the development of teacher trust. While at the individual level, social network characteristics only fostered trust or had no significant effect, at the school level we found evidence that certain social configurations could also have negative consequences for the development of professional communities. In this regard, findings of network reciprocity at both levels of analysis showed an interesting picture. At the individual level, the amount of an individual's reciprocal relationships did not affect his/her trust in colleagues. On the contrary, at the school level, we found a negative predictive relationship between reciprocity and teacher trust. An explanation may be found in the dyadic nature of the measurement of reciprocity. Reciprocity is a measure based on relationships between a pair of two people, also called a 'dyad'. It could be that school teams in which individuals rely heavily on one-on-one reciprocal relationships are generating lower levels of

trust, because people outside these reciprocal relationships may feel like outsiders and distrust these 'cliques' of heavily reciprocated relationships. When a school is characterized by many reciprocal relationships, it may indicate an environment in which it feels 'unsafe' to discuss work-related matters and be vulnerable and open to many people in the team (Hoy & Tschannen-Moran, 2003; Daly & Finnigan, 2009; Daly, 2009). In these settings, teachers may only be vulnerable to the people they know will not 'harm' them, that is, the colleagues with whom they have had many experiences of long-lasting, safe exchange of knowledge and information. In contrast, teams that share work-related matters among a more dispersed group of colleagues instead of having to rely on one-on-one relationships may thus generate a 'safe' atmosphere in which trust can grow. In such a social configuration of relationships, knowledge is transferred, modified, and shared among the whole team, in which teachers have to be less worried about being 'left out of the loop' or socially excluded. The reciprocation of resources in this type of climates is not necessarily restricted to dyadic relationships but may occur in larger groups of people than dyads, thus resulting in lower (dyadic-based) reciprocity between individuals.

In this regard we also have to address the possibility of a circular relationship, in which patterns of social interactions may influence trust that in turn may influence individuals' behavior and patterns of social interactions. Of course, when reciprocal dyadic relationships generate distrust among faculty, this climate of distrust may very well cause more dyadic 'closure' in the relational patterns in schools, in which people tend to only go to 'safe' others with whom they already have frequent contact, thereby in turn increasing the number of reciprocal relationships.

In sum, our findings suggest that in order to push professional communities and nurture trust, it is more important to focus on building relationships across the whole team, than small-scale one-on-one relationships that carry the risk of damaging trust by highly closed reciprocal relationships. Future research could further investigate this assumption by examining relational patterns at levels between the dyad and the school team, such as triplets. Moreover, our results underline the need for more extensive social network research into the 'dark' side of social network configurations.

Limitations and future directions
Although this chapter offers a valuable contribution to theory on social capital and professional communities, several limitations with regard to generalization of the study have to be addressed. While causality between the relationships

under study is suggested by the reviewed literature, our research design was not developed to specifically test causality. It would be interesting to study the emergence of trust in newly formed professional communities, using experimental designs, and the development of trust alongside social interaction over a period of time by means of longitudinal research. Moreover, although the number of schools participating in the study was sizeable, it is desirable to examine larger samples in order to substantiate our claims. That way, advanced technical statistical analyses, such as multilevel structural equation modeling, may be conducted to validate the findings of this study and test more complex conceptual models. These models can contribute to a better understanding of the paths through which social networks and trust have an impact on teacher practice and student outcomes. However, our sample of 49 schools provided reasonable statistical power, and the magnitude of the reported significant effects can be regarded at least as a first indication of the importance of the relationships under study (Mohammed & Ringseis, 2001).

Because the embeddedness of individuals in social networks may differ in various contexts, it would be valuable to explore social interactions and trust underlying professional communities in various international contexts and educational settings, such as secondary, higher, and vocational education. A next step in the study of professional communities and social networks would be to empirically validate the relationship between elements that foster professional communities, and suggested outcomes of professional communities, both for teachers and schools (for instance, teacher satisfaction and turnover, orientation towards innovation, collective involvement, collective efficacy) as well as for students (cognitive and non-cognitive achievement). Much is still to explore on factors that affect social interaction, such as leadership and teacher behaviors. This chapter showed that social network analysis across schools enriches our understanding of the foundation of social relationships on which professional communities are built, and offers great opportunities to explore the potential of social relationships for the development of professional communities.

Building professional communities: implications for educational policy and practice
Scholars around the globe draw attention to teacher collaborative structures, such as professional learning communities and communities of practice, as the vehicles to establish a system of life-long learning and teacher development in daily school practice. Knowledge on how teacher collaboration, fundamental to professional learning communities, impact levels of trust among teachers gives valuable insights in the chain of variables that characterize professional

learning communities, provide school-wide capacity for teacher development and will ultimately contribute to teacher and student learning. In this chapter, we suggest that a first step to build and maintain successful professional learning communities is to understand the social fabric of which professional communities are woven. While the number of work-related relationships is a material that makes for strong social fabric underlying professional communities, other materials, such as high dyadic reciprocity, might be less favorable. To enhance trust in professional communities, and ultimately student performance, educators, scholars and policy-makers justifiably emphasize the importance of social interaction and collaborative structures. In the right configuration, this social fabric provides the structure to nurture an open and safe climate in which trust prevails and school-wide capacity for teacher development is consequently advanced.

CHAPTER 6

Ties with Potential:
Social Network Structure and Innovative Climate
in Dutch Schools [1]

ABSTRACT

Background. Similar to the United States, governmental efforts to improve education in the Netherlands are focused on innovation and the development of collaborative structures to support the generation of new knowledge. However, empirical evidence of the relationship between social linkages and innovation in education is scarce.

Purpose. The aim of the study was to examine the impact of social network structure on schools' innovative climate, as mediated by teachers' involvement in decision-making.

Method. This article reports on a study among 775 educators in 53 elementary schools in a large educational system in the Netherlands. A quantitative survey using Likert-type scales and social network questions on work-related and personal advice was analyzed using social network analysis and multiple regression analyses.

Conclusions. Findings indicated that the more densely connected teachers were in regard to work related and personal advice, the more they perceived their schools' climate to be supportive of innovation. Highly dense work-related network structures also typified teams that perceived strong teacher involvement in decision-making. Moreover, results suggested that the positive relationship between density of work-related advice networks and innovation-supportive school climate could be partially explained by increased shared decision-making.

INTRODUCTION

Efforts at improving public educational systems in support of better student achievement are commonplace across the globe. Renewed interest in improving education is being heavily influenced by governmental agencies that are encouraging educators to reconsider existing processes and engage in the development of innovations (Gewertz, 2009). The push for creating new knowledge and practice is present both in the United States and the Netherlands where this study takes place. Scholarly attention has reflected this emphasis by a growing focus on change and the development and diffusion of innovation through networks and professional learning communities (Giles & Hargreaves, 2006; Lieberman, 2000; Penuel, Riel, Krause, & Frank, 2009). In educational practice, these communities are increasingly developed to create a climate oriented toward knowledge exchange and shared learning, with the goal to improve instruction and student learning (McLaughlin & Talbert, 1993; Newmann & Wehlage, 1995; Wood, 2007).

Recently, a developing set of educational studies suggests that social network structures underlying professional learning communities may be related to schools' capacity to change and orientation towards innovation (Coburn & Russell, 2008; Penuel, Frank, & Krause, 2007b; Penuel & Riel, 2007). Innovation is believed to be closely linked to social relationships ('ties') within and across systems (McGrath & Krackhardt, 2003; Tenkasi & Chesmore, 2003). Literature from outside of education indicates that social relationships between organizational members, whether formal or informal, should be considered a valuable resource in the creation of new knowledge and practices (Ahuja, 2000; Tsai & Ghoshal, 1998). In this study we add to the literature by exploring the extent to which structural characteristics of schools' social networks are related to their climate for innovation.

In debates about innovation and instructional improvement, the importance of teachers as active participants in decision-making processes that shape school goals is stressed. Shared decision-making provides teachers with the opportunity to collaboratively refine and deepen practice in a conducive environment (Hargreaves, 1999; Smylie, Lazarus, & Brownlee-Conyers, 1996). Research suggests that school wide shared decision-making processes may support innovation and instructional improvement (Conley, 1991; Smylie, et al., 1996; Geijsel et al., 2001). While scholars have pointed to the value of social ties for joint problem solving and teacher involvement (Uzzi, 1997; Liden, Wayne & Sparrowe, 2000), evidence on the interplay between social network structure and shared decision-making is scarce.

This study extends recent literature by emphasizing the potential of relational ties for organizational outcomes (Balkundi & Kilduff, 2005; Daly & Finnigan, 2009; Kilduff & Krackhardt, 2008) and makes a unique contribution by examining the mediating role of shared decision-making in the relationship between social network structure and schools' innovative climate. In this chapter we present the results of an investigation into the potential of ties to support schools' climate for innovation in 53 schools representing a large educational system in the Netherlands. Our inquiry examined the following question: To what extent are school-level characteristics of social networks predictive of schools' innovative climate, as mediated by shared decision-making? We will provide a brief overview of the literature on organizational innovative climate, followed by a more comprehensive review of social network literature, which provides the conceptual frame of our study. After reviewing the literature on (teacher) involvement in shared decision-making, we will pose hypotheses around the relationships between social network structure, innovative climate and shared decision-making.

THEORETICAL FRAMEWORK

Schools' innovative climate

The study of innovation has a rich history in management and organizational science literature (Hage, 1999). One of the most salient and consistent features of innovation studies is an emphasis on the creation of new knowledge as opposed to transmission of existing knowledge (Nonaka & Takeuchi, 1995). Thought of in a different way, innovation is concerned with creating the "societal new", meaning engagement in learning processes that takes place with others and generates new practices and knowledge (Paavola, Lipponen & Hakkarainen, 2004; Tsai & Ghoshal, 1998). Although studies around innovation have a common focus on the generation of new knowledge, the construct has been examined in a variety of ways. In this study we narrow our focus to a subset of the innovation literature that examines the potential of an organization to generate new knowledge through an innovation-conducive climate. This stands in contrast to other literature that has examined the adoption, diffusion or implementation of innovations themselves (Geijsel, Van den Berg & Sleegers, 1999, Rogers, 1995). We draw upon Van der Vegt, Van de Vliert, and Huang (2005) in defining Innovative Climate as the shared perceptions of organizational members concerning the practices, procedures, and behaviors that promote the generation of new knowledge and practices.

Key elements underlying this definition are teachers' willingness to adopt an open orientation toward new practices and change, and to collectively develop new knowledge, practices, and refinements to meet organizational goals. In the next sections, we will describe the organizational structures and social processes that are suggested to contribute to an innovative climate in organizations.

Supportive organizational structures

Previous research suggests that the creation of new ideas is facilitated by the technical expertise and knowledge of organizational members (Andrews & Smith, 1996; Perry-Smith & Shalley, 2003). Individuals drawing upon their work-related knowledge, skills, and experiences provide the initial catalyst in creating knowledge. This suggests that the human capital within an organization is essential for the generation of innovations. However, in order for an organization to capitalize on its innovative capacity, interactions with others in change oriented innovative climates that support risk taking are equally necessary components (Calantone, Garcia & Droge, 2003; Hage, 1999; Nohari & Gulati, 1996). A pro-change climate has been associated with informal organic organizational structures that yield opportunities for collaboration and input in adapting to non-routine challenges (Hage, 1999). More centralized organizations have been found to be supportive in the exchange of more technical knowledge (Cummings & Cross, 2003), but in turn may also inhibit the development of flexible responses to change (Daly, 2009; Daly & Finnigan, 2009). Those organizations that provide for more flexibility and encourage participation in decision-making by community members have also been associated with generation of new ideas (Daly, 2009).

Supportive social processes

Major theorists have described the process of innovation as iterative and cyclic; a process that is established and maintained through interaction that provide opportunities for refinement (Kanter, 1983). Conceptualized in this manner, the development of innovations can be understood as a social process. This stands in contrast to the more traditional narrative of an individual making a sudden discovery. Innovation can be described as a circular and recursive process with multiple opportunities for input, insight, and initiative (Engestrom, 1987; Nonaka & Takeuchi, 1995). Social processes are therefore critical in knowledge creation to the point that innovation, "emerges *between* rather than *within* people (Paavola et al., 2004 p. 564). Communication and opportunities to engage in discussion between organizational members are central to an open

orientation towards innovation (Monge, Cozzens, & Contractor, 1992). Moreover, the degree to which actors are willing to take risks and accept the vulnerability of possible failure supports a climate oriented toward organizational learning and change (Klein & Knight, 2005). When faced with non-routine challenges that require the creation of knowledge, as is often the case in contemporary schools, actors must often collaboratively invent the way in which they work through managing and drawing upon social ties in realizing goals (Honig, 2009).

An innovative climate therefore can be conceptualized as a resource within a social network that comprises creative actors, the ideas they initiate, and the ties connecting them (Tsai, 2001). Providing the supportive structures and processes for community members to engage in risk taking and to be involved in the stream of social activity related to developing new knowledge is essential (Frank, Zhao & Borman, 2004). Supportive relationships developed over time may also foster risk-tolerant climates, which are critical in the creation of knowledge (Bryk & Schneider, 2002; Frank et al., 2004). Hargreaves (1999) argues that in order to create innovative educational institutions, educators must be the creators of professional knowledge and provided with opportunities to collaboratively refine and deepen practice in a conducive environment. This implies the importance of teachers as active participants in the decision-making processes that shape the goals and directions of schools.

Social capital: The role of social networks

In order to understand the supportive role of social ties for an innovative climate, we draw on the concept of social capital. Several scholars have contributed to social capital theory, each offering a nuanced understanding of the concept and emphasizing a different aspect of social capital (see, for example, Bourdieu, 1986; Burt, 1992; Coleman, 1988; Lin, 2001; Putnam, 1993a). Our research is guided by the work of Lin (2001) who defines social capital as, "The resources embedded in social relations and social structure which can be mobilized when an actor wishes to increase the likelihood of success in purposive action" (Lin, 2001; p. 24). From an organizational standpoint, social capital may be conceptualized as an organization's pattern of social relationships through which the resources of individuals can be accessed, borrowed, or leveraged (Tsai, 2001). This differentiates social capital from human capital, which refers to training, development, or certifications of individuals (Bourdieu, 1986; Coleman, 1988; Dika & Singh, 2002; Lin, 2001). The pattern of social ties that provide access to social resources is often assessed by exploring social networks (Tsai & Ghoshal, 1998).

Social networks can be characterized by the content that is exchanged within the social relationships (Scott, 2000). For example, friendship networks may primarily be aimed at the transfer of personal support, confidential discussions and information sharing. Collaboration networks may encompass information exchange, knowledge transfer, and advice. The content of the resources flowing through the social network creates a structure that defines the purpose of the network. Common terms to describe the social network structure at the organizational level are density, reciprocity, and centralization. Density refers to the existing proportion of ties in a network to possible ties; in a dense network, many people are connected to one another, while in a sparse network, there are much less connections between the individuals in the network. Reciprocity addresses the "mutuality" of ties; a relationship between two people is reciprocal when both individuals indicate to be connected to one another. The higher the reciprocity in a network, the more dyadic (one-on-one) relationships are mutual. Centralization of a social network is high when certain individuals are more 'popular' in the social network than others, meaning they send and receive more ties. This variability can translate into some individuals have more access to network resources than others.

Social network structure may vary according to the resources that are being exchanged, and influence the speed and ease with which resources travel through the network. For instance, a social network around the exchange of technical knowledge, information, and expertise may look significantly different from a social network around personal support and the discussion of confidential matters. While both networks transfer resources through their ties (the first being knowledge, the second personal support), the social network structure of both patterns of interaction may appear quite different. Accordingly, social network researchers often distinguish two types of social networks according to their function: instrumental and expressive networks (Ibarra, 1993). Instrumental social networks describe relationships among organizational members that transmit information and resources that can help successfully contribute to organizational goals (Cole & Weinbaum, 2007). Examples of instrumental relationships are advice-seeking, advice-giving, and discussing work-related matters. In contrast, expressive social networks most often refer to affective relationships between organizational members that are formed to exchange social resources such as friendship and social support that are not directly aimed at achieving organizational goals. Expressive relationships in comparison to instrumental relations tend to be stronger, durable, and more difficult and time-consuming to develop given the level of trust necessary in their formation (Granovetter, 1973; Ibarra, 1993; Marsden, 1988; Uzzi, 1997).

The study of social networks in education is receiving increased attention. Research has been conducted in a variety of settings, including school and teacher networks (Bakkenes, De Brabander & Imants, 1999; Coburn & Russell, 2008; Daly et al., in press; Lima, 2007; Moolenaar, Karsten, Sleegers, & Zijlstra, 2009; Penuel et al., 2007a, 2007b, 2009); leadership networks and departmental structures (Friedkin & Slater, 1994; Lima, 2003, 2004; Spillane, 2006); school-parent networks (Horvat, Weininger, & Laureau., 2003); between school networks (Mullen & Kochan, 2000; Veugelers & Zijlstra, 2002); and student networks (Lubbers et al., 2006). Many of these studies examined social networks at the individual or dyadic level of analysis. This study contributes to the existing literature by defining and assessing the effect of social network measures at the school level. Moreover, while many studies refer to the potential of social networks for innovation, empirical evidence on the relationship between social network structure, innovative climate, and shared decision-making is scarce.

Opportunities for the transfer of resources in the form of social capital are dependent on the pattern and quality of the social ties in the network (Burt, 1992; Coleman, 1988, 1990; Granovetter, 1982; Lin, 2001; Putnam, 1993a). Prior research demonstrates that strong social relationships facilitate joint problem solving (Uzzi, 1997) and the exchange of tacit, non-routine, or complex knowledge (Hansen, 1999; Reagans & McEvily, 2003). Moreover, strong ties have been associated with low-conflict organizations (Nelson, 1989). Less dense networks can yield brokering opportunities between actors (Burt, 1992; Granovetter, 1973) and tend to be well suited for the transfer of simple, routine information (Hansen, 1999). Interestingly, both strong and weak ties are necessary within a social structure as they facilitate access to different kinds of information (Haythornthwaite, 2002; Tenkasi & Chesmore, 2003).

The exchange of resources in a social network may be facilitated by an optimal configuration of ties in a network. For instance, the cohesion and connectivity of a network enable the circulation of creative knowledge and material that can be recombined into new creative materials and ideas (Uzzi & Spiro, 2005). However, when the necessary relationships are lacking or insufficiently accessed, networks may also constrain the flow of knowledge and information (Daly & Finnigan, 2009; Hite, Williams & Baugh, 2005). Given the importance of social network structure for an individual's access to the flow of resources in the organization, Cross, Baker & Parker (2003) pose that the old adage 'It is not what you know, but who you know', is more accurately, 'Who you know defines what you know'. Social network structures in schools may hold valuable potential for innovation, as an increase in the number and depth

of social relationships may facilitate the generation, application, and diffusion of new knowledge and evidence (Cross et al., 2003; Daly & Finnigan, 2009). Moreover, a centralized network structure may facilitate the diffusion of knowledge and practices related to a top-down implementation of innovations, as is often the case in (Dutch) school improvement programs. Based on these findings, we expect that social network structure (density, reciprocity, and centrality) will have a positive effect on perceptions of a school's innovative climate (*Hypothesis 1*).

Shared decision-making

As schools respond to increased pressure to improve through the development of innovations, the importance of exploring teacher interactions in support of an innovative climate becomes evident. Dense social networks among teachers may be of particular use in the development of an innovative climate as social interactions provide opportunities to increase teacher involvement in decision-making. Involvement of educators, in the form of shared and participative decision-making, is receiving increased attention (Chrispeels, 2004; Murphy, 2005). Shared decision-making and involvement have been described as "an instrument of school improvement" (Smylie, Conley & Marks, 2002 p. 64), and a "pre-condition for school improvement" (Datnow & Castellano, 2003 p. 205), and without this involvement, "it is unlikely that schools will achieve or sustain outcomes" (Chrispeels, 2004 p.13). Previous studies have shown that organizational barriers like isolation often act against teacher involvement and constrain the development of new practices (Bakkenes et al., 1999; Chrispeels, 1992).

Shared Decision-making refers to the degree to which teachers are jointly engaged in the decision-making processes within their schools (Sweetland & Hoy, 2000; Terry, 1996). School wide decision-making processes support schools' innovative climate by providing teachers the opportunity to, "widen [their] focus from the immediate outcomes of their performance to continuous learning by to the organization as a whole" (Somech & Drach-Zahavy, 2004, p. 285). The notion of being a part of a larger collective decision-making group may yield an increase in ownership, responsibility, and ultimately success for school efforts (Chrispeels, 2004; Clune & White, 1988; Smylie, 1996). Moreover, a sense of involvement is a critical foundation upon which to deepen and sustain change efforts in schools that require the generation of new knowledge (Coburn, 2003; Copland, 2003). Shifting existing decision-making structures to provide for more active involvement and voice for teachers is an important step

in the work of school change (Geijsel, 2001; Geijsel et al., 1999; Katzenmeyer & Moller, 2001; Murphy, 2005; Van den Berg & Sleegers, 1996a).

A theoretical relationship between teacher interaction and collective involvement in decision-making has a strong intuitive appeal (Bogler & Somech, 2005; West, 1994), yet a small empirical base (Smylie et al., 1996; Weiss, 1993). Many scholars have pointed to the importance of social relationships to enhance joint problem solving and develop coordinated solutions (Uzzi, 1997) and to engage and empower teachers (Liden et al., 2000; McBride & Skau, 1995; Thomas & Velthouse, 1990). In turn, teacher involvement in decision-making processes may give rise to ample opportunities to collectively create new knowledge and practices thereby strengthening the school's innovative climate. It is suggested that teacher involvement in decision-making may be related to the generation of knowledge (Redding, 2000), seeking new ways to improve teaching (McBride & Skau, 1995), and creating innovative solutions to problems of practice (Wilson & Coolican, 1996). However, this shift to more involvement is unlikely to occur unless it is supported by the "broader organizational and institutional contexts in which teachers interact and function" (Smylie et al., 2002, p. 175). If schools are to improve then attention must be paid to social interactions and opportunities to collaborate as both may trigger the generation of new knowledge and practices (Geijsel et al., 2009; Obstfeld, 2005).

The balance of literature suggests the importance of social ties in combination with shared decision-making in developing a school wide innovative climate. Densely connected social network structures with many reciprocal ties may foster an innovative climate both directly and indirectly by increasing opportunities for shared decision-making. In contrast, it is plausible that in a strongly centralized network teachers may perceive limited influence in the decision-making process in their school, since 'the power to decide' is 'shared' among only a few influential people. Hence, we pose that social network structure (density and reciprocity) will have a positive effect on shared decision-making, while network centralization will have a negative effect on shared decision-making (*Hypothesis 2*). Moreover, we expect that the relationship between schools' social network structure (density, reciprocity, and centralization) and their innovative climate will be positively mediated by shared decision-making (*Hypothesis 3*). In order to examine these hypotheses we will now describe the data collection and analysis methods employed in this study.

Table 1. Sample characteristics of schools (N = 53) and educa-
tors (n = 775)

		Teachers (%)	
Gender	Male	210	(27.1 %)
	Female	565	(72.9 %)
Experience	1-3 years	152	(19.6 %)
at school	4-10 years	256	(33.0 %)
	> 11 years	367	(47.4 %)
Team experience	6 months to 2 years	20 teams (37.8 %)	
	More than 2 years	33 teams (62.2 %)	

Table 2. Sample characteristics of schools (N = 53) and educators (n = 775)

	N	M	Sd	Min.	Max.
Teachers					
Age	775	45.7	10.7	21	63
Percentage of working hours (FTE)[1]	774	.73	.25	.20	1.00
Administrative tasks (no/yes)	724	.19	.39	0	1
Shared Decision-making (SD)	775	3.38	.52	1.14	4.00
Innovative Climate (IC)	775	2.95	.55	1.00	4.00
School					
Socio-economic status (SES) [2]	53	7.9	9.5	0.4	47.3
School size (number of students)	53	213.0	116.6	53	545
Team size (number of educators)	53	14.8	6.8	6	31

[1] E.g., a teacher with 0.40 fte is employed at the school for (a total of) two days per week.
[2] Students' SES is calculated as the weighted percentage of students for whom the school receives extra financial resources

METHOD

Context

Similar to the United States, the Ministry of Education in the Netherlands is focused on school improvement through innovation (Netherlands Ministry of Education, 2009). The study was conducted in 53 Dutch elementary schools located in the south of the Netherlands representing 775 educators. The schools formed the Avvansa School District[1] and were provided administrative, financial, and professional development support by a single board. The sample schools were selected as the district participated in an ongoing school and teacher monitoring process around improvement.

Sample

We surveyed 53 schools and collected data on the schools' social network structure, shared decision-making, and innovative climate. Data were gathered from 775 educators (teachers and principals), reflecting a response rate of 96.8 %. Of the sample, 27.1 % of the respondents were male and 72.9 % female. These numbers approximately reflect the gender ratio in Dutch elementary education across the country. Each school-level team had a minimum six months of experience in their current configuration, with the majority of teams (62.3 %) having had at least two years of shared experience. Additional sample demographics are presented in Table 1 and 2.

Instruments

Social networks. We assessed schools' social network structure as a characteristic at the school level. The patterns of social interactions in the sample schools were examined using social network analysis. In the survey, respondents were asked to identify the individuals with whom they have a relationship described by the social network question. Based on previous organizational studies on social networks and innovation (Copeland, Reynolds, & Burton, 2008; Obstfeld, 2005), we used advice relationships in examining schools' social networks. Advice relationships are important to innovation as asking for advice implies vulnerability and risk-taking on the part of the advice-seeker. Moreover, advice relationships are a powerful tool to assert social control as they convey information about the advice-seeker, thus giving the advice-giver the power to actively influence his/her behavior.

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[1] All names are pseudonyms

We assessed two types of advice relationships, namely work related advice and advice on personal matters. While the exchange of technical knowledge and personal support is associated with the generation of novel ideas (Perry-Smith & Shalley, 2003), few studies have compared and contrasted the impact of these types of advice on an organization's innovative climate. In this study, work related advice relationships were captured by asking the respondents the following question: 'Whom do you go to for work related advice?' In line with Ibarra (1993), we will refer to this social network as the *instrumental network*. The *expressive network*, regarding social relationships around personal support, was assessed with the question; 'Whom do you go to for guidance on more personal matters?' A school specific appendix was

Table 3. Items and factor loadings of the scales used in the study (n = 775)

Factor	I	II
Shared Decision-making (α = .90)		
1. At our school, we decide together on the use of new teaching strategies	.83	.14
2. At our school, we decide together about changes in our daily practice	.83	.19
3. At our school, we decide together on new educational goals for our school	.81	.20
4. At our school there is ample room for teachers to adjust plans for their own classroom	.75	.12
5. At our school, teachers have a say in which new teaching and learning materials are purchased	.74	.02
6. During the implementation of an intervention, the implementation plan is adjusted if necessary	.74	.16
7. Teachers in this school decide together how education is spread over the grades to provide children with a continuous and logical path of education	.68	.28
Innovative Climate (α = .87)		
1. Teachers are continuously learning and developing new ideas	.10	.82
2. Teachers are generally willing to try new ideas	.16	.81
3. Teachers are constantly trying to improve their teaching	.12	.77
4. Teachers have a positive 'can-do' attitude	.21	.75
5. Teachers are willing to take risks to make this school better	.14	.75
6. Teachers are encouraged to go as far as they can	.15	.68

attached to each survey, which included the names of all the school's team members and a corresponding letter combination (e.g., Mr. Simon Peters[1] = AB). Respondents could answer the social network questions by indicating the letter combination of the intended colleague(s), and they could name as many colleagues with whom they interacted.

Innovative Climate (IC). Schools' Innovative Climate was measured with six items designed to assess schools' orientation to improve (Bryk, Camburn, & Louis, 1999; Consortium on Chicago School Research, 2004). The scale taps the extent to which the teachers perceive the organizational climate in their school as innovation-supportive. The scale measured the degree to which teachers collectively: are willing to try new things; are continually learning and creating new ideas; and have an open orientation toward change. For example, teachers were asked to evaluate, "In our school, teachers are willing to take risks to make this school better". The questions were translated and adapted to fit the context of Dutch elementary education. Principal component analysis provided evidence that the six items contributed to a single factor solution explaining 60.1 % of the variance (Cronbach's α = .87).

Shared Decision-making (SD). Shared Decision-making (SD) measured the degree to which teachers perceived that they have the opportunity to influence school-level decisions and share in the decision-making process. This scale comprised seven items based on Geijsel et al. (2001). For instance, teachers were asked to respond to the prompt, "At our school, we decide together on the use of new teaching strategies". Principal component analysis confirmed that the seven items loaded highly on a single factor, explaining 61.9 % of the variance (Cronbach's α =.90).

Both constructs were defined and measured at the individual level of analysis, as teacher perceptions of organizational level phenomena. Both instruments used a four-point Likert type agreement scale with the anchors 1 = disagree and 4 = agree. The IC and SD items were both entered in a single principal component analysis with varimax rotation resulting in a two-factor solution, explaining 61.5 % of the variance, indicating that the two scales assessed separate constructs. The items and factor loadings of this principal component analysis are summarized in Table 3.

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[1] All names are pseudonyms

Demographic variables. We collected demographic variables to assess the presence of any relationships between demographics and social network structure, IC, and SD (See Table 1 and 2). At the school level, we assessed the following demographic variables: school size, team size, gender ratio, average age, years of team experience in current formation, and SES. We included school size (number of students) and team size (number of educators) as important background variables since they are known to be directly related to the social network structure of organizations (Tsai, 2001). Also, large schools may have more resources at hand to develop innovation, in terms of personnel, financial resources, and community and district-level support. We included team composition variables such as gender ratio and age, as "they provide a context in which certain team beliefs and processes are likely to evolve" (Chen et al., 2002, p. 385). Experience of the team in its current formation was examined as groups with shared experiences may have higher expectations, or higher standards based on previous experiences (see chapter 2). We added the socio-economic status (SES) of the schools (based on a governmental weighting factor for additional financial support) as the community surrounding the school may influence the extent to which there is a perceived urgency for innovation. Typically, schools, especially those under pressure to improve and that serve more high-needs communities, are associated with greater urgency in developing new approaches (Sunderman, Kim & Orfield, 2005).

At the individual level, we entered the following variables as demographic control variables: age, gender, number of working hours (FTE), staff (administrative) tasks, and number of years experience in the school. Age and gender have been shown to be related to perceptions of organizational innovative climate, participative decision-making, and network structure (Geijsel, 2001, see chapter 2). The number of working hours was included since it could influence both the perception of the schools' innovative climate, as well as directly limit the possibility of involvement in shared decision-making. We also added whether or not a teacher fulfilled additional staff (administrative) tasks in support of the principal, because this may directly affect the teacher's actual involvement in decision-making and perceptions of innovativeness because of increased contact with the staff. Finally, we included number of years of experience in the school as individuals with more experience in the school may have different expectations and standards for the schools' climate than newer teachers, which may color their perception of their school's innovative climate and process of decision-making.

Data analysis

Social networks. We used the social network measures of team density, reciprocity, and centralization for the instrumental (work-related advice) and expressive (personal advice) relationships within each school (Borgatti, Jones and Everett, 1998). These social network characteristics were calculated and analyzed using UCINET 6.0 (Borgatti, Everett, & Freeman, 2002). The following paragraphs discuss the network characteristics in detail.

The *density* of the advice networks was calculated as the proportion of existing relationships to the maximum number of relationships possible in the network. The value of density varied between 0 (no relations in the network) and 1 (all actors are connected to each other). For example, the more dense the advice network, the more team members seek work-related advice from one another. The more dense the network of personal advice, the more teachers turn to each other for advice on personal matters. The social network measure of *reciprocity* mirrors the two-way nature of the relationships in the network. Reciprocity was calculated as the ratio of the number of pairs with a reciprocated relationship relative to the number of pairs within any given relationship. A high level of reciprocity thus reflects a mutual exchange of work-related and personal advice. *Centralization* of a social network refers to the difference between one or a few highly central person(s) and other (more peripheral) people in the network. A highly centralized network is one in which all ties run through one or a few nodes, thus decreasing the distance between any pair of nodes (Wasserman & Faust, 1997). The value of centralization will reach the maximum of 1 when every teacher in a network only asks advice from a single person in the network, while these teachers themselves are not asked for advice at all. The lowest value of 0 indicates that all members of the network are chosen for advice as frequently. The more centralized the social network is, the more knowledge and advice spreads from a single, or a few influential source(s) to the rest of the network, in contrast to a decentralized social network, in which advice is much more evenly shared among all members.

Innovative Climate and Shared Decision-making. For the Innovative Climate (IC) and Shared Decision-making (SD) scales we calculated descriptive and inferential statistics including correlations and internal consistencies (see Table 4).

Analysis strategy

The proposed hypotheses were tested through a four-step process. First, we examined correlations to analyze the relationships among the study variables. Second, we studied the influence of demographic variables on the

Table 4. Means, standard deviations, correlations and internal consistencies (Cronbach's alpha) for the study variables (N = 53, n = 775).

|	M	Sd	1b	1c	2a	2b	2c	3	4
1. Instrumental Network									
a. Density	.23	.09	.19	.27	.79 **	.40 **	.41 **	*.23 ** *	*.25 ** *
b. Reciprocity	.25	.12	1.00	-.19	.36 **	.46**	.13	*.01*	*-.05*
c. Centralization	.38	.13		1.00	.20	-.04	.37 *	*.13 ** *	*.11 ** *
2. Expressive Network									
a. Density	.30	.11			1.00	.35 **	.48 **	*.20 ** *	*.24 ** *
b. Reciprocity	.37	.13				1.00	.06	*.09 **	*-.02*
c. Centralization	.33	.12					1.00	*.17 ** *	*.11 ** *
3. Shared Decision-making (SD)	3.38	.52						(.90)	*.38** *
4. Innovative Climate (IC)	2.95	.55							(.87)

Notes: * p < .05, ** p < .01, *** p < .001
Correlations in regular font are calculated at the school level of analysis (N = 53)
Correlations in italics are calculated at the individual level of analysis (n = 775)

proposed relationships between social network structure, IC, and SD. Third, we conducted multilevel (HLM) analyses to test the direct effect of density, reciprocity, and centralization of the instrumental and expressive social networks on IC and SD (Hypotheses 1 and 2). Finally, we tested the mediating influence of SD on the relationship between social network structure and IC (Hypothesis 3). For comparing the multilevel models, we used maximum likelihood estimation in the Statistical Package for the Social Sciences version 16.0.

According to Baron and Kenny (1986), four conditions must be met to support the mediation hypothesis (see Figure 1 for a path diagram of the hypothesized multilevel relationships under study): (1) a significant effect of social network structure on innovative climate (IC) (Path *c* in Figure 1, addressed by Hypothesis 1); (2) a significant effect of social network structure on shared decision-making (SD) (Path *a*, addressed by Hypothesis 2); (3) a significant effect of SD on IC while 'fixing' the effect of social network structure (Pearl, 2000) (Path *b*); and (4) mediation is indicated when the direct effect of the independent variable is either zero (full mediation) or reduces significantly in absolute size (partial mediation) after adding the mediating variable (addressed by Hypothesis 3). Following Krull & MacKinnon (2001) we calculated the size of the mediated effect by multiplying the estimate for *Path a* with the estimate for *Path b* while 'fixing' the effect of social network structure. The significance of the mediated effect was evaluated by calculating Sobel's test (1982).

Figure 1. Path diagram of hypothesized multilevel mediation
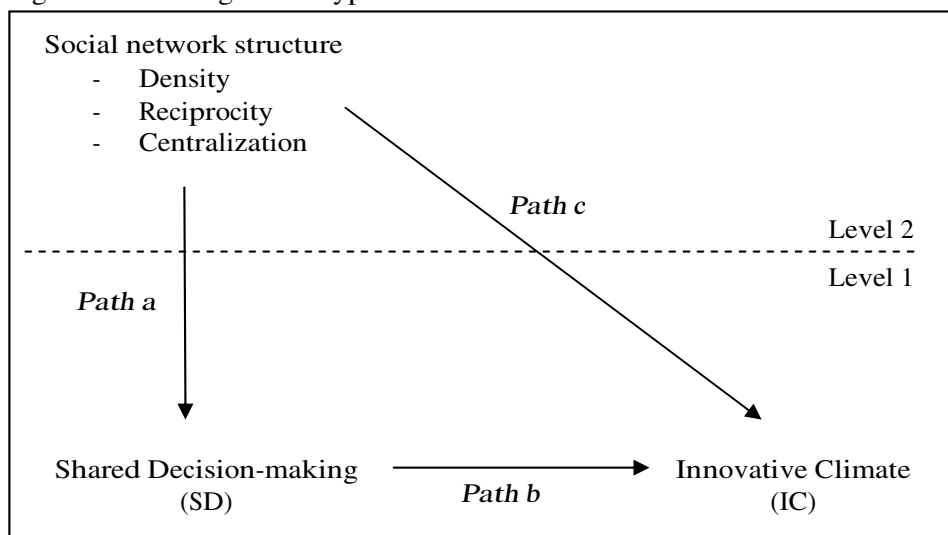
It is an important methodological point to note that when conducting regressions using network measures, violations to the basic assumption of independence underlying regression analysis may occur (see Kenny, Kashy, and Bolger, 1998). Individuals in a social network are by definition interdependent, and the two types of networks describe the same set of individuals, the school level social network measures of our two network types cannot be considered independent. This is reflected in the high correlation (.79, p < .01) between the densities in both types of networks. Therefore, using similar network measures in the same regression equation (e.g., density of instrumental *and* expressive network) would challenge the assumption of independence of the data. We avoid this methodological challenge by comparing the work related and personal advice networks and contrasting their respective impact on schools' innovative climate, as mediated by shared decision-making. Another issue is multicollinearity, which arises because of the moderate correlations between the school level social network data within each type of network. While multicollinearity does not affect the predictive power of the model as a whole, it may inflate the standard errors of the individual predict-tors. We checked whether multicollinearity formed a serious threat to the stabi-lity of our findings by rerunning the models on different subsets of the data (by alternatively excluding reciprocity and centralization) and found that the results for density remained largely unchanged across all models. In combi-nation with the substantial size of our dataset, we may assume that multicol-linearity did not pose a significant threat to the robustness of our findings.

RESULTS

Instrumental and expressive advice networks in relation to schools' innovative climate and shared decision-making. As is displayed in Table 4, the social networks of expressive relationships (personal advice) tended to be slightly more dense and reciprocal than instrumental relationships (work related advice). On average, there were more personal than work related advice relationships in the school teams, with personal advice relationships being generally more mutual than work-related relationships. With regard to centralization, findings indicated that instrumental relationships in schools were slightly more centralized around a few actors than expressive relationships. Results from the correlation analyses indicated that both schools' innovative climate (IC) and shared decision-making (SD) were moderately related to density of the instrumental and expressive networks. The denser the advice networks in the sample schools

were, the more teachers perceived the schools' climate as innovative, and the more they felt that they shared in the decision-making process at their school. IC and SD were weakly associated with centralization of both networks, and SD was marginally related to reciprocity in the expressive network. Finally, findings indicated that shared decision-making was significantly and positively related to schools' innovative climate.

Multilevel analyses

The intercept-only multilevel model for IC showed that a statistically significant amount of variance in individual trust scores is attributed to the school level. The intraclass correlation coefficient for IC is .244 (χ^2 (1) = 103.85, p < .001), thus indicating the need to use multilevel analysis techniques to examine the relationship between school level social network measures and schools' innovative climate. In other words, 24.4 % of the variability in teachers' climate perceptions occurs between schools, and the remaining 75.6 % of the variance occurs within schools at the teacher level. The intercept-only multilevel model for SD also confirmed that a statistically significant amount of variance is accounted for at the school level (ICC = .15, χ^2 (1) = 68.85, p < .001). In other words, 15.3 % of the variability in teachers' perceptions of shared decision-making occurs between schools, and the remaining 84.7 % of the variance occurs within schools at the teacher level. Results for the multilevel models are depicted in Table 5.

The influence of demographic variables on schools' innovative climate and shared decision-making

Prior to testing our hypotheses, we examined the predictive effect of various demographic variables on both innovative climate(IC) and shared decision-making (SD). In a first step, we ran our multilevel models including all demographic variables in varying subsets. Results indicated that only one demographic variable had a significant effect on the relationships in the study; whether or not a teacher also fulfilled staff (administrative) tasks in support of the school leader (see Table 5). Therefore, in the second step, only this demographic variable was included in all subsequent multilevel models. These models showed that teachers that perform staff tasks generally perceive the schools' climate to be less supportive of innovation and change. In contrast, performing staff tasks was positively related to perceptions of shared decision-making within the team. However, the influence of performing staff tasks on IC and SD is relatively small. Other demographic variables were excluded from the analyses.

Table 5. Multilevel regression analyses of the effect of Social Network Structure and Shared Decision-making (SD) on Innovative Climate (IC) and the effect of Social Network Structure on Shared Decision-making (SD) (N = 53, n = 775)

| | Innovative Climate (IC) | | | | | | | | Shared Decision-making (SD) | | | | | |
| | Model 1 | | Model 2 a | | Model 2 b | | Model 3 | | Model 1 | | Model 2 a | | Model 2 b | |
	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Intercept	2.97	.04	2.93	.037	2.932	.038	1.70	.13	3.38	.04	3.35	.03	3.36	.03
Teacher level														
Administrative tasks (dummy)	-.04 *	.02	-.05 **	.02	-.05 *	.019	-.07 ***	.02	.06 ***	.02	.06 ***	.02	.06 ***	.02
School level														
Instrumental Network														
- Density			.15 ***	.04			.10 **	.03			.11 ***	.03		
- Reciprocity			-.05	.03			-.04	.03			-.03	.03		
- Centralization			.05	.04			.04	.04			.04	.03		
Expressive Network														
- Density					.17 ***	.04							.06	.04
- Reciprocity					-.08 *	.04							.01	.03
- Centralization					-.01	.04							.05	.04
Shared Decision-Making (SD)							.37 ***	.04						
-2*log likelihood	1095.74		1074.89		1079.10		976.588		1043.92		1027.31		1034.92	
	χ^2 D. (1) = 5.55 *		χ^2 D. (4) = 26.40 ***		χ^2 D. (4) = 22.19 ***		χ^2 D. (5) = 124.70 ***		χ^2 D. (1) = 11.73 ***		χ^2 D. (4) = 28.34 ***		χ^2 D. (4) = 20.72 ***	
Explained variance														
School	0.6 %		10.1 %		9.1 %		21.7 %		1.3 %		7.0 %		5.1 %	
Teacher	0.3%		31.3 %		28.7 %		40.7 %		33.7 %		49.5 %		45.0 %	

Notes: * p < .05, ** p < .01, *** p < .001
Intercept-only for Innovative Climate (IC): χ^2 (3) = 1101.287; ICC$_{IC}$ = .244, χ^2 (1) = 103.853, p < .001
Intercept-only model for Shared Decision-Making (SD): χ^2 (3) = 1055.645; ICC$_{SD}$ = .153, χ^2 (1) = 68.849, p < .001
Total variance for Model 1 (IC): school level variance 24.4 %, teacher level variance 75.6 %
Total variance for Model 1 (SD): school level variance 15.3 %, teacher level variance 84.7 %

The influence of social network structure on schools' innovative climate and shared decision-making

The first hypothesis concerned the influence of social network structure (density, reciprocity, and centralization) of the instrumental and expressive advice relationships on innovative climate (IC) (See Table 5). Findings indicated that the density of both instrumental and expressive social networks had a significant effect on IC. Both models explained respectively 10.1% and 9.1 % of the school level variance, and 31.3% and 28.7 % of the teacher level variance. The more densely connected the school social networks around work related and personal advice, the more teachers perceived their school to have an innovative climate in which teachers were willing to collectively create new knowledge and practices. Contrary to our hypothesis, the more reciprocal the social network around personal advice, the less the school's climate is perceived to be innovative. Moreover, the extent to which the advice networks are centralized around a few influential people is not significantly related to perceptions of innovativeness in schools. Therefore, these findings only provided partial support for Hypothesis 1.

The second hypothesis involved the relationship between advice network structures (density, reciprocity, and centralization) and shared decision-making (SD) (See Table 5). Results indicated a significant positive effect of the density of schools' instrumental social network structure on SD, explaining 7.0 % of the school level variance, and 49.5 % teacher level variance. The more teachers were embedded in a densely connected work-related advice network, the more teachers perceived that they were involved in the decision-making process with their colleagues. This finding was not replicated in the expressive network, indicating that the amount of personal advice relationships among team members did not significantly influence educators' perceptions of shared decision-making. These results suggest that work-related advice relationships have a more substantial impact on creating a sense of involvement around decision-making in schools than personal relationships. Similar to the results of the IC analysis, reciprocity in both networks had no significant effect on SD. Surprisingly, the extent to which the advice networks were centralized did not significantly affect the teachers' sense of shared decision-making. As such Hypothesis 2 was only partially supported.

Mediating role of shared decision-making in predicting schools' innovative climate by social network structure

To test whether shared decision-making played a mediating role (Hypothesis 3), additional analyses were conducted. We followed procedures as suggested

by Baron and Kenny (1986) and Krull and MacKinnon (2001) to test for full mediation. Findings indicated that centralization was not significantly related to both IC and SD. Moreover, reciprocity was not significantly related to SD, as was the density of the expressive network. Thus, preconditions for mediation of the relationship between these social network measures and IC were not met. Therefore, we only tested the mediating role of SD in the relationship between density of the instrumental network and IC (see Model 3 in Table 5).

Previous analysis already established that the density of the instrumental social network structure accounted for significant variance in innovative climate (IC) (path c in Figure 1) (β_c = .145, p < .001). Findings also suggested that the density of the instrumental social network was positively related to schools' shared decision-making (SD) (path a) (β_a = .114, p < .001). In order to confirm mediation, it must be shown that the mediator is related to the dependent variable while 'fixing' the independent variable (Pearl, 2000). Therefore, we entered SD in the regression equation in which IC was regressed on the instrumental social network measures to examine whether this mediator accounted for any additional explained variance above the impact of social network structure on IC.

The mediator Model 3 (see Table 5) indeed explained more variance at both teacher and school level than the model without the mediator (Model 2 a). Results showed that teachers' shared decision-making influenced their perception of their school's innovative climate significantly, above the prediction of IC by social network measures (β_b = .368, p < .001). However, the main effect of density of the work-related advice network on schools' innovative climate remains significant as well, indicating that density and shared decision-making both affect teachers' perceptions of schools' innovative climate. Mediation by SD is evidenced when the direct effect of density on IC in this model is either zero (full mediation), or reduces significantly in absolute size (partial mediation). Addition of the proposed mediator SD to the regression equation reduces the direct effect of density on IC significantly (from β_c = .145 p < .001 to $\beta_{c'}$ = .103, p < .01), thus indicating partial mediation. Examination of Sobel's test confirmed the significance of the reduction (Sobel test statistic = 3.46, p < .001). The mediated effect can now be calculated as (β_c - $\beta_{c'}$) or $\beta_a * \beta_b$, which results in a mediated effect of β_b = .04. This suggests that the relationship between density and Innovative Climate is partially explained by Shared Decision-making. In other words, density of the work-related advice network facilitates the creation of new knowledge and builds orientation towards innovation partly because teachers in more densely connected advice networks perceive more participation in shared decision-making. Being embedded in a

dense network of work-related advice facilitates a more innovation-supportive school climate and involves teachers in shared decision-making, which in turn also benefits this innovation-supportive school climate. Therefore, results provided partial support for hypothesis 3.

Summation

In this line of inquiry we explored the relationship between school-level social network structures and shared decision-making in support of a school's innovative climate. Our study was guided by three hypotheses built on literature around social networks and innovation. The first hypothesis concerned a test of the positive effect of school-level density, reciprocity, and centralization of advice networks on schools' innovative climate. Our findings provided partial support for the first hypothesis, with density of work-related and personal advice networks having a significant positive effect on teachers' perceptions of the extent to which their school is characterized by an innovation-supportive climate. Neither the amount of reciprocal relationships, nor the centralization of the expressive and instrumental networks affected teachers' perceptions of their school's innovative climate. Secondly, we hypothesized a positive effect of density and reciprocity and a negative effect of network centralization on shared in decision-making. Results partially confirmed the second hypothesis indicating that density of the work-related advice network positively influenced perceptions of shared decision-making. Thirdly, we tested whether shared decision-making would positively mediate the relationship between schools' social network structure and their innovative climate. Results also provided partial support for the third hypothesis. The effect of the density of the work-related advice network on schools' innovative could be partially explained by increased teacher involvement in decision-making.

CONCLUSIONS AND DISCUSSION

With governmental pressure on school systems to develop new knowledge and practices there is an increasing need to better understand how organizations support orientation towards innovation. Scholarship from business indicates that ties within and across systems are important for innovation (McGrath & Krackhardt, 2003; Tenkasi & Chesmore, 2003). In addition, a few smaller scale studies within education suggest the relationship between innovation and social networks (Coburn & Russell, 2008; Penuel et al., 2009). This chapter

contributes to the literature around innovation in education by empirically testing the predictive quality of advice relationships on innovative climate with a large sample of schools.

In this chapter we draw on social network theory as a way to explore school organizations' innovation-supportive climate rather than focus on the implementation of specific innovations. In support of this goal we examined the relationship between social network structure and innovative climate in 53 schools in a large educational system in the Netherlands. We also explored the potential mediating effect of shared decision-making on the relationship between social network structure and schools' innovative climate. The literature around innovation suggested that relationships involving risk-taking may support the development of new knowledge (Calantone et al., 2003; Hage, 1999; Nohari & Gulati, 1996). In order to operationalize these risk-taking relationships we examined the social networks around work related and personal advice as these relations imply a level of vulnerability and risk. Results indicated that school teams with more densely connected relationships around advice were characterized by a more innovative climate than less densely connected teams. These findings lend support to the importance of relational linkages ('bonding') as a resource upon which to draw in fostering and sustaining school wide innovation-supportive climates. In this section we provide the key themes from our findings and implications for research and practice.

Developing advice relationships catalyzes schools' innovative climate
Our findings indicated that teachers embedded in more densely connected networks around work related and personal advice perceive their school's climate as more innovation-supportive, more open towards change and knowledge creation than schools with less dense networks. The relationships around work-related and personal advice have at their core a willingness to be vulnerable and engage in a level of risk taking. It is this willingness to be vulnerable and engage in risk taking with multiple others in the organization that appears important for the development of innovations and the creation of new knowledge at the school level. Risk-taking and vulnerability are central to trusting relations, which have been found to support productivity, leadership, and a more responsive climate in schools (Bryk & Schneider, 2002; Daly, 2009; Frank et al., 2004; Tschannen-Moran, 2004). Our findings build on this work and suggest that relationships based in trust may also be associated with the generation of new knowledge and practices. Therefore, efforts to create trusting environments within a school may also improve the school's innovative climate.

Interestingly, patterns of reciprocity within work advice were not predictive of perceptions of the schools' innovative climate, while reciprocity of personal advice was only slightly negatively related to innovative climate. This is not to suggest that reciprocated advice relations are not important within organizations. Reciprocated relationships may in fact be very important in low trust climates. Research has shown that low trust settings in schools are characterized by less dense networks, but relatively high reciprocity compared to high trust settings (Moolenaar et al., 2009). In those uncertain environments in which trust is perceived to be lacking, actors may seek out only a few 'safe' colleagues with whom to interact (Granovetter, 1982; Shah, 1998). In contrast, in systems in which relationships are embedded in a risk tolerant climate, actors may depend less on reciprocated relationships with only a few reliable individuals, as there may be multiple other actors with whom one has trusting relations (Moolenaar et al., 2009). This explanation may also account for the small negative correlation between reciprocity of personal advice and schools' innovative climate.

Similarly, the extent to which schools' social networks around work related and personal advice are centralized did not affect perceptions of innovative climate and shared decision-making. In comparison, a rich stream of organizational literature has provided evidence of both positive and negative relationships between formal centralization and innovation (Moch & Morse, 1977). In education, scholars point to the potential benefits of the distribution of leadership among formal and informal leaders based on expertise and knowledge (Spillane, 2006) and suggest that formal centralization may hinder schools' adaption to changing environments (Ouchi, 2009; Tschannen-Moran, 2009). Although advice network centralization and innovative climate were weakly associated, multilevel analyses did not support a predictive relationship between centralization and innovative climate. In other words, the distribution of work and personal advice among team members did not influence teachers' perceptions of the team's openness to change and willingness to collectively develop and implement new practices. Since few studies have addressed social network structures in schools, additional research is warranted to deepen our understanding of the extent to which, and the way in which, informal centralization and the distribution of leadership practices shape conditions for school improvement.

In the current educational climate there is an increasing need to collaborate and redesign the way in which teachers work through managing and drawing upon social ties (Honig, 2009). Access to these ties may be facilitated through a general orientation within the organization toward change

and risk taking. This orientation provides increased opportunities for actors to interact with multiple others and potentially creating new knowledge and practices. Therefore, the more an organization provides opportunities for members to enter the stream of social activity, the more actors are exposed to multiple others, and the more likely new ideas can be exchanged and practices created. Innovation in this sense is a less linear process and involves more circular and recursive paths with multiple opportunities for the engagement of actors (Engeström, 1987; Nonaka & Takeuchi, 1995). Pro-change environments may reduce the need to rely on only a few reciprocated relationships as the source of information, as may be the case in low trust environments, and opens the systems to multiple interactive opportunities for the development of new knowledge.

Research into innovation in schools suggests a relationship between a school's innovative climate, and expectations and satisfaction in regard to the degree of collaboration (Geijsel et al., 1999; Van den Berg & Sleegers, 1996b). Studies showed that teachers in schools with a strong innovative climate had higher expectations of collaboration than teachers in low innovative climate schools. In addition, teachers in innovative environments were less satisfied with the existing extent of collaboration in their schools and preferred a higher level of interaction. Our work suggests that a stronger innovative climate is related to higher levels of teacher interaction with regard to advice. This implies that in schools with strong innovation-supportive climates, there may be a continuous push from within the school to intensify teacher interaction by setting and maintaining high goals for collaboration and its school-wide outcomes.

Increasing shared decision-making in support of schools' innovative climate
The notion of being a part of a larger decision-making process has been suggested to provide ownership, responsibility, and ultimately success for school efforts (Chrispeels, 2004; Clune & White, 1988; Smylie, 1996). Moreover, this sense of shared decision-making is a critical foundation upon which to deepen and sustain change efforts in schools (Coburn, 2003; Copland & Boatright, 2004). Our work suggests the importance of the relationship between shared decision-making and an innovative climate which to date has had a limited empirical literature base (Frank et al., 2004). This study adds to the knowledge base in finding a significant positive relationship between teacher involvement in the decision-making processes and teacher perceptions of their school's innovative climate.

We found that while both the work related and personal advice networks were predictive of schools' innovative climate, it was only the work related advice network structure that also predicted shared decision-making. Therefore, in supporting the collective development of new knowledge and practices and an open orientation towards improvement through innovation, teachers and leaders would be advised to create pro-change climates in which members are encouraged to seek one another for work related advice. Our findings also suggest the importance of teachers seeking work related information from a variety of colleagues as a way to be an informed member of shared decision-making processes in their school.

Our results indicate that network relations are important in predicting teachers' perceptions of their schools' innovative climate. For work related advice this effect could be partially explained by teachers' perceptions of shared decision-making. Therefore, shared decision-making can be seen as the means through which work related advice relationships build a school-wide innovative climate. This study provides evidence to suggest that teacher involvement in decision-making can be strengthened through more densely connected work related advice networks. In order to increase innovation potential, teachers and leaders would be well advised to invest in work related advice relationships. As our work suggests these work-related advice ties not only support the school's innovative climate, but also yield gains in shared decision-making that in turn augments the schools' capacity to generate new knowledge and practices in order to constantly adapt to changing environments.

The larger implication of this work is for educational policy. Many educational policies stress the importance of access to technical knowledge and work-related information as important in the generation of new practices. Our findings indicated significant relationships between advice relations, shared decision-making, and innovative climate. However, many policy instruments are uni-directional in targeting the development of technical skills and rarely attend to relational linkages. Therefore, as policies around innovation are being crafted and implemented in both the Netherlands and US, policy-makers would be well served to include both a human *and* social capital component in policy aimed at enhancing the orientation towards innovation of schools.

Limitations

Although we see the potential of this study for influencing research and practice, we recognize its limitations. A sample size of 53 schools provided reasonable statistical power, but we acknowledge the sample size limits in

making definite statistical claims. However, finding statistically significant effects of the magnitude as reported suggests the importance of the relationships under examination (Mohammed & Ringseis, 2001). Studies including larger and more varied samples are clearly indicated. We also would like to test the relationships with schools in different stages of reform efforts at multiple levels (secondary and higher education). It should be noted that Dutch schools in general serve less students than elementary schools in the US, which may limit generalizability to larger school districts in the United States. Moreover, while causality of the relationships in the study is suggested by literature, our methods were not intended to validate the causal nature of these relationships. Therefore, caution must be exercised in regard to causal interpretation of the findings.

Several authors have investigated teacher social networks by choosing the teacher as the level of analysis (Coburn & Russell, 2008; Penuel et al., 2009). Our study extends the potential of social network research in education by examining social networks at the school level. We illustrated that examining a larger sample of schools renders valuable insights in the variability of social network structures among schools and its influence on school outcomes, such as orientation towards innovation. While acknowledging the value of studying teacher interactions at the individual level, we also underscore the need for studies of social networks with schools as the unit of analysis as these studies can identify differences between schools that modify their potential to meet goals. In addition, studies that include social network measures at multiple levels of analysis are needed to clarify the interplay between social relationships at both teacher and school level. Multilevel social network studies have the potential to refine our understanding of social linkages in relation to characteristics that are associated with teacher communities, such as trust, collective efficacy, shared norms and values, and ultimately student achievement.

Areas for future research
Although in this study we did not formally examine the role of leadership in supporting organizational capacity for innovation, many of our findings may be directly related to the practice of leadership. As has been noted in the literature, climates that support risk taking and reflection are necessary components for an innovative (Calantone et al., 2003; Hage, 1999; Nohari & Gulati, 1996). Leadership may play an important role in providing opportunities for increased interaction and engaging teachers in shared decision-making (Geijsel et al., 2009). In fact, recent research suggests that the more opportunities for

involvement provided to teachers the more flexible educators are in responding to increasing demands for improvement (Daly, 2009).

Approaching leadership as a shared practice that is spread over actors is a central feature in the study of distributed leadership. The developing empirical base around distributed leadership suggests a positive relationship between the distribution of leadership and school change (Harris, 2007; Spillane, 2006). This work around distributed leadership underscores the manner in which leadership provides opportunities for teacher involvement around decision-making with recent work suggesting strong relationships with professional learning communities (Stoll & Louis, 2007). Future work in this field may also assist in more nuanced understanding of professional learning communities as potential structures to improve student achievement. The intersection between social networks, teacher involvement, and distributed leadership appears a rich area for further investigation.

Ties with Potential

Governmental pressures in the Netherlands and United States continue to demand innovative practices in order to increase performance. However, despite the push for more innovation there is a limited empirical base on supportive conditions for innovation in schools. In this chapter we suggest that the first step in the push for innovation is to understand what makes the fertile ground upon which innovations can flourish. Building and sustaining relationships that support risk-taking and informed participation appears to be one route to increase the organizational capacity to innovate and perhaps ultimately improve performance. It is through these ties with potential that the development and generation of new knowledge and practices flow and hold the promise of building capacities toward improvement.

CHAPTER 7

Yes, We Can!
Linking Teachers' Networks and Student Achievement through Collective Efficacy [1]

ABSTRACT

Background. Educational reform efforts aimed at increasing student achievement have embraced collaborative practice as a means to intensify teacher interaction in support of improved instruction and student learning. While recent studies suggest the importance of strong teacher networks for school conditions that may benefit student achievement, empirical evidence of the direct effect of teacher networks on student learning is weak.

Purpose. The goal of this study was to examine the relationship between schools' social network structure and student achievement and the potential mediating role of teachers' collective efficacy beliefs.

Method. Data were collected from 775 teachers of 53 elementary schools in a large educational system in the Netherlands. Student data were obtained at the school level, representing the results of 1383 sixth grade students on a nation-wide standardized final test administered one month after the collection of the teacher data. Using social network analysis and multiple regression analysis, we analyzed data from a quantitative teacher survey in combination with school level student achievement data. The teacher survey consisted of a Likert-type scale on perceived collective efficacy and social network questions on work related and personal advice.

Conclusions. A direct effect of social network structure on student achievement could not be evidenced. Yet, findings suggest an indirect effect of social network structure on student language achievement through collective efficacy. Highly dense teacher networks are associated with strong teacher collective efficacy, and in turn, strong teacher collective efficacy was related to school level student achievement.

INTRODUCTION

A typical feature of contemporary educational landscapes of many countries are pervasive and often large-scale efforts aimed at raising student performance. In recent years, educational reforms have been focused on improving instructional quality and student learning through an increased focus on collaborative practices and intensified teacher interaction (Brownell, Yeager, Rennells, & Riley, 1997; Goddard, Goddard, & Tschannen-Moran, 2007; Louis, Marks, & Kruse, 1996). Terms such as 'professional learning community', 'community of practice', 'community of learners' 'community of continuous inquiry and improvement' (Barth, 1990; Hord, 1997; Louis & Kruse, 1995; McLaughlin & Talbert, 1993; Mitchell & Sackney, 2000) all promote an atmosphere of collective efforts and shared practice. Motivated by indications that strong professional communities of teachers indeed produce increased student learning (Lee & Smith 1996; Newmann, King, and Youngs 2000), educational policy and practice has seemed to embraced teacher collaboration 'as a contemporary Zeitgeist' (Gable & Manning, 1997, p. 219).

Since teacher collaboration takes shape through teacher interaction (Friend & Cook, 1992; Mostert, 1998; West, 1990), recent studies have focused on teacher networks as a lens to study collaborative efforts in schools (Coburn & Russell, 2008; Daly, Moolenaar, Bolivar, & Burke, in press; Moolenaar, Daly, & Sleegers, in press; Lima, 2004; Penuel, Frank, & Krause, 2007b; Penuel & Riel, 2007). Social network research outside education suggests that the configuration of organizational networks may benefit organizational functioning (Balkundi & Kilduff, 2005; Kilduff & Krackhardt, 2008 Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998). In line with this argument, educational social network studies often emphasize the potential importance of teacher networks for school change and educational reform (Coburn & Russell, 2008) and student achievement (Daly & Finnigan, 2009; Moolenaar et al., in press; Penuel et al., 2007a). However, this argument has not yet been subject to extensive empirical study. While recent studies suggest the importance of strong teacher networks for school conditions that may benefit student achievement, empirical evidence of the effects of teacher networks on student learning is limited.

Recent research suggests that the relationship between student achievement and teacher collaboration, while important for instructional improvement, 'is likely indirect' (Goddard, Goddard, & Tschannen-Moran, 2007). Meaning, teacher collaboration may benefit teachers' practice in many ways, which in turn will affect student achievement. As main benefits of collegial relationships that may affect student achievement, scholars refer to

feelings of equally shared responsibility for positive outcomes (Brookhart & Loadman, 1990), alignment of expectations for students, increased feelings of effectiveness (Little, 1987), and raised sense of efficacy (Ashton & Webb, 1986; Bandura, 1993; Johnson et al., 1981; Louis, 1992; Rosenholtz, 1989; Ross, 1995; Ross, Cousins, & Gadalla, 1996). Collective efficacy is a concept that amalgamates these benefits as it expresses shared perceptions of a group's ability to achieve collective goals (reflected in the motto 'Yes, we can'). Perceived collective efficacy is both associated with teacher collaboration (Ashton & Webb, 1986) and student achievement (Goddard, 2002, Goddard, Hoy & Woolfolk Hoy, 2000). As such, collective efficacy may be a mechanism that can explain how configurations of teacher networks affect student achievement.

This chapter is aimed at examining teachers' collective efficacy as a plausible mechanism that explains the suggested relationship between teacher network structure and student achievement. We will argue that teacher networks may be especially important in promoting student learning and increased student performance since connections between teachers may enlarge teachers' skill sets (Mostert, 1998; Phillips & McCullough, 1990; Trent, 1998) and increase the confidence of teachers in their beliefs about how well they can collectively motivate students and in turn improve their learning. As such, this chapter not only makes a significant contribution to the growing literature base around social networks in education, it also offers important insights potential elements that shape teachers' collective efficacy. In this chapter, we present the results of an investigation schools social networks, perceived collective efficacy, and student achievement in 53 elementary schools in a large Dutch school district. In the next section, we will review the literature around social networks and perceived collective efficacy, and elaborate the relationships between advice network structure, collective efficacy, and student achievement.

THEORETICAL FRAMEWORK

Teachers' social networks

Teachers' social networks are being increasingly studied to understand how policy efforts at reform take shape in teachers' interactions (Coburn & Russell, 2008; Daly et al., in press). Moreover, scholarly efforts are focusing on the extent to which teachers' social networks support or constrain teacher and school conditions, such as trust (Moolenaar, Karsten, Sleegers, & Zijlstra, 2009), teacher involvement in shared decision-making, and schools' innovative climate

(Moolenaar et al., in press). Studies into the effects of teacher social networks all share an underlying assumption that teacher interactions, as embedded in teachers' social networks, ultimately benefit student achievement. Often, this assumption is supported through using a lens of social capital theory (Coburn & Russell, 2008; Daly et al., in press; Moolenaar et al, 2009; Moolenaar et al., in press).

Social capital theory postulates that social relationships provide access to resources that can be exchanged, borrowed and leveraged to facilitate achieving goals (Bourdieu, 1986; Putnam, 2000). According to this theory, teachers with many social relationships can access a multitude of valuable resources through these social ties, such as advice, instructional materials, social support, knowledge, or information. At the school team level, high levels of social capital may evidence a frequent exchange of these resources, which, in turn, may facilitate in achieving instructional goals and help overcome obstacles that occur in daily teaching practice. While findings from organizational research indicate that organizational social capital can enhance organizational outcomes (Adler & Kwon, 2002; Nahapiet & Ghoshal, 1998; Leana & Van Buren, 1999; Walker, Kogut, & Shah, 1997), these results have not yet been fully examined in the context of public education with regard to student achievement.

Crucial to the exchange of resources in the network are the pattern and quality of the social relationships that form the network (Burt, 1992; Coleman, 1990; Lin, 2001; Putnam, 2000). While patterns of dense and cohesive relationships may support the transfer of resources such as knowledge and information through a network, the lack of sufficient relationships can impede or constrain the network's capability to facilitate collective action and achieve desired goals (Daly & Finnigan, 2009; Hite, Williams, & Baugh, 2005). Common characteristics by which to describe social network structure at the organizational level are density and the centralization of the network (Daly et al., in press; Moolenaar et al., in press).

The density of a network refers to the number of existing ties in a network in relation to the maximum number of possible ties. In a dense network, many people are connected to one another, while in a sparse network, there are a few relationships among the actors of the network. Recently, studies have found that the density of a teacher network is related to the extent to which teachers are willing to take risks to improve their school, are continuously learning and trying to improve their teaching (Moolenaar et al., in press) and perceive that they have a say in the implementation of reform and decisions around daily instructional practice. In contrast, less dense networks

are well suited for the exchange of non-complex, routine information (Hansen, 1999).

In another informative network characteristic is network centralization. A network is highly centralized when a few actors in the network send and receive many relationships, whereas many other actors only have a few relationships. High network centralization may signify that a few actors are 'controlling' the flow of resources in a network in which others are less involved (see also *Chapter 4*). While more centralized networks may constrain an organization's flexibility in adapting to change (Daly & Finnigan, 2009), network centralization has also been found to facilitate the exchange of more technical knowledge (Cummings & Cross, 2003).

In addition to the pattern and quality of the social relationships in a network, the content that is exchanged within a social network also matters (Coburn & Russell, 2008; Scott, 2000, see *Chapter 2*). The structure of a social network can be defined by the content of the resources that flow through its relationships. The nature of these resources may affect the ease and speed with which they are transferred in the network. For instance, the pattern of social relationships that are formed with the purpose of sharing technical information and knowledge may differ significantly from the pattern of relationships that are created around friendship or the discussion of confidential matters (see also *Chapter 2*). While the ties of both social networks exchange resources (the first being knowledge, the second personal support), the configuration of ties in both networks may look quite different.

In social network literature, studies often make a distinction between instrumental and expressive social networks (Ibarra, 1993). Instrumental networks contain social relationships that are aimed at achieving organizational goals, and may transfer resources such as work related information, knowledge, instructional materials, and task related advice. In contrast, expressive networks encompass social relationships that transfer resources with an affective component, such as social support, friendship, and advice about personal matters that are not directly aimed at achieving organizational goals. Expressive relationships are often more time-consuming to grow, given the level of trust that is involved, than instrumental relationships, but tend to be more stable and often stronger over time (Granovetter, 1973; Ibarra, 1993; Uzzi, 1997).

In line with previous studies on social networks in education (Moolenaar, Daly, Sleegers, in press; Moolenaar, Karsten, Sleegers, & Zijlstra, 2009), we focused on instrumental and expressive relationships related to advice among the educators in the sample schools. Advice relationships are important to student achievement and school improvement as they reflect patterns of

information exchange that were found to be supportive of innovative climates and shared decision-making (Moolenaar et al., in press).

While it is unlikely that the pattern of teacher interactions within a school team will directly affect student achievement (Goddard, Goddard, & Tschannen-Moran, 2007), there are indications that teachers' social networks may indirectly affect student achievement through various school and teacher level conditions. Recent studies have indicated that dense teacher networks around work related advice support an innovative school climate, in which people are willing to take risks to collectively improve educational instruction (Moolenaar et al., in press). Also, teachers that maintained many connections with colleagues and that were embedded in a densely connected network displayed higher levels of trust in their colleagues (Moolenaar et al., 2009). Both teacher trust and schools' innovative climates have been associated with student achievement (Bryk & Schneider, 2002; Tschannen-Moran, 2001). While teachers' social networks may indirectly affect student achievement through these school and teacher level conditions, studies into the mechanisms that may explain the relationship between teacher interaction and student achievement are scarce. In the next section, we will introduce collective efficacy as such a plausible mechanism that may serve as the missing link between schools' network structure and student achievement.

Building collective efficacy through social networks

Building on earlier work on self-efficacy, Bandura (1997) conceptualized collective efficacy as a group-level phenomenon that links learning and functioning of groups (Bandura, 1997). Collective efficacy 'represents a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produces given levels of attainment' (Bandura, 1997, p. 477-478). As such, collective efficacy perceptions are future-oriented beliefs about the functioning of a collective in a specific situation or context (Bandura, 1997). Applied to the educational setting, 'perceived collective efficacy refers to the judgment of teachers in a school that the faculty as a whole can organize and execute the courses of action required to have a positive effect on students' (Goddard, Hoy, & Woolfolk Hoy, 2004). Research has established collective efficacy as a group-level phenomenon and indicated that collective efficacy affects organizational commitment and group performance (Chen et al., 2002; Lindsley, Brass & Thomas, 1995; Ross & Gray, 2006; Riggs & Knight, 1994). Schools with high collective efficacy have teachers which are more willing to exert extra effort and pro-social behavior for the organization (Somech & Drach-Zahavy, 2000; Ross & Gray, 2006).

Teachers' collective beliefs about their capacity to realize desired collective results may be dependent on the relationships that can be leveraged and the resources that can be accessed through their school's social networks. Teacher networks provide the social context in which teachers share knowledge and information, provide and receive social support, and collaborate to achieve collective goals that could not be accomplished by an individual working in isolation (Macinko & Starfield, 2001). By breaking away the isolation of the classroom, collegial relationships among teachers lead to increased feelings of effectiveness and satisfaction (Little, 1987). Several scholars have suggested that the interdependency of teachers contributes to teachers' collective efficacy beliefs (Bandura, 1993; Kurz & Knight, 2004).

Research has indicated a positive relationship between perceptions of collective efficacy and teacher interaction in the form of collegiality and collaborative work (MacKenzie, 2000). By exchanging knowledge, sharing experiences, and collectively searching for solutions to problems, teachers may build confidence in their team's collective capability to motivate students, offer a targeted instructional program in support of student learning, and handle difficult situations. Teacher interaction can bring shared sense of purpose and a feeling of collectivity (Barth, 1990; Darling-Hammond, 1997; Lee, Dedrick, & Smith, 1991; Little, 1982; Mostert, 1998). A positive relationship between schools' social networks and teachers' perceptions of their collective capability to educate their students is further supported by the idea that teacher interaction offers opportunities to experience the team's ability to promote student learning and to build consensus around shared goals and expectations for students. For instance, teachers that exchange advice on work related matters, such as the use of new teaching materials, may benefit from the skills and ability of their colleagues. Moreover, they have the opportunity to build consensus on the use and expected benefits of the teaching material, which will shape their future expectations.

Teachers' social networks around advice relationships may play a substantial role in shaping teachers' collective efficacy beliefs. The act of asking for advice implies that the advice seeker expects an advice-giver to possess potentially valuable knowledge or information and to have the ability and competence to provide useful advice (Ho, 2005; McAllister, 1995; Zagenczyk et al., 2008). Asking for advice may indicate to the advice-giver a willingness to learn on the part of the advice seeker. Also, the act of giving advice may demonstrate the skills of the advice-giver and increase the advice-giver's sense of efficacy by sharing expertise and offering personal guidance. As such, densely connected networks that reflect the exchange of shared expertise and

personal guidance may increase teachers' beliefs about their collective competence to solve collective problems, achieve desired goals, and improve school-wide performance.

Besides building collective efficacy through shared experiences, collective efficacy may be influenced by observing successful role-models (Goddard; 2001, 2003b; Goddard et al., 2004; Gorrell & Capron, 1988; Schunk & Zimmerman, 1997). It is therefore plausible to assume that networks in which advice is centralized around a few central individuals are characterized by higher levels of perceived collective efficacy. Taken together, we hypothesize that dense and centralized teacher networks positively influence teachers' perceptions of collective efficacy (*Hypothesis 1).*

Collective efficacy in support of student achievement
Throughout the years, different scholars have suggested that teachers' personal self-efficacy influences students' motivation and achievement. Although negative correlations between teachers' sense of self-efficacy and students' self-concept of ability and self-reliance have been found (Brookover, Beady, Flood, Schweitzer, & Wisenbaker, 1979), most studies have found a positive relationship between teacher efficacy beliefs and several student cognitive and non-cognitive outcomes such as achievement in core academic subjects (e.g. Anderson, Greene, & Loewen, 1988; Ashton & Webb, 1986; Ross & Cousins, 1993), motivation (Roeser, Arbreton, & Anderman, 1993), attitudes toward school (Miskel, McDonald, & Bloom, 1983) and performance and skills (Midgley, Feldlaufer & Eccles, 1989; Ross, Hogaboam-Gray, & Hannay, 2001).

Although conceptually different, the relationship between teacher efficacy and student outcomes has been replicated at the collective level. Empirical evidence indicates that teachers' perceptions of self-efficacy and perceived collective efficacy are strong predictors of school level student achievement (Bandura, 1993; Goddard, 2001; 2002; Goddard & Goddard, 2001; Goddard et al., 2000; Goddard, Hoy & Woolfolk Hoy, 2000, 2004; Hoy, Sweetland, & Smith, 2002; Ross, Hogaboam-Gray, & Gray, 2003; Tschannen-Moran & Barr, 2004). In some studies, collective efficacy has even been found to be a stronger predictor of student achievement than socio-economic status (SES) or ethnicity, even controlled for other factors such as gender and students' prior achievement (Bandura, 1997). Explanations for the beneficial effect of teachers' efficacy beliefs on student achievement have been sought among educationally productive elements, such as: level of effort and persistence with students (Tschannen-Moran & Woolfolk Hoy, 2001); classroom strategies that are better planned and organized (Allinder, 1994); and student-centered and humanistic

approaches (Czerniak & Schriver, 1994; Enochs, Scharmann, & Riggs, 1995; Woolfolk Hoy & Hoy, 1990). In line with these findings, we hypothesize that teachers' perceptions of collective efficacy will positively affect student achievement (*Hypothesis 2).*

In sum, the presented literature review suggests that the pattern and content of teachers' relationships in schools indirectly affects student achievement through increased teacher perceptions of collective efficacy. In order to examine the relationships between social networks, collective efficacy, and student outcomes, we will now describe the method and results of a study conducted in 53 schools of a large educational system in the Netherlands, designed to address these hypotheses.

METHOD

Context

In the Netherlands, as in many western countries, educational policy-makers, scholars, and practitioners are interested in teacher communities as a means to improve teaching and learning, and ultimately, student achievement. Data for this study were collected in 53 Dutch elementary schools of the Avvansa School District[1], located in the south of the Netherlands, which provides administrative, financial, and professional development support to the schools. The schools were selected as the district engaged in a district-wide monitoring process around school improvement and teacher professional development.

Sample

A total of 53 schools participated in the study by distributing questionnaires on social networks and collective efficacy among all teaching personnel. Data were gathered from 775 educators (teachers and principals), reflecting a response rate of 96.8 %. Of the educators, 27.1 % of the respondents were male and 72.9 % female. These numbers approximately reflect the gender ratio in Dutch elementary education across the country. The average number of educators per school is 15 (M = 14.8, SD = 6.8). Each school level team had a minimum six months of experience in their current configuration, with the majority of teams (62.2 %) having had at least two years of shared experience. The average number of students per school is 213 (M = 213.0, SD = 116.6). Additional sample demographics are presented in Table 1 and 2.

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[1] All names are pseudonyms

Table 1. Sample characteristics of Grade 6 students (n = 1383) in schools (N = 53).

<u>Gender</u>				
Male	676	(48.9 %)		
Female	707	(51.1 %)		
<u>Age</u>				
10 years	7	(0.5 %)		
11 years	831	(60.1 %)		
12 years	516	(37.3 %)		
13 years	29	(2.1 %)		
<u>Parents' country of Birth</u>	<u>Mother</u>		<u>Father</u>	
Netherlands	1215	(87.9 %)	1167	(84.4 %)
Turkey	4	(0.3 %)	4	(0.3 %)
Morocco	17	(1.2 %)	14	(1.0 %)
Suriname	4	(0.3 %)	4	(0.3 %)
Netherlands Antilles	8	(0.6 %)	13	(0.9 %)
Another country, in Europe	62	(4.5 %)	47	(3.4 %)
Another country, in Africa	7	(0.5 %)	8	(0.6 %)
Another country, in Asia	28	(2.0 %)	26	(1.9 %)
Other	10	(0.7 %)	3	(0.2 %)
Unknown	28	(2.0%)	97	(7.0 %)
<u>Parents' highest level of completed education</u>	<u>Mother</u>		<u>Father</u>	
No school / elementary education	30	(2.2 %)	22	(1.6 %)
High school	661	(47.8 %)	590	(42.7 %)
Above high school	607	(43.9 %)	677	(49.0 %)
Unknown	85	(6.1 %)	94	(6.8 %)
<u>Home language</u>				
Dutch	952	(68.8 %)		
Another language	245	(17.7 %)		
Two or more languages concurrently	149	(10.8 %)		
Unknown	37	(2.7 %)		

Instruments

Social networks. We examined teachers' advice networks in the sample schools using social network analysis. The respondents were offered two social network questions regarding advice relationships. To assess the work related advice network in the sample schools, the educators were asked to answer the question: 'Whom do you go to for (work related) advice?'. Following Ibarra (1993), we will refer to this network as the *instrumental network*. To examine the personal advice network in the sample schools, we asked the educators to respond to the question: 'Whom do you go to for guidance on more personal matters?'. We will refer to this network as the *expressive network*. The social network survey was accompanied by a school-specific appendix that listed the names of the schools' educators together with a letter combination (e.g., Mr. Allen Driver[1] = AB). The educators could answer the questions by indicating the letter combinations of the colleagues, with whom they have the relationship as described in the social network question. They could name as many colleagues as they wanted.

   Collective efficacy. Perceptions of collective efficacy of the school staff were measured with five items of the Collective Efficacy Scale (CE-Scale) developed by Goddard (2002). This instrument was translated and adjusted to the Dutch context of elementary education. The scale was designed to assess faculty perceptions of collective efficacy. For example, in one item teachers were asked: 'Teachers in this school are able to get through to difficult students'. Respondents could express their agreement with the items on a 4-point scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Principal component analysis provided evidence that the five items contributed to a single factor solution explaining 49.8 % of the variance (α = .73). The items and factor loadings for the scale are presented in Table 3.

   Although we measured collective efficacy at the individual level, the concept should be interpreted as a school level variable since 'perceived collective efficacy is an emergent group-level attribute rather than simply the sum of members' perceived personal efficacies' (Bandura, 1997, p. 478). Following previous research (Goddard, Hoy, & Woolfolk Hoy, 2004), we used aggregate measures of individuals' perceptions of group referent capability. "Group referent" indicates that we changed the object of the efficacy perception – the items are similar to teachers' perceptions of individual efficacy but all started with "we" instead of "I". While a claim to assess collective efficacy at the collective level is conceptually justified, empirical evidence is also needed to

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[1] All names are pseudonyms

Table 2. Sample characteristics of schools (N = 53)

	N	M	Sd	Min.	Max.
Student level					
School level student gender ratio	53	50.0	13.6	25.0	83.3
Socio-economic status (SES) [1]	53	92.1	9.5	52.7	96.6
School level					
School size (number of students)	53	213.0	116.6	53	545
Team size (number of educators)	53	14.8	6.8	6	31
Gender ratio [2]	53	76.8	10.7	57.0	100.0

Table 3. Items, factor loadings and Cronbach's alpha for Collective efficacy (n = 775)

	Factor I
Collective efficacy (α = .73)	
At this school…	
1. Teachers are able to motivate their students	.78
2. Teachers are able to challenge their students to learn	.78
3. Teachers in this school are able to get through to difficult students	.70
4. Teachers in this school really believe every child can learn	.68
5. If a child doesn't want to learn teachers here give up (*Reversed*)	.57

[1] SES is calculated as the weighted percentage of students for whom the school <u>does not</u> receive extra financial resources; the lower this percentage, the more students with low SES the school serves.

[2] Percentage of female educators

validate aggregation of individual level data (Klein & Kozlowski, 2000). In order to justify the aggregation of individual teacher perceptions of collective efficacy into a school level aggregate, we calculated interrater agreement (*r* wg[*j*]; James, Demaree, & Wolf, 1984) and interrater reliability (ICC[1] and ICC[2]; cf. Bliese, 2000; LeBreton & Senter, 2008). An *r* wg[*j*] higher than 0.70 implies high within-group agreement (LeBreton et al., 2003). The ICC[1] is typically interpreted as an effect size (Bliese, 2000; Raudenbush, & Bryk, 2002). Values of .01, .10, and .25 can thus be interpreted as a small, medium, or large effect. The ICC[2] can be interpreted as a reliability coefficient, with 0.70 as a sufficient value to assume interrater reliability (see LeBreton & Senter, 2008, for a useful review of interrater agreement vs. interrater reliability). The three measures were found to be sufficiently supportive of aggregation (*r* wg[*j*] = .91, ICC[1] = .11, ICC[2] = .64;). Supported by these findings, we therefore aggregated individual teacher perceptions of collective efficacy to a school level variable.

School level student achievement. We included school level student achievement as the school level mean score on a standardized test that was administered to all sixth-grade students of the sample schools (age 11-12). In the final year of elementary education, sixth-grade students participate in a nation-wide standardized Final Primary Education Test (CITO). Based on the result of this test and the school's advice, the students are assigned to different levels of high school to continue their education. We included students' standardized score on the topics Language (100 items) and Aritmetic / Mathematics (60 items), as these are considered the core competences assessed by the test. The multiple choice questions could be answered by selecting the right answer from three, four, or five options. The test is considered to be a reliable and valid measure of student achievement (Cito, 2009).

Demographic variables. We collected demographic characteristics of students, teachers, and schools to assess the presence of relationships between demographics, advice network characteristics, collective efficacy, and student achievement. With regard to students, we included the school level student gender ratio (percentage of girls) as a control variable because research has repeatedly demonstrated that boys outperform girls in mathematics (Bae, Choy, Geddes, Sable, & Snyder, 2000; Van Schilt-Mol, 2007). We also included school level socio-economic status (SES) of the schools (based on a governmental weighting factor for additional financial support) and percentage of bilingual students since this may influence school level student achievement (Van Schilt-Mol, 2007). The community surrounding the school may directly influence teachers' perceptions of the abilities, and motivations of the students, and the

level of support they receive from home and the community, which is captured by the task analysis scale of collective efficacy. Research has evidenced that school teams that serve a high proportion of socioeconomically disadvantaged students tend to be characterized by a lower sense of collective efficacy (Bandura, 1997; Parker, 1994).

With regard to school characteristics, we included school size (number of students) and team size (number of educators) as important demographic variables since they are known to be directly related to the social networks (Cole & Weinbaum, 2007; Tsai, 2001). In addition, we included team composition variables such as gender ratio (percentage of female educators) and age, because both have been associated with teachers' perceptions of collective efficacy (Bandura, 1997). We added years of conjoint team experience because groups with a longer history of shared experiences may have more information to support their perceptions of collective efficacy compared to teams with less shared experience. Also, it provides "a context in which certain team beliefs and processes are likely to evolve" (Chen et al., 2002, p. 385).

Data analysis

Social networks. We examined density and centralization of instrumental (work related advice) and expressive (personal guidance) advice networks among educators within each school (Borgatti, Jones & Everett, 1998). These social network characteristics were calculated using UCINET 6.0 (Borgatti, Everett, & Freeman, 2002). The following paragraphs discuss the school level network characteristics in detail.

Network *density* refers to the number of relationships in a network, relative to the size of the network. Density of the advice networks was calculated as the proportion of existing relationships to the maximum number of relationships possible in the network. The value of density can vary between 0 (there are no relationships among the actors in the network) and 1 (all actors are connected to each other). For example, the more dense the expressive (personal advice) network, the more team members turn to each other for advice on personal matters. Density can be used to indicate group cohesion (see Blau, 1977; in Wasserman & Faust, 1997, p. 181).

Network *centralization* is a network characteristic that informs about the relative centrality of a single actor in contrast to the other actors in the network (Wasserman & Faust, 1997). An actor occupies a central position in a network when s/he is nominated by many colleagues as a valuable source for advice. While an individual respondent with high centrality can be regarded as the most central person in a network, a network with a high centralization depicts a

high variability among individual centralities in the network (Wasserman & Faust, 1997). Network centralization was standardized to facilitate comparisons among schools. Centralization will reach the maximum value of 1 when every teacher in a network only asks advice from a single person in the network, while these teachers themselves are not asked for advice at all. The minimum value of 0 indicates that each teacher is nominated as frequently. The more centralized the social network is, the more advice is spread from a single or a few influential source(s) to the rest of the network, in contrast to a decentralized social network, in which advice is much more evenly shared among all members.

Collective Efficacy. For the Collective Efficacy scale and the school level student achievement scores we calculated descriptive statistics and correlations (see Table 4).

Analysis strategy

A four-step procedure was followed to examine the indirect effect of teachers' social networks on student achievement. Figure 1 graphically represents the proposed hypotheses. First, we studied the influence of demographic variables on the proposed relationships between social network structure, collective efficacy, and student achievement. Second, we examined correlations to analyze the relationships among the study variables. Third, we investigated the influence of teachers' advice network density and centralization on collective efficacy (Hypothesis 1). Then, we conducted multiple regression analyses to check whether social network structure directly affected student achievement in our sample (the dashed line in Figure 1). Finally, we examined the influence of collective efficacy on school levels of students' cognitive achievement given schools' social network structure (Hypothesis 2).

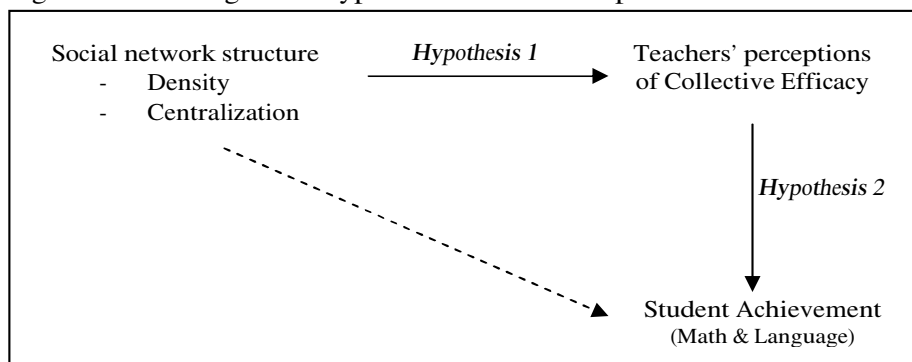Figure 1. Path diagram of hypothesized relationships

Table 4. Descriptive statistics and correlations at school level (N = 53)

		M	Sd	Min	Max	2a	2b	3a	3b	4	5a	5b
1.	Socio-economic status (SES) [1]	92.12	9.81	52.70	96.60	.06	.23	.08	.28*	.27	.58**	.71**
2.	Instrumental network											
	a. Density	0.23	0.09	0.07	0.53	.24	.24	.79**	.38**	.41**	.06	-.02
	b. Centralization	0.38	0.13	0.12	0.66	1.00	1.00	.19	.38**	.33*	.08	.14
3.	Expressive network											
	a. Density	0.30	0.11	0.12	0.53			1.00	.45**	.43**	.12	-.01
	b. Centralization	0.34	0.12	0.09	0.61				1.00	.37**	.25	.28*
4.	Collective efficacy	3.31	0.24	2.46	3.87					1.00	.29*	.48**
5.	Student achievement											
	a. Mathematics	73.13	8.32	53.30	89.70						1.00	.83**
	b. Language	75.66	6.15	54.40	84.40							1.00

Notes: ** p < .01, * p < .05

[1] SES is calculated as the weighted percentage of students for whom the school <u>does not</u> receive extra financial resources; the lower this percentage, the more students with low SES the school serves.

There is a methodological challenge to address when employing 'traditional' statistical methods with social network characteristics. This challenge is formed because network data are per definition interdependent. Therefore, violations to the basic assumption of independence underlying regression analysis may occur (see Kenny, Kashy, and Bolger, 1998). Since the two types of advice networks used in this study refer to the same group of individuals, the school level social network measures of our two advice network types cannot be considered independent. This is reflected in the high correlation (.79, p < .01) between the densities of the instrumental and expressive networks. Therefore, using similar network measures in the same regression equation (e.g., density of instrumental *and* expressive network) would challenge the assumption of independence of the data. To solve this issue, we have decided to separately compare and contrast the influence of both networks on student achievement and collective efficacy.

Another issue is multicollinearity, which arises because of the moderate to high correlations between the school level social network data within and among both network types. While multicollinearity does not affect the predictive power of the model as a whole, it may inflate the standard errors of the individual predictors. To verify whether multicollinearity devalued the stability of our findings, we reran the analyses on different subsets of the data (and alternatively excluding demographics, density and centralization) and found that the results remained largely stable across all models. In addition, the models' variance inflation factors (VIF) and tolerance statistics did not indicate the presence of multicollinearity in the models. When we also take into account the considerable size of the dataset, we may assume that multicollinearity did not pose a significant threat to the robustness of our findings.

RESULTS

The influence of demographic variables on advice networks, collective efficacy, and student achievement
Before testing our hypotheses, we analyzed the influence of various demographic variables on characteristics of advice networks (density and centralization), collective efficacy, and student achievement. Demographic variables included school level student characteristics, such as student gender ratio (the percentage of girls in the target classes), school level socio-economic status (SES), and school characteristics such as school size, team size, team gender ratio, and team experience in current composition. Findings suggest that

subsequent analyses should control for school level SES, which was found to have a strong positive effect on student achievement (see Table 4). Since the other demographic variables did not appear to affect the variables and relationships under study, these demographic variables were excluded from further analyses.

Advice networks in relation to collective efficacy and student achievement: correlation analyses

Examination of the descriptive statistics (see Table 4) indicates that expressive advice networks were slightly denser than instrumental advice networks. In general, 30 % of the maximum possible personal related advice relationships does exist in reality (as indicated by the educators), compared to 23 % of the maximum possible work related advice relationships. On average, work related advice networks are slightly more centralized than personal advice networks (respectively .38 versus .34).

Results from the correlation analyses suggest that social network characteristics of both networks are largely unrelated to student achievement. Only the centralization of personal advice networks in schools appear to be positively related to student achievement in language ($r = .28$, $p < .05$). In other words, students on average perform better in these areas in schools where the network of personal advice is centralized around a single or a few educator(s). Also, results suggest that social network characteristics are positively related to collective efficacy. The denser and more centralized the advice networks, the higher educators' perceptions of collective efficacy. Findings indicate significant correlations between network density and centralization of both types of advice networks and perceived collective efficacy (ranging from $r = .33$, $p < .05$ to $r = .43$, $p < .05$). In turn, our findings demonstrate that collective efficacy is positively related to student achievement, with the highest correlation between collective efficacy and language test scores ($r = .48$, $p < .01$). Meaning, educators that perceive their team capable of motivating students to learn often work in schools that achieve higher student achievement with regard to language. Finally, the social network characteristics are moderately to strongly interrelated ($r = .33$, $p < .05$ to $r = .79$, $p < .01$) and the school level achievement scores are highly interrelated ($r = .83$, $p < .01$).

The influence of advice network characteristics on collective efficacy

Then, we tested the first hypothesis concerning the relationship between advice network characteristics (density and centralization) and collective efficacy (see Table 5, Model 1). Results from multiple regression analyses suggest that the

densities of both advice networks have a similar positive and significant effect on teachers' perceptions of collective efficacy (β = .31, p < .05, and β = .32, p < .05 for the instrumental and expressive networks respectively). The denser the advice networks around both work related and personal matters, the more teachers perceive that they are collectively able to get through to the students, motivate them, and have the skills to deal with even the most difficult students. While network density positively influenced perceived collective efficacy, centralization of the advice networks did not affect teachers' collective sense of efficacy. In sum, a positive effect of advice network density on collective efficacy was confirmed by the data.

The influence of collective efficacy on student achievement

Before testing an indirect effect of schools' network structure on student achievement through collective efficacy, we first examined whether density and centrality of schools' advice networks directly affected student achievement. Multiple regression analyses were conducted to test the influence of network density and centralization on mathematics and language achievement (see Table 5, Model 2a). Results indicate that, above the strong positive effect of school level socio-economic status (SES) on student achievement, none of the characteristics of advice networks were directly related to student achievement. While a positive correlation between the centralization of personal advice networks and language achievement was found earlier, a significant direct effect could not be evidenced. On average, SES proved to be the strongest predictor of student achievement, with explained variance ranging from 35.6 % (mathematics) to 52.8 % (language).

Since advice network characteristics did not have a significant direct effect on student achievement, we continued by testing the effect on student achievement through its impact on collective efficacy. Therefore, we analyzed the effect of collective efficacy on student achievement while 'fixing' social network structure (Pearl, 2000). In other words, we predicted student achievement by collective efficacy, given the effect of social network structure on student achievement. As such, we could determine the unique contribution of collective efficacy in the prediction of student achievement above the influence of network density and centralization.

Results indicate that, again, school level SES is a strong and significant positive predictor of student achievement in mathematics and language (see Table 5, Model 2b). Above the effect of SES, teachers' perceptions of collective efficacy were not significantly associated with students' mathematics

Table 5. Multiple regression analyses of social network characteristics predicting standardized achievement scores (N = 53)

	Model 1 Collective efficacy			Model 2a Mathematics			Language			Model 2b Mathematics			Language		
	B	S.E.	β	B	S.E.	β	B	S.E.	β	B	S.E.	β	B	S.E.	β
Instrumental network															
(intercept)	2.98	.11		72.46	3.70		76.83	2.43		56.03	15.17		44.28	8.72	
School SES	.05	.03	.21	4.87	1.04	.59**	4.42	0.68	.71**	4.57	1.07	.55**	3.82	.61	.62**
Density	.80	.34	.31*	9.51	11.53	.11	-2.80	7.57	-.04	4.56	12.32	.05	-12.62	7.08	-.19
Centralization	.41	.26	.21	-3.96	8.86	-.06	-1.43	5.82	-.03	-5.68	8.97	-.08	-4.83	5.15	-.10
Collective efficacy										5.49	4.19	.16	10.87	2.82	.42**
R²	*.25*			*.35*			*.50*			*.37*			*.63*		
Adjusted R²	*.20*			*.30*			*.47*			*.31*			*.59*		
F	*5.03*			*7.84*			*14.70*			*6.22*			*18.19*		
Sign.	*.004*			*.000*			*.000*			*.000*			*.000*		
Expressive network															
(intercept)	3.01	.11		68.39	3.56		75.15	2.33		56.36	14.91		44.60	8.59	
School SES	.05	.03	.21	4.42	1.04	.54**	4.15	0.68	.67**	4.20	1.07	.51**	3.59	.62	.58**
Density	.70	.33	.32**	4.04	10.74	.05	-7.80	7.03	-.13	1.11	11.34	.01	-15.25	6.54	-.26*
Centralization	.28	.33	.13	10.67	10.66	.14	8.59	6.98	.15	9.78	10.75	.13	6.33	6.20	.11
Collective Efficacy										3.98	4.79	.11	10.11	2.76	.39**
R²	*.23*			*.37*			*.52*			*.38*			*.63*		
Adjusted R²	*.18*			*.32*			*.49*			*.32*			*.60*		
F	*4.58*			*8.47*			*15.75*			*6.48*			*18.50*		
Sign.	*.007*			*.000*			*.000*			*.000*			*.000*		

Notes: * $p < .05$, ** $p < .01$

achievement. In contrast, perceived collective efficacy was positively associated with increased language achievement, above the influence of SES. Thus, teacher teams who perceive that they possess the skills and expertise to collectively influence their students often achieve higher language performance than teachers with less confidence in their team's collective efficacy. As indicated by earlier findings, the density and centralization of work related advice networks did not directly affect student achievement significantly. However, we found that the density of personal guidance networks in schools had a negative effect on students' language achievement when collective efficacy was entered into the equation. There are indications that this is a suppression effect due to the addition of collective efficacy to the model, causing the partial correlations between network density (of both the instrumental and expressive network) and students' language achievement to be higher than the original bivariate correlations as depicted in Table 4.

While a direct effect between advice network characteristics and student achievement could not be evidenced, findings did suggest that being embedded in a dense network around work related and personal advice increased teachers' perceptions of their group's efficacy, which in turn was positively associated with school level language achievement. As such, an indirect effect of advice network density on student achievement could be confirmed.

CONCLUSIONS AND DISCUSSION

Since governmental pressure for schools to improve has risen around the world due to increasingly stringent accountability policies, the urge for systematic efforts to increase student achievement is anchored in daily educational practice. Emerging studies on teacher social networks indicate that strong ties among educators are important to the implementation of reform and school elements such as trust and innovative climates (Coburn & Russell, 2008; Moolenaar et al., 2009; .Moolenaar, Daly, & Sleegers, in press). While scholars have pointed to the need to examine the relationship between teacher ties and student achievement (Daly et al., in press), until now, empirical studies that focus on the relation between teacher ties and student achievement are scarce. This chapter addresses this gap in our knowledge by examining the link between schools' social network structure and student achievement as a function of teachers' collective efficacy.

Grounded in literature around collective efficacy and social networks, we argued that by offering shared experiences and aligning collective goals,

schools' social networks may enhance teachers' perceptions of their collective capacity to increase student learning, which in turn may affect student achievement. To test our hypotheses, we conducted a survey study on the relationship between teachers' social networks, perceived collective efficacy, and student achievement in 53 Dutch elementary schools. Based on the findings, we could not confirm a direct effect of teachers' social network structure on student achievement at the school level of analysis. Neither the density, nor the centralization of advice networks was found to directly affect student achievement in mathematics or language. However, findings suggested the density of work related and personal advice networks affected teachers' perceptions of collective efficacy, which in turn was associated with increased student achievement. As such, collective efficacy served as an intervening variable that may explain how dense social networks among educators may ultimately benefit student achievement. We will now discuss three themes that arise from our findings and offer implications for reform efforts, leadership practice, and future research.

Dense networks foster increased efficacy beliefs

Dense networks appear to support and nurture teachers' confidence in the capacity of their team to impact students' learning and achieve school goals. The potential to build collective efficacy beliefs is offered by both personal and work related advice relationships. This finding contributes earlier studies that emphasized the significance of densely connected teacher teams for school organizational characteristics, such as teacher trust, innovative school climate, perceived involvement in decision-making, and the implementation of reform (see Chapters 5, 6; Coburn & Russell, 2008; Penuel etc, Daly). As previously suggested (Bandura, 1993; Kurz & Knight, 2004), the social environment that resulted from teachers' interdependency on advice exchange seemed to affect teachers' beliefs in the capacity of their team. In our sample, network centralization did not affect teachers' collective efficacy beliefs, which implies that these beliefs are more likely influenced by the exchange of advice throughout the whole team, rather than the centralization of advice around certain focal individuals.

Strong collective efficacy beliefs endorse student achievement

Our findings indicated that teachers' collective efficacy beliefs supported student achievement. Teacher teams that felt that they were able to motivate and challenge their students, and get through even to more difficult students, were teaching in schools that achieved higher student performance for

language. These findings are the first to partly replicate earlier studies that have been conducted in the USA (Bandura, 1993; Goddard, 2001; 2002; Goddard & Goddard, 2001; Goddard et al., 2000; Goddard, Hoy & Woolfolk Hoy, 2000, 2004; Ross, Hogaboam-Gray, & Gray, 2003; Tschannen-Moran & Barr, 2004) in a Dutch educational setting. However, in this setting the school level socio-economic background of the students proved to be a more powerful predictor than teachers' collective efficacy, in contrast to findings by Bandura (1997).

An interesting find is that teachers' collective efficacy beliefs appeared to be beneficial to students' language achievement, but not to mathematics achievement. While this was an unexpected find that is perhaps not easily explained, we do have some suggestions to understand our finding. In the Netherlands, language instruction is a much debated topic in policy and practice since students' reading achievement results have decreased significantly in the last years (Mullis et al., 2007; Netten & Verhoeven, 2007). As a result, there is much attention for language instruction, with additional governmental funding directed at improving reading comprehension results through teachers' professional development and, in some cases, increased time for reading in the curriculum (Netherlands Ministry of Education, 2007). Therefore, teachers' exchange of advice may have been overly focused on advice around language instruction, which in turn may have affected teachers' collective efficacy beliefs specifically with regard to their potential to improve reading. In schools with high collective efficacy beliefs about language instruction, students' language achievement may therefore have been higher than schools with lower perceptions of collective efficacy. Additionally, gender stereotyping with regard to mathematics instruction may have played a role in finding no significant effect of collective efficacy on students' mathematics achievement. Teachers' self-efficacy may be affected by such things as grade level of students and the subject matter taught (Bandura, 1993; Greenwood, Olejnik, & Parkay, 1990; Midgley, Feldlaufer, & Eccles, 1988). Given the predominance of women in Dutch, and probably global elementary education, lower collective efficacy beliefs may have partly reflected lower self-efficacy beliefs. Meaning, our study may indeed reflect that collective efficacy beliefs are potentially subject related – a hypothesis worth exploring in further research.

Teachers' advice networks and student achievement
Scholars have previously suggested that collective efficacy may be the missing link between social capital and organizational functioning (Sampson, Morenoff, & Earls, 1999). Results from this study support the potential of strong teacher relationships for creating a work environment that ultimately benefits student

achievement. While the exchange of advice among teachers may help overcome obstacles of daily practice and facilitate achieving instructional goals, patterns of advice exchange are not directly related to increased student achievement. This finding lends support for the notion that the relationship between teacher collaboration and student achievement is likely indirect (Goddard, Goddard, & Tschannen-Moran, 2007) and, as evidenced in this study, can be explained by increased collective efficacy beliefs. As such, this study resembles school organizational and school leadership studies, in which effects on student achievement are also likely indirect and direct effects are often small or absent (Leithwood & Riehl, 2003). Although collective efficacy beliefs may not be the sole mechanism through which teachers' networks affect student achievement, it is indeed a significant mechanism, and what is as important, a mechanism that may be affected by educational leadership and policy through fostering strong teacher relationships. It may also be that the limited relationship between networks and achievement has to do with the type of relationship studied in this chapter - meaning that examining patterns of relationships more directly related to achievement, such as interactions around specific mathematics or language instructional practice, would have yielded significant effects on student achievement. In conclusion high collective efficacy beliefs, as supported by teachers' advice interaction, provides an important route increased student performance.

Delimiters and future research
While the contribution of this chapter to literature, policy, and practice is substantial, we acknowledge its limitations. The findings showed that only a small to moderate percentage of the variance in the learning activities was explained by collective efficacy. It is likely that other factors not included in our model may also affect student learning. Research into teachers' perceived self-efficacy showed that personal self-efficacy not only affects students' learning directly but also indirectly via the instructional strategies teachers use to create a supportive learning environment (Ashton & Webb, 1986; Dembo & Gibson, 1985; Geijsel, Sleegers, Stoel, & Krüger, 2009; Smylie, 1988; Wheatley, 2002). The connections between collective efficacy beliefs and student outcomes depend in part on the reciprocal relationships among these collective efficacy beliefs, teachers' personal sense of efficacy, teachers' professional practice, and teacher's influence over instructionally relevant school decisions (Goddard, Hoy, & Woolfolk Hoy, 2004; Ross, 1995). In addition, it should be noted that the generalizability of this study to large U.S. school districts may be limited as Dutch elementary schools in general serve less students than elementary

schools in the US. We would therefore encourage a validation of our findings in different countries and at different educational level (e.g., secondary, vocational, and higher education).

Recent studies have emphasized the need to study teachers' social networks in a multilevel framework (Moolenaaret al., in press). We underline the importance of multilevel studies that take into account the nested nature of student and teacher data within schools. Therefore, we regret that a multilevel examination of our hypotheses was not feasible due to the school level nature of the available student achievement data. While the results in this study are robust, we nevertheless would advise additional multilevel studies to substantiate our findings. Although causality of the proposed relationships is based on a substantial literature base, our cross-sectional design did not serve a validation of the causal nature of these relationships. Future research may be advised to explore multilevel causal models in which the chain of variables that connect teachers' social networks and student achievement, are conceptualized and tested. These models can contribute to a better understanding of the paths through which social networks and collective efficacy have an impact on teacher and student outcomes.

Implications for reform efforts and leadership practice

Through heightening awareness of a school's capacity for organizing and implementing effective actions to meet desired goals, collective efficacy is a powerful concept for both leadership and the successful implementation of reform. Looking at the school as the significant unit of change in reform efforts (Fullan, 1990), we can see that studying collective efficacy has the potential to enrich our understanding of the complexity of the psychosocial aspects of schools as organizations. A social context that supports the exchange of instructionally valuable advice clearly supports teachers' perceptions of their schools' ability to collectively impact student learning. Research on collective efficacy demonstrates that when certain organizational aspects of schools converge – high expectations of student behavior and performance, collaborative interaction and collegial encouragement, and strong principal leadership - student achievement improves (Hoy & Sabo, 1998). Leadership may increase collective efficacy beliefs by increasing teachers' perceptions of their individual and shared ability to successfully manage tasks by creating the opportunities for teachers to succeed at achieving desired goals (creating mastery experience) and for colleagues to witness and share this success, and acting role modeling (Bandura, 1997).

Yes, we can!

Increasing student performance through strong professional teacher communities is high on the agenda for educational leaders across the globe. Although the potential of strong linkages among teachers for innovation and policy implementation is supported by emerging studies, few empirical studies address the relationship between teachers' social networks and student achievement. In this chapter we suggest that the benefit of strong teacher networks for student achievement lies in its potential to foster teachers' collective efficacy beliefs. By offering shared experiences, creating a feeling of collectivity, and providing the opportunity to exchange expertise, strong teacher networks nurture teachers' beliefs in the capacity of their team, which in turn was associated with increased student achievement. A potential route to school improvement therefore may be to grow strong ties among teachers, cultivate their collective belief in 'yes, we can', and as a result, harvest increased student achievement.

CHAPTER 8

With a Little Help from my Friends:
Relationships in Reform [1]

ABSTRACT

Background. Scholars have focused their attention on district-wide reform as a way to support instructional coherence. These efforts are often layered onto existing social relationships between school staff that are rarely taken into account when enacting reform. Social network theory posits that the structure of social relationships may influence the direction, speed, and depth of organizational change and therefore may provide valuable insights in the social forces that may support or constrain reform efforts. This study contributes to school reform literature by drawing on social network theory as a way to understand efforts at reform.

Purpose. Our aim is to determine how social networks within grade levels and between grade levels and support staff may facilitate or constrain the reform initiative in this underperforming district. We further aim to examine the extent to which social network structures are related to teachers' perceptions of collective action, efficacy and satisfaction with regard to the reform.

Method. This mixed-methods exploratory case study examined five schools within one underperforming school district as it enacted a system-wide reform. Quantitative survey data was collected to assess social networks and teacher work perception of five schools enacting the reform. Qualitative data was gathered through individual interviews from educators within representative grade levels as a way to better understand the diffusion and implementation of the reform.

Conclusions. Despite being enacted as a district-wide reform effort, results suggest significant variance within and between schools in terms of reform-related social networks. These networks were significantly related to the uptake, depth, and spread of the change. Densely connected grade levels were also associated with more interactions focused on teaching and learning and an increased sense of grade level efficacy. Our findings underline the importance of attending to relational linkages as a complementary strategy to the technical emphasis of reform efforts, as social networks were found to significantly facilitate or constrain reform efforts.

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[1] This chapter is based on:
   Daly, A. J., Moolenaar, N. M., Bolivar, J. M., Burke, P. (2010). Relationships in Reform: The Role of Teachers' Social Networks. *Journal of Educational Administration.* (first two authors must both be considered as first authors).

INTRODUCTION

Across the globe, efforts at improving public educational systems in support of increased student achievement are commonplace. Many countries have experienced or are experiencing prime ministers, premiers, or presidents that define themselves as the 'education' leader and as such enact a series of changes targeted at improving their nation's schools. For many of these schools there is almost a revolving door of reforms (Henig & Stone, 2008). This 'reform churn', while intended to improve performance, often constrains efforts at organizational improvements as change-weary schools often engage reforms with a lack of depth and breath (Coburn, 2003; Datnow, Lasky, Stringfield & Teddlie, 2006; Hubbard, Mehan & Stein, 2006). Reform efforts are typically implemented using a variety of formal structures, processes, and accountability levers to improve performance. However, while these more formal, technical approaches at improving education are important and have been well documented, what has been less thoroughly explored in the change equation are the relational linkages between actors through which reform flows (Coburn & Russell, 2008; Penuel, Riel, Krause & Frank, 2009).

While educational scholars throughout the world acknowledge the importance of interpersonal relationships and social interaction for continuous school improvement and organizational change (Carmichael, Fox, McCormick, Procter & Honour, 2006; Hopkins & Reynolds, 2001; James, Dunning, Connolly, & Elliot, 2007; Moolenaar, Karsten, Sleegers & Zijlstra, 2009), knowledge about the social structures in which school reforms take place is scarce. Findings from organizational literature indicate that organizational improvement is closely linked to the ties within and across systems (McGrath & Krackhardt, 2003; Tenkasi & Chesmore, 2003). In education, this has led to the development of professional learning communities and emphasis on collaborative structures targeted at the grade level (McLaughlin & Talbert, 1993; Newmann & Wehlage, 1995; Wood, 2007; Stoll & Louis, 2007). Most often, these types of communities are developed to increase communication and collaboration among teachers within and across grade levels (Stoll & Louis, 2007). Recent research has suggested that informal social structures, in particular, provide opportunities for information transfer and development of new knowledge between individuals and levels in organizations (Ahuja, 2000; Tsai & Ghoshal, 1998). To date, there is little empirical understanding of how the underlying social networks, in which district-wide change efforts take place, support or constrain reform efforts (Coburn & Russell, 2008). A more in-depth investigation of the social networks within schools may uncover important characteristics of these

social structures that facilitate or impede efforts at system-wide reform.

To better understand how underlying patterns of social interactions within schools may affect reform efforts, we draw upon social network theory and analysis. Social network analysis is a systemic approach used to quantify and visualize the ties and overall structures of formal and informal networks. Given the increasing number of underperforming educational systems across the globe there is an urgency to better understand the relational complexities of these organizations (Lima, 2009). Examining the structure of social networks may assist educators in better managing and leveraging patterns of interactions in support of meeting specific targeted academic goals (Ahuja, 2000; Tsai & Ghoshal, 1998).

In this study we examine the social networks of teachers in five schools as they engage a district-wide effort at reform. A 'district' in this context refers to a group of schools within a specific geographic region that are supported by a singular central office. Our exploratory case study takes place in the Esperanza[1] School District, an urban fringe district that is in the third year of progressive sanction for underperformance. In an effort to improve student achievement, the district has undertaken a targeted system-wide approach to reform focused on reading comprehension targeted at the grade level. In this chapter, we explore three social networks among teachers that represent social interactions related to these reform efforts: the social networks of lesson planning, reading comprehension, and effort recognition. Our aim is to determine how these networks may facilitate or constrain the reform initiative in this underperforming district. Our study is guided by the following research questions:

1. To what extent do formal and informal social network structures within grade levels support or constrain the access and exchange of collaborative lesson planning, knowledge of reading comprehension, and reform-related effort recognition around the district-wide change effort?
2. How do teachers in different formal and informal positions in the network both perceive the relational linkages through which the reform is diffused and enacted?
3. To what extent are social network structures related to teachers' perceptions of collective action, efficacy and satisfaction with regard to the reform?

We first provide our theoretical framework in which we briefly outline the importance of districts in reform efforts and how those efforts may be supported by teacher action and collaboration. We then provide a review of social network theory and analysis as a conceptual lens to understand the

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[1] All names are pseudonyms

impact of social linkages on reform. We propose that these literatures provide a useful frame to deepen our understanding as to how social networks may facilitate or inhibit efforts at reform.

THEORETICAL FRAMEWORK

District Reform and Collaboration

To better understand the context in which contemporary schools operate, a number of scholars have shifted their focus from the school site as the unit of reform to the relationship between central offices and sites (Elmore & Burney, 1997; Hightower, Knapp, Marsh & McLaughlin, 2002; Honig, 2006; McLaughlin & Talbert, 2003; Rorrer, Skrla & Scheurich, 2008; Togneri & Anderson, 2003). This line of inquiry acknowledges that schools are embedded within a larger context and that this context may have a direct impact on the success of improvement efforts (Copland & Knapp, 2006; Massell & Goertz, 1999; Rorrer et al., 2008; Spillane, 1996). One approach to reforming districts is a system-wide approach to improvement (Honig & Hatch, 2004), in which district administrators re-orient organizational structures and processes to align with reform goals (Rorrer et al., 2008). According to Datnow and Castellano (2003), this reorientation creates "supportive conditions at the district level that are important to successful implementation and sustainability of whole school reform" (p. 203).

Successful reform efforts, therefore, may require a shift in the way that change strategies are conceptualized and enacted within a school district. This shift entails a move from a singular focus on individualized segments of the organization to engaging the entire system in a network of connections. For example, a successful networked approach has been demonstrated in the United Kingdom through the National College of School Leadership's (NCSL) Network Learning Group of 104 schools (Earl & Katz, 2007; Earl, Katz, Elgie, Ben-Jaafar & Foster, 2006). This network yielded positive outcomes in a variety of areas including developing leadership, strengthening communities, and positively influencing student achievement (Earl et al., 2006). Facilitative conditions for these successful networks included frequent and pervasive communication, shared understanding and purpose, joint challenging work, and relationships built on trust that enabled the transfer of tacit and explicit knowledge (Earl & Katz, 2007). Although the NCSL project represents a much broader network of schools than may exist in a single school district, implications from this work potentially hold importance as a way to create and

understand networks within school districts. Above all, the balance of this work suggests the need for a more interconnected systems approach to organizational change (Fullan, 2005; Hargreaves & Fink, 2006; McLaughlin & Talbert, 2003), requiring that district and site leaders, "…think systemically about schools and their development and see educational organizations in terms of their interdependent parts" (Smylie, Wenzel & Fendt, 2003; p. 155).

Studies of successful districts that applied more systemic approaches in developing collaboration across teams suggest a range of specific strategies that educators can engage in building stronger intra-organizational ties (Chrispeels, 2004; Honig & Hatch, 2004; Togneri & Anderson, 2003). These strategies include; creating structures for increased collaboration and knowledge exchange within schools (McLaughlin & Talbert, 2003), enhancing communication channels and support focusing on teaching and learning (Agullard & Goughnour, 2006), distributing leadership (Leithwood, et al., 2007; Spillane, 2006), providing opportunities for input on decision-making (Brazer & Keller, 2008), and building a collective sense of efficacy (Goddard, Hoy & Hoy, 2004).

The significance of collaborative structures and social networks for successful school improvement and continuous teacher development is underlined by studies on educational reform and school change across the globe, such as southeast Asia (Hallinger, 1998), Australia (Hollingsworth, 2004), the Netherlands (Moolenaar et al., 2009; Moolenaar, Daly, & Sleegers, in press; Veugelers & Zijlstra, 2002), Portugal (Lima, 2007, 2009), Uganda (Hite et al., 2006a, Hite, Rew, & Nsubuga, 2006c), the United Kingdom (Durrant & Holden, 2006; Earl & Katz, 2007; Hargreaves, 2001, 2003; Hopkins & Reynolds, 2001), and the United States (Daly & Finnigan, 2009). Whether in the form of communities of practice (Wenger, 1998), learning organizations (Senge, 2006), professional learning communities (McLaughlin & Talbert, 1993; Newmann & Wehlage, 1995; Stoll & Louis, 2007), or distributed leadership (Spillane, 2006), the social context, and in particular increased social interaction among all of the school's stakeholders, is believed to be at the heart of system reform and school improvement.

The work of reform through a social context is captured well by Hubbard and colleagues (2006), who in their book on district reform define an organization as existing "in the interrelationships between activities of individuals" (p. 263). It is the interaction between and among individuals that comprises the culture and structure of an organization. The assumption that undergirds this definition is that changes in educational systems are often socially constructed (Hubbard, et al., 2006). Therefore, attempts to modify

formal structures in support of reform often require changes in existing social relationships (Bartunek, 2001; Borgatti & Foster, 2003; Stevenson, Bartunek & Borgatti, 2003). It is the organizational interdependence of action (Giddens, 1979), reflecting a network of ties, that may ultimately moderate, influence, and even determine the direction, speed, and depth of a planned change (Krackhardt, 2001; Mohrman, Tenkasi & Mohrman, 2003). According to Mohrman et al. (2003), because change processes emerge and are maintained through interpersonal relationships, "…lasting change does not result from plans, blueprints, and events. Rather change occurs through the interaction of participants (p. 321)." This research suggests that the careful exploration and analysis of social networks in an organization may broaden the understanding of the factors that support or constrain organization wide reform (Tenkasi & Chesmore, 2003).

Teachers that are able to successfully engage in collaborative work have been defined as "group of people across a school who are engaged in common work; share to a certain degree a set of values, norms, and orientations towards teaching students, and schooling; and operate collaboratively with structures that foster interdependence" (Achinstein 2002, p. 421-422). Teacher teams' ability to make decisions and focus action related to instruction has been associated with access to expertise and instructional knowledge (Andrews & Lewis, 2007; Frank, Zhao & Borman, 2004; Johnston, Knight & Miller, 2007; Louis & Marks, 1998; Love, 2008; McLaughlin & Talbert, 2006; Smylie, 1996). Teachers working in collaboration tend to have a wider skill variety, be more informed about their colleague's work and student performance, report increased instructional efficacy, and are more likely to express higher levels of satisfaction (Chrispeels, Andrews & Gonzalez, 2007; Little, 2003a; Moore-Johnson, 2004; Stoll & Louis, 2007; Wenger, 1998). Although there have only been limited studies on the direct connection between patterns of reform-related social interaction in teacher networks and student outcomes, recent work suggests that teacher collaboration around curriculum and instruction is related to student achievement (Goddard, Goddard & Tschannen-Moran, 2007).

Studies suggest that teachers who collaborate are better able to access and make use of the individual and collective resources embedded in their professional network (Rigano & Ritchie, 2003). These 'professional learning communities' have a rich international presence as has been documented by Stoll and Louis (2007), who, in a variety of global contexts, have noted the importance and potential of teachers working together. As teachers design and plan together, best practices are shared and developed through their discussion (Chrispeels, et al., 2007; Little, 2003a; Wenger, 1998). It is this partnership of

action and learning that may enable reforms to be better taken up at the school level (Hubbard et al., 2006). However, despite the growing empirical base around teacher work in professional communities, there still exists a significant gap in our knowledge as to the quality of collaborations and how these social interactions may impact the depth of district reform (Coburn & Russell, 2008; Little, 2003a). Therefore, given the identified gaps and importance of better understanding teacher collective action, efficacy, and satisfaction in reform (Chrispeels, Andrews & Gonzalez, 2007; Goddard, Hoy & Hoy, 2004; Little, 2003a; Moore-Johnson, 2004; Stoll & Louis, 2007), we will include these important variables for examination as well as how these constructs may be associated with reform-related networks. We now introduce social network theory as a lens to explore how patterns of social interaction among teachers may support or constrain district-wide efforts at reform.

Social Network Theory

One of the basic conceptual foundations in understanding social network theory is the concept of social capital. A number of theorists have written on social capital; each foregrounding a different aspect of the concept and offering nuanced understanding of the idea (see, for example, Bourdieu, 1986; Burt, 1992; Coleman, 1988; Lin, 2001; Putnam, 1993a). Lin (2001) notes that the common denominator between all major theorists includes the understanding that social capital consists of: "The resources embedded in social relations and social structure which can be mobilized when an actor wishes to increase the likelihood of success in purposive action" (p. 24). Social capital is therefore composed of a system's social relations through whom the resources of other individuals can be accessed, borrowed, or leveraged. This differentiates social capital from human capital, which refers to training, development, or certifications of individuals, or physical capital that is contained in infrastructure and equipment (Bourdieu, 1986; Coleman, 1988; Dika & Singh, 2002; Lin, 2001).

Social capital is concerned with the resources that exist in social relationships (sometimes referred to as 'ties') between individuals as opposed to the resources of a specific individual. This implies that actors must be aware of the assets in their network and take action through social ties to access these resources (Portes & Sensenbrenner, 1993). It is the quality of those ties between individuals in a social system that creates a structure that ultimately determines opportunities for social capital transactions and access to resources (Burt, 1992; Coleman, 1988, 1990; Granovetter, 1982; Lin, 2001; Putnam, 1993a). Strong social ties support the transfer of tacit, non-routine, or complex knowledge (Hansen,

1999; Reagans & McEvily, 2003), joint problem solving, and the development of coordinated solutions (Uzzi, 1997). Strong ties have also been associated with low-conflict organizations (Nelson, 1989). Less dense networks tend to be better suited for the transfer of simple, routine information (Hansen, 1999) and can provide for brokering opportunities between actors (Burt, 1992; Granovetter, 1973). Taken together, both strong and weak ties are necessary within a social structure as they facilitate access to different kinds of information (Haythornthwaite, 2001; Tenkasi & Chesmore, 2003).

Networks can be identified by the content that is transacted through the social ties (Scott, 2000; Wasserman & Faust, 1997). For example, communication networks may encompass information exchange, knowledge transfer, and advice. The content that flows through relationships defines the purpose of the network and how well the resources flow between actors (Wasserman & Faust, 1997). For example, the social structure of a work-related knowledge network may differ significantly from the structure of a more normative social network, such as trust. In both examples resources flow through ties (the first being knowledge, the second trust), but the overall structure of the network may look quite different.

Network structures may facilitate the transfer of resources if the necessary relationships are in place and are accessible, but they may also constrain resource exchanges if the network does not hold sufficient connected ties to move the resource (Daly & Finnigan, 2009; Hite, Williams & Baugh, 2005). In many cases, the underlying social structure determines the type, access, and flow of resources to actors in the network leading some scholars to suggest that the old adage 'It is not what you know, but who you know', is more accurately, 'Who you know defines what you know' (Cross, Baker & Parker, 2003). Therefore, understanding network structures may be useful for educational organizations enacting reform efforts as these underlying networks may be leveraged to better create, use, and diffuse knowledge and evidence (Cross, et al., 2003). These resources may be of particular use as schools and districts attempt to diffuse reform strategies as a way to meet demands in high-stakes educational contexts.

The balance of scholarship in this section points to the value of exploring the network interactions in schools within a school district engaged in a focused reform. Dense interconnected networks at all levels of an organization may facilitate the uptake of complex knowledge thus increasing the potential for organizational change. International interest in social networks in the field of education has to date resulted in analyses of principal networks (Friedkin & Slater, 1994); school and teacher networks (Bakkenes, De Brabander & Imants

1999; Coburn & Russell, 2008; Granovetter, 1986; Penuel, Frank & Krause, 2007b; Penuel, et al., 2009); teacher professional development networks (Lima, 2007); departmental structures (Lima, 2003, 2004; Spillane, 2006); school-parent networks (Horvat, et al., 2003); and between school networks (Mullen & Kochan, 2000; Earl & Katz, 2007). Although it has been recently suggested (Coburn & Russell, 2008; Penuel, et al., 2009), there are few studies that examine the social networks of teachers in reform and even fewer that explore these networks in underperforming schools. This study builds on recent scholarship emphasizing the importance of understanding relational linkages in support of organizational outcomes (Balkundi & Kilduff, 2005; Daly & Finnigan, 2009; Kilduff & Krackhardt, 2008); and makes a unique contribution to the literature by describing how district reform unfolds through teacher networks and related grade-level work measures in five schools as they take up a district-wide reform effort.

METHOD

An exploratory case study design was used to examine three social networks that described the reform-related social interactions in the sample schools: the social networks of collaborative lesson planning, knowledge around reading comprehension and effort recognition. In addition, we collected a series of grade level teacher work measures related to collective action, efficacy, and satisfaction. A case study approach is most appropriate when the phenomenon of interest has a level of complexity that requires multiple data sources and methods to gain an in-depth understanding (Yin, 2003). We used social network analysis (SNA) (Scott, 2000; Wasserman & Faust, 1997), grade level work measures (Bryk, Camburn, & Louis, 1999, Goddard, Hoy & Woolfolk Hoy, 2000), and semi-structured interviews (Patton, 1990) to better understand how these social networks support or constrain the uptake of the reform initiated by the Esperanza School District (ESD). We selected this particular district, as it has been enacting a district-wide reform effort around reading comprehension for the past two years in response to its underperformance.

Context
The Esperanza School District (ESD) is an urban fringe district near San Diego, California USA. Being in the third year of sanction from the federal government for underperformance, Esperanza typifies systems that have enacted multiple reform initiatives in order to meet accountability mandates and increase student

Table 1. Sample demographics at the school level (N = 5)

School	Enroll	Free/ Reduced Lunch	English Learners	Hispanic	White	African American	API
A*	696	62.10%	53.60%	63.40%	18.80%	5.20%	726
B	777	28.10%	17.80%	27.70%	57.80%	2.40%	875
C *	779	63.20%	52.00%	73.20%	16.90%	3.10%	709
D	729	82.90%	66.70%	88.50%	8.20%	1.50%	692
E*	770	61.40%	52.90%	70.00%	20.00%	4.90%	762
Sample Average	750.2	59.54%	48.60%	64.56%	24.34%	3.42%	752
District Average	698	61.00%	44.80%	65.00%	25.50%	2.90%	734

Note: *Interview school

Table 2. Sample demographics at the school staff level (n = 196)

School	# Parti-cipants	% Male	% Female	Years at the school	Years in current position	Years as an educator
A*	36	14	86	8.03	6.41	13.69
B	42	17	83	8.53	6.69	16.50
C*	42	7	93	10.11	7.09	16.54
D	35	6	94	7.48	5.32	12.52
E*	41	10	90	9.11	7.88	18.35

Note: *Interview school

performance. The district currently serves 18,745 students in kindergarten through eighth grade in 24 schools, representing the student diversity found in many schools across California (the most populous state in the US) and in urban settings across the globe. Esperanza's underperformance with low achievement scores in English Language Arts (ELA) prompted the district-wide reform focus on reading comprehension. In an effort to increase achievement in ELA across all schools for the past year and a half, ESD has been implementing a district-wide reform centered on reading comprehension aimed at the grade level. The reform includes; a district-wide literacy curriculum, instructional strategies for reading comprehension, targeted professional development, and a commitment for a multi-year sustained effort. The intent of the reform is to provide a consistent approach across all schools to ensure access to high quality literacy instruction and improve district performance.

Sample

We selected five ESD elementary schools representing grades kindergarten (age of students 5 years) through fifth grade (age of students 10 years) as sample schools. The schools were selected as they are reflective of the range of schools in the district with regard to socio-economic background and academic performance levels. In addition, the five sample schools were involved in a University partnership that provided supplementary professional development and a team-based collaborative approach around the reform focus. Although the schools are representative in regard to district-wide demographics, their participation in this University partnership does make them different than other district schools. However, we purposely selected these schools, as they presumably should have the 'best' opportunity to consistently enact the district change given the additional reform support. Therefore, this sample represents a 'best case' laboratory to test out the degree to which social networks support or constrain reform efforts. Table 1 provides the demographic data for the district and sample schools including the Academic Performance Index (API) score. API is a California state measure of a school's academic performance on a scale of 200-1000 with 800 as a target of minimum desired performance.

Aside from school size, with the sample schools being larger on average than the other schools in the district, the sample reflects overall district averages. Within the sample, the schools and grade level teams were also comparable with respect to school and team size. Overall, the network and work measures instruments, designed to collect the quantitative data for our study, had a very strong average response rate of 89%, with a range from 85% to 93%. Final survey results represented 196 teachers and support staff

(principals and coaches) in thirty grade levels across five schools. Table 2 provides the overall school staff demographics that were relatively consistent across schools.

Data collection and analysis

Social network data: Collection
In order to assess the social networks in Esperanza we developed an online survey that comprised multiple distinct networks questions. We asked site administrators, teachers, and support staff at each of the five schools to indicate the frequency of interaction with other school members. Items were generated from previous social network research (Daly & Finnigan, 2009; Cross & Parker, 2004) and accompanied by original items. We selected three types of network questions for analysis that were related to the reform effort: lesson planning collaboration, reform knowledge, and recognition of reform efforts. These network relations were selected as they have been associated with higher organizational performance in the literature outside of education (Krackhardt, 2001; Mohrman, et al., 2003). For the lesson planning collaboration network we asked every school member to respond to the survey prompt, "Please select your frequency of interaction around reading lesson planning between you and the following school members…?" The reform knowledge network was generated by the prompt, "Please select the frequency of interaction with school members with whom you share knowledge around the reading comprehension reform…?" And finally the effort recognition network was measured through the following prompt "Please select the frequency of interaction around who recognizes you for reform related efforts…?" Respondents could indicate the frequency of interaction in the relationship on a 5-point scale ranging from one (no interaction) to five (1-2 times a week). Participants within each school received a roster with their school members in rows and the frequency of interactions for each relationship in columns. This bounded method is a preferable social network strategy that provides a more complete picture of the network and thus supports valid results (Scott, 2000).

Social network data: Analysis
While the data collection process rendered social networks at various frequencies of interaction, we chose to focus on the most frequent interaction patterns within each of the reform networks. These interactions typically represent stable structural patterns (Krackhardt, 2001) and respondents are more accurate at identifying ongoing patterns than determining occasional

interactions (Carley & Krackhardt, 1999). In order to be considered a frequent tie individuals would have had to interact once every two weeks to a couple of times a week (4 and 5 on the rating scale). We calculated a series of network measures using the UCINET software (Borgatti, Everett & Freeman, 2002) on each of these frequent relationships (lesson planning, reading comprehension, recognition) to better understand and compare network structure in schools and grade levels.

We assessed the *density* of the grade level teams to determine the percentage of ties within each of the grade levels. The density of a network can be thought of as a measure of network connectedness or cohesion (Blau, 1977). Density is calculated as the number of connections between actors divided by the number of total possible connections in the network. This means that the greater the proportion of social relationships between school staff members, the more dense the social network. Density was scaled between 0 (indicating no relationships between teachers) to 1 (representing a social network in which all teachers are connected to one another). A dense network is thought to be able to move resources more quickly than a network with fewer ties (Scott, 2000). Density was calculated for each of the elementary grade level teams within schools. Moreover, we calculated the average density per grade level to explore possible variations between grade levels across schools. It is important to note that the sample schools and grade levels were comparable with respect to school and team size allowing for comparison between grade levels as well as across schools.

We measured the *rate of interaction* between individuals in grade levels and their respective support staff (principals and coaches) by calculating the number of incoming and outgoing ties between grade level teams and support staff, divided by network size. The rate of interaction varied on a scale of 0 (indicating no in or out ties to support staff) to 1 (all grade level team members had frequent reform-related interaction with all support staff members). The higher the rate of interaction, the more grade level members were in contact with support staff around reform-related topics. We measured the level of *reciprocity* between teachers in grade levels to establish the percentage of reciprocal relationships within each grade level as higher levels of reciprocity have been associated with increased organizational performance and complex knowledge exchange (Kilduff & Tsai, 2003). Reciprocity was calculated using a scale of 0 to 1, with 0 representing no mutual relationship present in the grade level team, and 1 representing a grade level team in which all relationships are reciprocated, controlling for the size of the network.

For each of the individual actors, we calculated their *centrality* in the social networks by determining the total amount of ties an actor received and sent in each of the networks divided by the size of the network. Centrality can vary on a scale of 0 (the teacher has no in- and out-going relationships and occupies a marginal position in the social network) to 1 (the teacher initiates all the in- and outgoing ties and occupies the central position in the network). Centrality was analyzed as network data to better understand overall the overall structure of the network.

We also conducted a series of Quadratic Assignment Procedure (QAP) correlations in UCINET to determine the similarity between the three reform networks. QAP correlations must be used to run correlational analysis on social networks as relations between individuals are nested and embedded within the same network. When conducting social network research, statistical assumptions of independence, on which Pearson correlations rest, are violated. The QAP correlation procedure follows a specific process. First a Pearson correlation coefficient is calculated for two corresponding cells of two rosters that contain network data. Then, it randomly permutes the rows and columns of one of the matrices hundreds of times (each time computing a new correlation coefficient), and compares the proportion of times that these random correlations are larger than or equal to the original observed correlation. A low proportion ($p<.05$) suggests a strong relationship between the matrices that is unlikely to have occurred by chance (Baker & Hubert, 1981). QAP results for our study indicated that all three network structures were weakly related (lesson planning and reading comprehension $r = .25$; lesson planning and effort recognition $r = .29$; reading comprehension and effort recognition $r = .21$). While the social network questions all examined reform-related interactions among teachers, the weak correlations suggest that each of the three networks measures a different aspect of reform-related interactions. In addition, we conducted more traditional Pearson correlations on the relationships between network measures (density, interaction rate with support staff, reciprocity) and teacher work measures (collective action, efficacy, and satisfaction) to determine the presence of any significant relationships between the study variables.

Teacher work measures: Collection and analysis
In addition to the social network questions, the 196 participants were asked to respond to three additional measures of the grade level: collective action, grade level efficacy, and satisfaction with collaboration. The action and efficacy instruments were based on previously developed and validated teacher surveys (Bryk, Camburn, & Louis, 1999, Goddard, Hoy & Woolfolk Hoy, 2000) and the

satisfaction scale was developed for the study (see Table 3). The measures were aggregated to the grade level as they were intended to assess the collective phenomena.

Collective Action (CA). The collective action instrument measured the perception of collaborative engagement in tasks around teaching and learning such as the development of common lessons, feedback around instructional practices, review of student work, and focus on teaching and learning using a five-point Likert type agreement scale with the anchors 1 = strongly disagree and 5 = strongly agree. The seven-item scale was designed to assess teachers' collaborative practices within the school and was adapted to both the grade level and reading comprehension focus of the reform studied (Bryk, Camburn, & Louis, 1999). For example, teachers were asked in relation to the reform to assess, "Teachers in our grade level collaboratively review student work to improve instructional practices". Results of principal component analysis with varimax rotation provided evidence that the seven items contributed to a single factor solution, explaining 68.4 % of the variance (α = .89) with individual items loadings from .65 to .83. We then aggregated the teachers' perception of grade level collective action to the grade level producing an average collective action grade level score.

Grade Level Efficacy (GLE). The Grade Level Efficacy instrument measured the collective efficacy of teachers at the grade level around teaching and learning using a five-point Likert type agreement scale with the anchors 1 = strongly disagree and 5 = strongly agree. The survey was based on seven items adapted from the original Goddard, Hoy & Woolfolk Hoy (2000) instrument on collective efficacy. Out of the twenty-one items from the original survey we selected seven that focused most directly on teacher competence from the two-factor solution suggested by Goddard et al (2000). We selected this subset of questions as they were most closely connected to the intent of the district reform and could be modified to reflect a grade level focus. A typical item from this revised scale included, "In our grade level, teachers believe that they have what it takes to get children to learn". Principal component analysis with varimax rotation provided evidence that the seven items contributed to a single factor solution explaining 59.5% of the variance (α = .82) with individual items loadings from .74 to .81. Following the process outlined by Goddard et al (2000), we aggregated the efficacy scores from each teacher creating an average collective efficacy score by grade level.

Table 3. Item and factor loadings of the scales used in the study (n = 196).

Scale	Factor loading
Collective Action (α = .89)	
1. Teachers in our grade level plan together to meet the needs of diverse learners	.83
2. Teachers in our grade level work collaboratively to implement the instructional focus on reading comprehension	.82
3. Teachers in our grade level collaboratively review student work to improve instructional practices	.78
4. Teachers in our grade level collaborate to provide feedback to colleagues on instructional practice	.77
5. Teachers in our grade level share lessons that lead to meaningful student learning	.75
6. Teachers in our grade level collectively focus on lessons that promote higher order thinking skills	.74
7. Teachers in our grade level have opportunities to observe peers	.65
Grade Level Efficacy (α = .82)	
1. In our grade level, teachers believe that in spite of family challenges we are able to teach all students to become proficient	.81
2. In our grade level, teachers are skilled on various reading comprehension strategies	.80
3. In our grade level, teachers believe that they have what it takes to get children to learn	.78
4. In our grade level, teachers are well-prepared on reading comprehension instruction to improve student learning	.77
5. In our grade level, teachers truly believe every child can learn	.75
6. In our grade level, teachers are confident they will be able to motivate their students	.74
7. In our grade level, teachers try different methods when a child doesn't learn something the first time	.74
Collective Satisfaction (α = .79)	
1. What is the level of satisfaction within your grade level around collaborative information exchange related to the reform effort?	.88
2. What is the level of satisfaction within your grade level around support for collaboration related to the reform effort?	.82
3. What is the level of satisfaction within your grade level around collaboration related to the reform effort?	.81

Collective Satisfaction (CS). The satisfaction scale was an original instrument comprised of three items on a five point satisfaction scale ranging from 1 = very dissatisfied to 5 = very satisfied. Respondents were asked to rate the level of satisfaction with grade-level collaboration related to the reform, collaborative information exchange, and support for collaboration. For example, "What is the level of satisfaction within your grade level around collaboration related to the reform effort." Principal component analysis with a varimax rotation indicated a single factor explaining 70.4% of the variance (α = .79) with individual items loadings from .81 to .88.

As a final test of the stability of the individual instruments we entered the collective action, grade level efficacy, and collective satisfaction items into a single principal component analysis to establish the stability of each scale. Using varimax rotation, this analysis resulted in an expected three-factor solution, explaining 68.3% of the variance, indicating that the three scales assessed separate constructs.

Interview data: Collection

While the social network data provided quantitative evidence regarding the structure of networks, and the teacher work measures assessed important elements related to teacher collaboration around reform, interview data offered insights into the nature of the networks in each of the schools. We conducted hour-long individual interviews with teachers using a semi-structured interview guide (Patton, 1990; Spradley, 1980) to provide additional information on the knowledge flow around the reading comprehension reform, the implementation of the reform, and collective interaction within the grade levels. Of the five schools, we selected three elementary schools that most closely mirrored the district's demographic average. Within each school we selected a primary grade (second) and an upper grade (fourth) as the target grade levels from which to select interviewees. These grade levels were chosen to enable between school comparisons as these cross-school grade levels use similar curricular literacy content and undergo standardized achievement testing. Moreover, the selected grade-level teams varied in the density of interactions among the grade level team members. Three of the selected grade-level teams could be typified as moderate to highly dense social structures (densities between .60-.80 on a scale of 0-1) and the other three grade levels were characterized by a sparse social network structure (densities between .08-.20).

From grades two and four in the three schools, individual teacher interviewees were selected based on their position in the social network

structure as determined by their centrality in the reading comprehension network. Centrality generally refers to how many ties an actor either initiates or receives and therefore is often thought of as an indicator of influence over the system. Per grade level, two teachers were selected that varied the most in the centrality of their network position. Specifically, we divided the centrality scores of the networks into quartiles and then selected teachers from the 1st (least central) and 4th (most central) quartile. This allowed us to select respondents who varied in regard to their centrality in the social network thus securing a variation in perspective based on network position and resulted in twelve interviewees. We have had success in previous studies (Daly & Finnigan, 2009) using this sampling strategy as a way to select respondents.

Interview data: Analysis

The interviews of the twelve teachers were audio-recorded and transcribed verbatim. Interview data were analyzed using a constant comparative analysis method (Boeije, 2002; Glaser & Strauss, 1967), as well as checking and rechecking emerging themes (Miles & Huberman, 1994). We grouped responses to the prompt and compared the perspectives of teachers at different grade levels. The themes that arose from this preliminary analysis were then re-examined, looking for patterns across grade levels and schools. This process of constant comparison "stimulates thought that leads to both descriptive and explanatory categories" (Lincoln & Guba, 1985, p. 341). In order to ensure the trustworthiness of interpretations, member-checking procedures were carried out as emerging themes developed and were shared with participants (Miles & Huberman, 1994).

RESULTS

Analysis of the social networks and interview data provided a detailed and nuanced understanding of how the district reading comprehension reform has been diffused and implemented. Our findings are presented around four major themes from the data: 1. Principals are the primary conduits through which the reform is initially diffused; 2. Significant variability exists within grade levels where the reform is primarily enacted; 3 Instrumental and expressive interactions are associated with collective action; and 4. Instrumental and expressive interactions are associated with efficacy and satisfaction.

Principals are the primary conduits through which the reform initially is diffused

As an original design component of the change effort, the district drew upon the formal hierarchical structure as the main channel of communicating the reform. Central office administrators informed principals who in turn shared the reform focus with the school staff. Centrality scores from the social network analysis reflected this hierarchical flow of information as principals were sought out for information related to the reform more often than other school staff. In-degree centrality scores, meaning the number of ties a principal received, for principals around reading comprehension information were 3.7 versus 1.8 for all other teaching staff. This finding indicates that on average, principals were nominated as sources of reform-related information more than twice as much as other teaching staff. Higher degree centrality is thought to be an indicator of overall influence in a network. Therefore, this finding suggests that individual principals have a strong potential influence on the diffusion of the reform in relation to other school staff. This finding is triangulated with qualitative data in which interviewees report that principals were the ones that primarily delivered information about the reform, while grade level leaders were described by one teacher as, "…doing the 'on the ground' work making the reform happen."

Interview data revealed that while principals received a similar message from the central office, they varied in the way they approached delivering the reform to school staff. Two of the five principals diffused the reform in a way that can be characterized as a technically oriented information sharing approach. These principals focused more on the "nuts and bolts" aspects of the reform elements such as following scripts and completing associated paperwork. A fourth grade teacher offered,

> *We're basically given an agenda by the administration, and we're told everything that we're supposed to have. We're supposed to turn in meeting minutes. So we have to write down everything that we talk about.*

In contrast, the three other principals were perceived to diffuse the reform through a collective learning-oriented frame. These leaders carefully outlined the broad scope of the reform, aims, and potential outcomes for the school. The principals were perceived as providing both information and guidance around the reform while respecting teachers' ability to implement the effort.

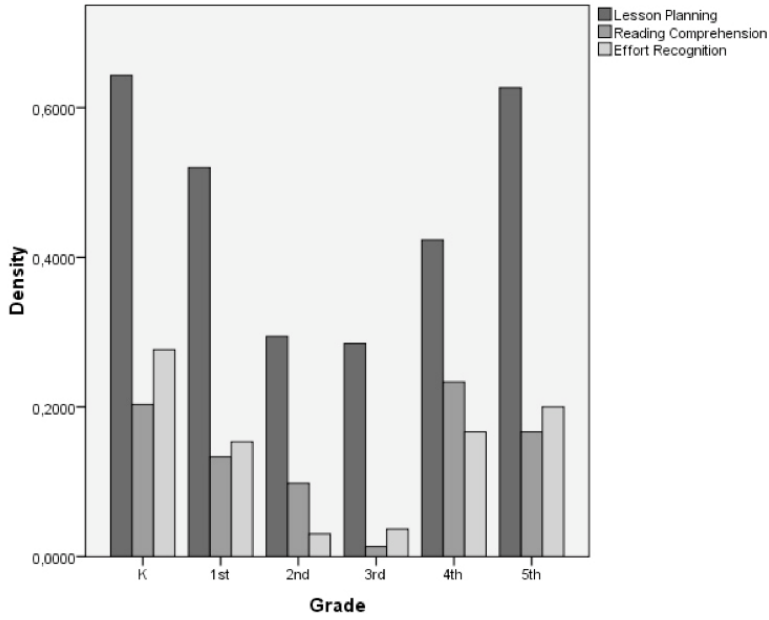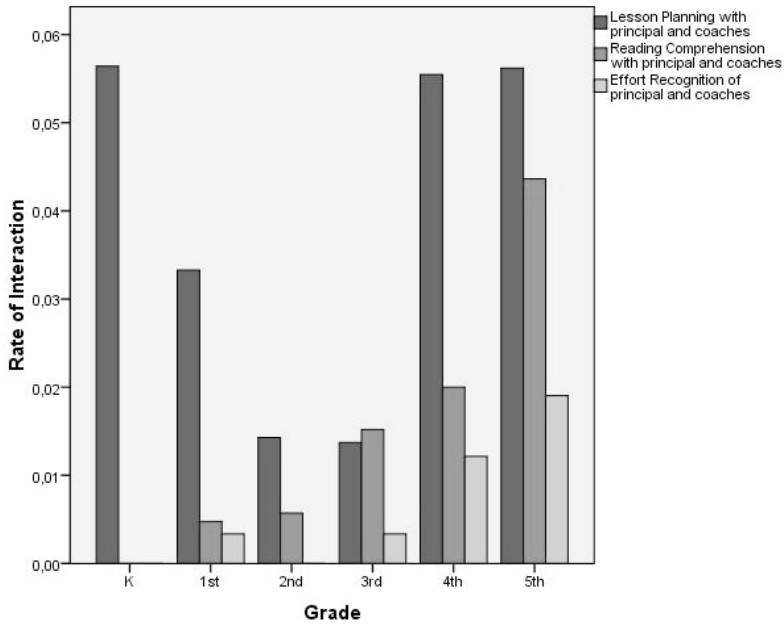Chart 1. Aggregated within grade level densities across sample

Chart 2. Aggregated grade level rate of interaction with support staff across sample

It appears that in these five schools leaders initially shaped and continued to influence the diffusion of information related to the reform. However, interviewees did not indicate that principals changed course in their initial approaches. If principals began the process by focusing on the technical elements of the reform they were likely to continue that path. A second grade teacher illustrated this finding,

> *I remember for a while, we were just like, 'OK, our focus is reading comprehension.' But nothing was said or done about it for a long time. Eventually, it was brought up again at another staff meeting from our Principal. He then repeated the information and tried to explain it a little bit better, but it was still the same stuff.*

Principals were described as having differing levels of skills, knowledge, and understanding of the reform that appeared to impact their ability to diffuse information. This variation may have also been exacerbated by a lack of specific direction provided the principals upon the initial introduction of the reform. This result suggests that the sample schools, even though they were a part of the larger reform effort within the same system, began the reform at vastly different points based on the introduction by the principal. These unequal footings may impact the school staff's ability to engage the change and perhaps ultimately affect the consistency and coherence of reform district-wide.

Significant variability exists within grade levels where the reform is primarily enacted
Aside from the role of the principals in disseminating information regarding the reform, grade levels (GLs) were the main organizational unit in which teachers interacted around the reform's content, meaning, and execution. Therefore, examining the interaction patterns between GL members is an important element in understanding the diffusion and enactment of the reform.

The density of grade level interactions and rates of interaction between grade levels and support staff were found to vary both within and between schools. Charts 1 and 2 provide the across school aggregated density measures of within GL and between GL and support staff interactions. Findings indicate that on average, the proportions of ties of *within* grade levels in all three networks are significantly higher than the proportion of interactions *outside* the grade level, (i.e. with support staff). Support staff (meaning principals and coaches) were instructed to support the implementation of the reform by supplying the grade level with reform-related information, materials, and knowledge on reading comprehension. Despite the presence of support staff,

Table 4. Correlations between reform networks and teacher work measures
(N = 30 Grade levels)

Reform Networks	M	SD	Action	Beliefs	Satisfaction
<u>Lesson planning</u>					
Density within grade	.47	.29	.49*	.38*	.54*
Reciprocity within grade	.40	.37	.25	.34	.43*
Interaction with Support Staff	.04	.05	.43*	.23	.31
Reading comprehension					
Density within grade	.14	.19	.25	.49*	.28
Reciprocity within grade	.09	.23	.37*	.24	.14
Interaction with Support Staff	.01	.03	.29	.04	-.24
Effort recognition					
Density within grade	.14	.19	.24	.44*	.39*
Reciprocity within grade	.06	.19	.03	.23	.45*
Interaction with Support Staff	.01	.02	.29	.27	-.09
Teacher Work Measures					
Collective Action (CA)	3.77	.53	1.00	.63**	.22
Grade level Efficacy (GLE)	4.17	.40		1.00	.30
Collective Satisfaction with collaboration (CS)	3.18	.38			1.00

Notes: *p<.05, **p<.01

teachers tended to interact most frequently within their grade level, while fewer interactions were reported between grade level members and support staff.

Triangulating this finding, interview data suggests that it was during grade-level weekly meetings where teachers would discuss reading comprehension material, assessment data, student work, and classroom strategies. These grade level meetings appeared to be the primary unit where the reform was understood, co-constructed (Datnow et al., 2006), and enacted. Grade level team members attempt to make sense of and implement the reform drawing on their own collective experience. Referring to this co-construction, a fourth grade teacher commented,

> *More than anything, I would say the grade level team is the main support for making it [the reform] work. Administration and the leadership team decide our reading comprehension focus and our team is really the best resource because we can dive into the material together and figure out what lesson we think is great, plan the instruction, and tackle it individually from there.*

This suggests that the reform goes through several layers of modification prior to reaching the classroom. The reform is first interpreted by the principal, modified at the grade level, and then finally delivered in the classroom. Although the reform was designed to be consistently enacted throughout the district, grade level interactions appear to modify what occurs at the classroom level. This is neither a commendation nor condemnation of the interaction patterns. However, the finding does suggest both the importance of examining the social structures upon which reforms are layered as well as advancing the more technical elements of reform.

While teachers described their grade level as the primary unit for implementing the reform, considerable variability was found between schools and across the thirty grade levels. We examined the density and reciprocity of reform-related networks within the grade level structures as well as the way in which grade level members described their work. Results from these analyses are provided in Table 4.

On average, most interactions between teachers take place around lesson planning. Considerably less reform-related interaction was noted on knowledge seeking regarding the reading comprehension reform as well as effort recognition. For all five schools, there are much more dense connections around lesson planning (M = .47, sd = .29) than reading comprehension (M = .14, sd = .19) or effort recognition (M = .14, sd = .19). This result indicates that much more interpersonal activity around the reform was concentrated on lesson planning than seeking reading comprehension knowledge, or recognizing

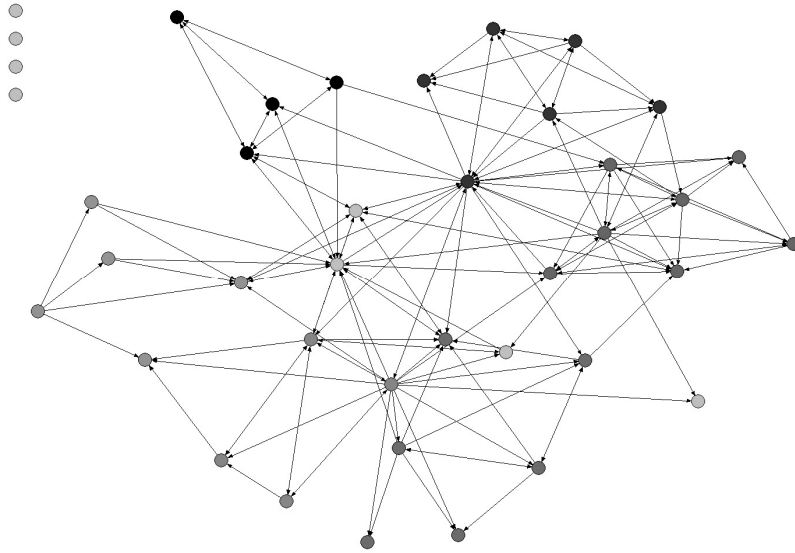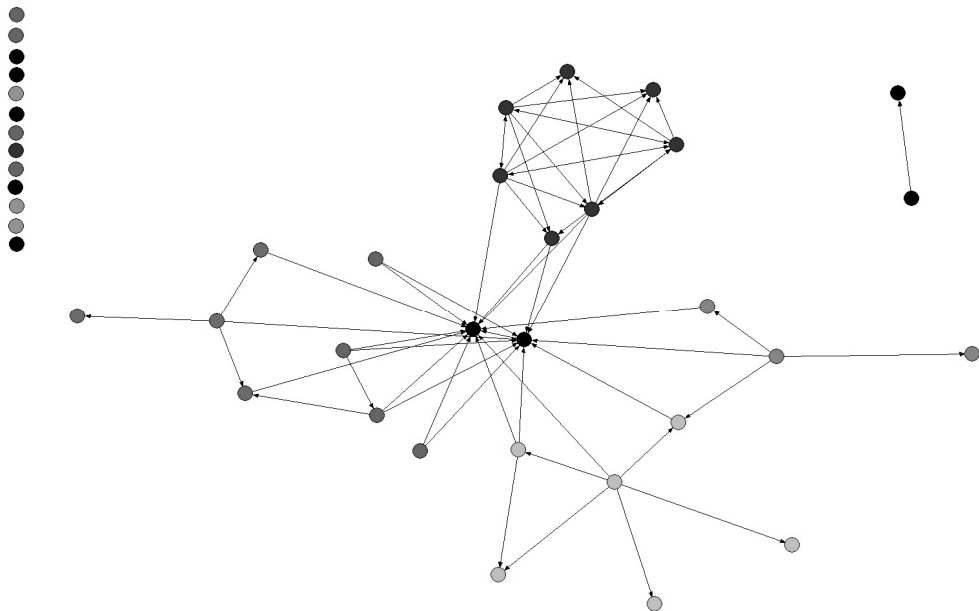Figure 1. Reading comprehension network of School E

Figure 2. Reading comprehension network of School C

efforts of colleagues who engaged the reform. This pattern also held for the levels of reciprocity within the grade levels with significantly more reciprocal relations existing in the lesson planning relation (M = .40 sd = .37) than in reading comprehension (M = .09 sd = .23) or effort recognition (M = .06 sd = .19). In sum, results indicate that the density and reciprocity of within grade-level interaction regarding the reform varied significantly, both across and within the five sample schools (average standard deviation vary between .19 and .37) (see Table 4).

These differences can also be represented graphically. Figures 1 and 2 represent the Reading Comprehension Networks at two of the schools at which teachers were interviewed. We have selected these schools to represent the range of variability in density and structure of school level networks with similar teacher and school level demographics. Figure 1 represents school E and is characterized by numerous frequent interactions at the school level and densely connected grade levels with few isolates (no frequent interactions with other members in the network, visualized as dots in the upper left corner). Figure 2 displays school C that consists of fewer school level interactions, more loosely connected grade levels, with more isolates and individuals at the periphery of the network.

Differences in grade level interaction seemed to be related to the way in which grade level members describe their collaborative work in the interviews. In those grade levels where more reform-related interactions were indicated teachers described a focus on a common reading goal with a commitment to building professional practice. A fourth grade teacher from a more connected grade level captured the general finding from these densely connected grade levels,

> *I think that we just all have a common goal, and the most important thing to us is our students. Our goal is to want to better the education of our students and ourselves as professionals. So during our [grade level] meetings we work together to meet that goal. I think that during our meeting time we know this is an opportunity where we have work that needs to be done and this is a time that we can better our teaching practices.*

This stands in contrast to how teachers at less connected grade levels describe their experience. A fourth grade teacher from a grade level with fewer interactions around the reform shared,

> *In my grade level, we're doing so many different programs in fourth grade, you know there are two teachers on shared days, then there's the ten day program, I have GATE [high performing/gifted] class, and there's a high point program, that we cannot work together as a grade level, so our grade level is actually pretty fragmented when it comes to planning [the reform].*

These findings imply that grade levels are the primary unit through which the reform is understood and enacted and that the social structures within and between grade levels vary considerably. Some grade levels establish clear goals and a focus on improving instruction while others are described as disjointed and have a more fragmented approach to both planning and implementing the effort. It appears that despite a singular district focus and emphasis on consistency, there may be multiple versions of the reform taking place at different levels of depth throughout the district. Moreover, these versions seem to be related to characteristics of the social networks underlying the teams in which the reform effort is implemented. This underscores the importance of social linkages as a key element in the planning and execution of reforms.

Instrumental and expressive interactions are associated with collective action
In order to understand to what extent the pattern of instrumental (work/content related) and expressive (affective) relationships were related to grade level teacher work measures, we investigated correlations between social network measures and work measures. This examination rendered a number of statistically significant relationships that are identified in Table 4.

Results indicate that the density of lesson planning interactions was associated with grade level scores on Collective Action (CA) (.49, p<.05). The CA scale assessed the work of the grade level as teachers collaboratively work to improve instruction and student learning. CA addresses specific professional activities that require collective action, such as: sharing lessons, giving feedback on practice, reviewing student data together, and collectively refining instructional practices. Moreover, the rate of interaction of grade levels with their support staff around lesson planning was also correlated with teachers' collective actions (.43, p<.05). These findings suggest that the more interactions within grade levels and between grade levels and support staff, the more likely these interactions were to focus on teaching and learning. In support of the relationship between instrumental interactions and teachers' collective actions around instruction and student learning, we found that reciprocity of grade level relationships around reading comprehension was significantly correlated with teachers' collective actions (.37, p<.05). This seems to suggest that the more

stable and reciprocal the collaborative relationships at a grade level, the more focused the team was on collectively discussing and refining instructional practice.

These findings are triangulated by interview data collected in both dense and sparse networks. The qualitative data provided a more nuanced understanding of teacher exchanges and the context of their collaboration as well as highlighting the degree of variability that exists between grade levels. In general, teachers in more densely connected reform networks noted three major themes: 1. focus on teaching and learning; 2. goal setting and shared decision making; and 3. learning orientation toward the reform.

Focus on teaching and learning. Teachers within densely connected grade levels reported a number of professional activities in which they engaged to improve teaching and learning. Interviewees from densely connected grade levels reported sharing lessons that were directly connected to the reform effort. They also sought opportunities to observe peers, develop lessons on higher order thinking, collaboratively refine instructional practices, and provide feedback on practice. Aside from improvements to teaching and learning, teachers in these densely connected grade levels indicated more frequent use of data for instruction, co-developed curricular assessments, and a focus on student work.

Qualitative findings from the densely connected grade levels stand in stark contrast to those with fewer interactions. In general, teachers in sparsely connected grade levels reported less focus on reform-related practices. In fact, these grade levels were likely to describe a more individual level approach to the reform. A fourth grade teacher in a sparsely connected grade level captured the general theme,

> *I feel like I'm working on it [reading comprehension] by myself. I have read the book by myself and I then try to implement the lesson in my class by myself. I don't feel like I'm in a professional community.*

Goal setting and shared decision-making. Although all grade levels met formally to discuss pedagogical issues, these meetings seem to be conducted in distinctly different ways and at varying levels of depth. Results suggest that the ability to influence the grade level's goals and plans differed with the amount of interactions that took place within the team. In particular, grade levels that were more densely connected reported to have more input on decision making in regard to their weekly agenda. A common practice in these grade levels was

to collectively develop a meeting agenda and provide additional opportunities for input and discussion specifically around the reform.

In contrast, grade levels with less frequent interactions often described themselves as on the receiving end of a rigid agenda set by the administration. A second grade teacher offered, "We receive a detailed agenda from our principal saying what we need to cover and talk about and that is the extent to our input." The lack of goal setting opportunities seemed to permeate interviews from these sparsely connected grade levels across teachers and schools. In a more unambiguous description of the lack of input, another second grade teacher from a different school stated, "Oh, we don't make any decisions. We're told everything."

Learning orientation toward reform. Teachers in densely connected teams also reported the creation and use of their own protocols and formats for planning around reading comprehension. These teams would frequently mention the development of common lessons and sharing of rubrics, assessments, and other tools to deepen the work of the reform. A fourth grade teacher captured this theme,

> *We meet every week and we talk about common lessons. We talk about what works, and what doesn't work. When we focused on inference [a reading reform strategy], we actually decided to go back and re-do it. We didn't like what we got the first time. We discuss among the four of us ideas for the lower level, ideas for the higher level, it didn't matter who was teaching what level, we all just talked. Somebody will share, 'Hey, this is really working.' You know, when I was teaching another grade level, we were just five different islands doing our own thing.*

This collaborative learning orientation toward the reform seemed to be present in those grade levels that had more dense connections. In more sparsely connected grade level teams teachers reported a focus on the more 'technical' aspects of the reform such as completing minutes or checklists. There seemed to be less of a focus on implementing the reform with depth. However, it is not to suggest that teachers wanted to maintain this technical approach, rather they expressed an unrealized desire to focus on more substantive issues connected to the reform. However, they often found themselves responding to a combination of administrative dictates and lack of opportunities for building connections that appeared to inhibit the depth engagement with the reform. A fourth grade teacher noted,

> *I would appreciate the freedom to make our own agenda, to talk about what we need to talk about, focus on more important things instead of filling out all this paperwork, we could get a lot more done and use our limited time wisely. But it seems like there's so much paperwork, so many other little things we have to do. All the other important stuff never gets talked about.*

The interviews of teachers from second and fourth grade in densely and sparsely connected grade levels suggested that the overall engagement, depth, and spread of the reform seems to be associated with the density of connections at the grade level. Although in this sample we lack the statistical power to make conclusive claims, we did find statistically significant correlations between grade level density and student achievement scores in literacy. This trend supports our findings around grade level density as well as providing additional evidence to recent studies connecting collaboration and student achievement (Goddard et al., 2007).

Instrumental and expressive interactions are associated with grade level efficacy and satisfaction

In addition to teachers' collective actions, quantitative results indicate that the amount and nature of grade level interactions was related to more affectively oriented teacher measures, namely grade level efficacy and collective satisfaction with collaboration. Efficacy was a particularly important factor for reform interactions as it was correlated with all three networks. Correlations indicated that the densities of within grade level interactions around lesson planning and reading comprehension were positively related to grade levels' score on the grade level efficacy scale (GLE) (.38 and .49, $p<.05$ respectively), which measured collective efficacy around student learning. These correlations suggest that teacher teams with more interaction around lesson planning and reading comprehension are also more likely to perceive their ability to collectively affect student learning.

Interactions around both lesson planning and reading comprehension were found to be significantly correlated with a grade level's degree of Collective Satisfaction (CS) (.54, $p<.05$). CS assessed satisfaction with collaborative work around the reform. This finding suggests that interaction within the grade level is related to teacher satisfaction, meaning the more grade levels interact around the reform, the more satisfied the team was with the levels of collaboration. Moreover, the more reciprocal the relationships around lesson planning, the more satisfied grade level teachers were with the level of collaboration within their grade level (.43, $p<.05$).

Grade level efficacy and collective satisfaction were also associated with the density of interaction within a grade level around recognition (.44 and .39, p<.05 respectively). This suggests that the more grade level members recognized one another for their efforts related to the reform, the higher the grade level's sense of satisfaction with the collaborative efforts as well as the belief that they can affect student learning. Moreover, satisfaction with collaboration also increased with the presence of more reciprocal relationships in the recognition network (.45, p<.05).

Overall, the pattern emerging from the quantitative data suggests that teachers in grade levels with more dense interactions around the reform are not only more satisfied with their collaboration, but also feel more competent as a team in increasing student performance than teachers in grade levels with fewer interactions. Our qualitative data triangulates these findings. Teachers in densely connected teams often mentioned the importance of working together in meeting reform goals. These teachers also voiced a shared sense of responsibility between team members and an explicit desire to build and maintain a professional school community.

Trust and respect were often cited by teachers as supportive of their team's functioning and providing a forum for open discussions about classroom practices and strategies. Teachers in more densely connected teams also reported drawing on the technical expertise of one another as well as accessing colleagues for emotional support. A fourth grade teacher illustrated this finding,

> *I think we all respect each other, but we also recognize that we're all different... We'll go to Kim for expertise with technology; we'll go to Greg for leadership questions. And I think the four of us feel comfortable that we'd say, 'Man, I'm having a rotten day.' And then somebody will say, 'Don't feel bad. I had a rotten day too.' And it's like 'Wow. I'm not the only one who had a rotten day.'*

The level of trust between members also seemed to provide opportunities for advice seeking on complex issues. Teachers reported it was crucial for individual teachers to be able to adapt to the needs and function of the team over personal issues in order to move the team forward on reading comprehension goals. This stands in contrast with less connected teams in which concerns about a lack of coherence and personal agendas were often mentioned.

Teachers in sparsely connected grade levels also noted themes around a lack of safety and being able to balance grade level politics. Educators in grade levels with fewer interactions indicated they tended to stay to themselves and focus on their individual classrooms. A fourth grade teacher shared,

> *There have been times when I have not known who the safe person is to go to. So I know I've hid myself in my classroom for weeks at a time because I do not want to get involved in the politics.*

Taken on balance, the quantitative correlations and interview data suggest that the density of grade level reform networks is associated with important grade level work measures related to the reform. Grade level teams with dense interactions around the reform were found to engage the reform with more depth. Efficacy and satisfaction, two work measures that refer to more 'affective' processes, appear to support a more flexible and learning-oriented approach to the use of reading comprehension strategies in their classrooms. In contrast, less connected grade levels were found to follow a more technical and rigid approach to the reform with ready-made procedures and tools to be implemented. Our data suggests higher levels of collective efficacy and relational trust appear to be important in supporting grade level interactions. In addition, teacher recognition of one another was associated with satisfaction with collaboration and a grade level focus on teaching and learning, as represented by a common perception of collective action. However, despite the importance of these social linkages on the change effort, they were not an explicit design feature of the district-wide reform.

CONCLUSIONS AND DISCUSSION

In this chapter we examined a district that is implementing a system wide reform around literacy across twenty-four schools. Drawing upon the broader literature of social capital and social network theory we examined three reform-related networks: lesson planning, reading comprehension, and recognition within five schools that were also receiving additional support for reform implementation. Findings suggest that the underlying social networks played a significant role in either supporting or constraining the ability of the grade level to understand and implement the reform. Grade levels with more dense interactions between members reported being able to enact the reform at a greater depth than those more sparsely connected grade levels. Moreover, these

interaction patterns were associated with a greater focus on teaching and learning as well as increased collective action, grade level efficacy, and collective satisfaction. This suggests the importance of attending to relational linkages as a complementary strategy to a focus on the technical core of enacting reform efforts. We will present several major themes related to reform efforts that are suggested by our study.

Leadership in reform

The primary mechanism for the reform entering and being diffused through the school occurred through the principals. However, principals engaged with the reform quite differently ranging from a more technical focus to a collective learning orientation. Principals appeared to mediate the understanding the scope and depth of the reform. Independent of interaction patterns, grade levels seemed to be influenced by the leader's perception of his/her role in diffusing the reform. Similar to other studies (see Chapter 4; Burch & Spillane, 2004; Honig, 2006, 2008), leaders modified and brokered reform-related resources such as information and knowledge. This suggests that, in this sample, principals acted upon the formal mandates of the reform in a different way that often defined how the reform was understood and ultimately enacted.

Relational linkages in reform

It is apparent from our data that, although embedded in the same school district and under the similar requirements to reform instructional practices, the sample schools communicated and collaborated in distinctively different patterns of social interaction. Similarly, the grade level teams, upon which the implementation of the reform rests, were significantly different in their social structures related to the reform. However, while the reform was targeted at grade level structures, at no point in the reform design were social linkages explicitly addressed as potential facilitators or inhibitors of change. The design of the reform was focused on the more technical aspects of reading comprehension, which supported the development of individual teachers. This human capital focus, especially in the form of new pedagogical strategies and standards, was important in moving the reform forward. However, the lack of attention from the district to the informal social structures of grade levels, which were ultimately enacting the change, may have inhibited deeper engagement with the reform.

Efforts at reform are layered onto existing social and professional networks that may in fact constrain these efforts in taking hold (Tsai, 2002). To increase the likelihood of successful and sustainable efforts at reform,

educational leaders at the district and school level may benefit from a deep consideration of existing teacher networks prior to and during the implementation phase of a reform. Formally creating opportunities and structures for these networks to flourish and generate appropriate and useful pedagogical knowledge may be an important intrinsic element of the reform itself (Smylie & Evans, 2006). It bears noting that this emphasis on the more relational aspects of the reform suggests an equally important supplemental role to the more technical aspects of school improvement that are currently demanded by many educational policy instruments (Spillane, Reiser & Gomez, 2006). It is the interplay of a focus on relationships and technical elements of reform that may yield the most positive outcomes. The challenge is to determine the right proportions of each, which may well vary by context.

Depth of reform

In addition to the reform being 'passed' from the principal to the teaching staff, the reform appeared primarily diffused through grade level interactions. However, grade levels between schools and within schools had significantly different patterns of interactions, levels of reciprocity, and engagement with the reform. Grade levels varied on the amount of time, content, and focus dedicated to the district-wide reform effort with some grade levels spending more time on administrative features while others focused on improving practice. In our sample, it appeared that those grade levels with more interaction also actively co-constructed elements of the reform in terms of lesson development and instructional practices, perhaps enacting the reform with more depth (Coburn, 2003; Datnow et al., 2006). From a network perspective this suggests that along with the principal's role, the social networks at the grade level may have played a supportive or inhibiting role in the depth of understanding and enactment of the reform.

The importance of dense networks is supported by previous research indicating that interaction patterns in networks in which members interact frequently around work-related issues perceive deeper levels of social and professional exchange (Hansen, 1999; Reagans & McEvily, 2003). When working in collaboration teachers are potentially able to access and make use of the individual and collective resources embedded in their professional network (Rigano & Ritchie, 2003). When teachers design and plan together, best practices may be shared and developed through their discussion, which in turn are taken into classrooms (Little, 2003a; Stoll & Louis, 2007). In this study, grade level teams with more interactions appeared to be better able to design and share reform-related pedagogical strategies, assessments, and lessons than less

connected teams. Densely connected teams reported engaging the reform with a level of depth that went beyond surface structures and procedures to include a focus on changing classroom practice (Coburn, 2003). Teachers in these more connected grade levels indicated they generated joint productive work and artifacts such as protocol development, lesson study, and common assessments that have been associated with better student outcomes (Chrispeels et al., 2007). That is not to suggest that dense networks are always beneficial for meeting organizational goals. One can imagine a network of grade level 'resistors' that are densely connected, but do not engage in the 'work' of reform. Therefore, dense connections in and of themselves appear a necessary, but not sufficient condition for successful reform. Attending to the content of transactions between grade level teams appears equally important.

Grade level differences in reform
Teachers reported a number of conditions that supported their ability to successfully interact. Educators in more densely connected networks reported ownership and being empowered to set focus of grade level meetings within the parameters of the reform effort. Teachers expressed the importance of input around decisions and support for their professional agency in moving reform forward. Growing evidence suggests that, "teacher ownerships of the improvement process is critical to long-term sustainability in school change and student learning" (Chrispeels, 2004, p. 8). In this study, the ability to interact with one another on a more frequent basis around reform was associated with an increased sense of collective efficacy which has been previously associated with student achievement (Bandura, 1997; Goddard et al., 2000; Goddard, Hoy & Hoy, 2004).

Teachers in this study described the importance of trusting relations in their work. This supports other studies that have reported the importance of relational trust as a condition for more productive interactions and overall improved outcomes (Bryk & Schneider, 2002; Daly & Chrispeels, 2008; Tschannen-Moran, 2004). High levels of trust may support the exchange of new strategies, and allow teachers to take instructional risks in improving practice. This ability to take risks creates opportunities for teacher learning that may ultimately impact the depth of engagement in complex reform efforts (Coburn & Russell, 2008). Additional studies have also suggested that informal social bonds based in trust can provide access to specific knowledge pertaining to a strategy and have an effect in adoption and implementation (Frank et al., 2004) thereby enhancing collective processes and outcomes (Nahapiet & Ghoshal, 1998). Interpersonal conflicts and uneasiness with colleagues were found in

several of the less connected teams where relationships between teachers appeared strained. This apparent deterioration in relations between grade level members may limit access to reform-related knowledge as well as outcomes. Therefore, improving relationships between members in these less connected grade levels may be of prime importance to the success of the reform.

Using social network data in reform

Although it has been rarely used in improving efforts at change social network data may provide insight into which individuals are in the best structural position (i.e., highly central actors) to move knowledge and practice throughout the system (Daly & Finnigan, 2009). These highly central actors may also serve as points of contact to lesser-connected actors perhaps building the social capital of the entire system and supporting efforts at understanding, implementing and evaluating efforts at reform (Honig, 2006). In addition, using social network data, principals and coaches may be equipped to make more informed decisions about roles and how to best invest their time in providing differentiated support to grade levels. A more coordinated and thoughtful effort at building ties within and between teachers appears important in enhancing an organization's overall capacity for change and increasing the likelihood of success (Daly & Finnigan, 2009; Kogut & Zander, 1996; Moolenaar, 2010; Smylie & Evans, 2006). Therefore, as a complementary strategy to the a system-wide reform effort a better understanding of the social relations through which tacit knowledge and practices flow may be an effective strategy in supporting reform.

Delimiters and areas for future research

There are several limitations to this exploratory case study. Although the case has provided insight into the social structure of a district in need of improvement, it is a case study of reform effort in one district, which limits the generalizability of findings. By focusing the scope of this chapter on teacher teams we may have under-represented the connections between the principal and central office staff as well as other school staff, such as reading or special education coordinators at the school site. Moreover, the sample of five schools is too small to infer robust claims from our quantitative data. While the sample size was chosen to conduct a mixed methods study that would provide for the exploration of social networks in reform, we acknowledge the need for large-scale empirical studies that can substantiate our findings in larger and more divers samples. Lastly, we only interviewed twelve teachers in three schools and despite randomly selecting individuals from a range of degrees of

centrality the interviewees may not be representative of the larger sample. These delimiters of the study also point to additional areas for inquiry and analysis.

First, we are interested in further examining the social networks in Esperanza, including the networks of innovation and trust to examine whether the similar patterns exists. In addition, networks are dynamic (Kilduff & Tsai, 2003) suggesting the importance of studying networks over time. Longitudinal studies may allow us to examine the interactions between network structures, implementation of change strategy, and resulting outcomes over time. Finally, examining patterns of interaction and collaboration between grade levels and between grade levels and support staff may offer additional insights into structural patterns that may increase our understanding of teachers' collaborative work and the role of coaching within school improvements. Although one of the early steps in empirically examining social networks in reform, our study suggests the importance of examining, and accounting for, relational linkages through which reform flows. When reform goes to school it appears supported by a little help from densely connected 'friends'. To that end, our work adds to the growing chorus of scholars that emphasizes the importance of combining both human and social capital approaches in successfully diffusing and implementing efforts at reform.

CONCLUSIONS & DISCUSSION

In sum, this dissertation contributes significantly to our understanding of social networks in school teams and underlines the potential of ties for school improvement and student achievement. In this chapter, we will first describe how the current educational context has created the need to understand the social fabric of school teams, the elements that shape this social fabric, and the individual and organizational consequences that arise from it. Then, we will summarize the main findings of the studies in this dissertation in light of the nomological network that was elaborated in the Introduction of this dissertation. We will further discuss the conceptual and methodological contributions of this dissertation to social network research. These contributions will be complemented by limitations, suggestions for further research, and implications for educational leadership, reform efforts, and educational policy.

The need for increased understanding of social networks in school teams
Similar to educational systems in many countries, the past decades of Dutch education can be characterized by continuous mandated reform efforts to improve instruction and student learning. Examples of nationally mandated changes in Dutch elementary education are a shift from acquiring content knowledge to developing skills in collaborative and autonomous learning ('new learning' [het nieuwe leren]), a drastic change in mathematics instruction ('realistic mathematics education' [realistisch rekenen]), growing autonomy for schools in the form of direct allocation of national funding to the schools ('lump sum funding' [lumpsum financiering]), and increased pressure of accountability.

Associated with these changes are increasingly complex tasks for both principals and teachers that urge the need for collaboration among educators, such as managing instructional and financial autonomy and collectively making sense of reform implementation. It is likely that this urge for collaboration among educators will continue to grow in the future, because of a shift in instruction to more complex (higher order) skills, an increasingly diverse student population, demands for adaptive and inclusive education, and a growing diversity of functional roles in schools (principals, teachers, teaching assistants, teacher leaders, mentors, coaches, didactic experts, remedial teachers, social workers) (Rosenholtz, 1989; Little, 1987).

To understand how schools can capitalize on collaboration among educators, scholars are examining a number of concepts that focus on teacher interaction in support of school improvement, such as organizational (team)

learning, community of practice and professional (learning) community. The prevailing notion underlying these concepts is that social relationships among educators matter as these relationships are important to the exchange and diffusion of information, knowledge, and expertise. Yet, our insights in the nature of relationships among educators and the extent to which these relationships affect educational practice are scarce. Also, knowledge on the elements that may shape social relationships within social networks is limited, as well as mechanisms through which social relationships among educators may benefit school outcomes. In order to address this paucity in the current discourse, this dissertation investigated the nature, antecedents, and consequences of social networks in school teams.

The dissertation is guided by the idea that social networks in school teams may support or constrain the exchange of resources that can be accessed and leveraged to achieve schools' goals. The introduction of this dissertation elaborates this idea in a literature review on social capital theory and social network theory. Social capital literature suggests that features of social organization, such as networks, trust, and norms of reciprocity, are critical to organizational performance (Adler & Kwon, 2002; Katzenbach & Smith, 1993a; Leana & Van Buren, 1999; Nahapiet & Ghoshal, 1998; Reagans & Zuckerman, 2001) and may add to a firm's value creation through innovation (Tsai & Ghoshal, 1998).

Social network literature offers deepened understanding of the mechanisms through which the configurations of social relationships in networks may affect the exchange and diffusion of resources. Important mechanisms that may explain the flow of resources in a network include network homophily and structural balance, the strength of weak ties, and structural holes. Social capital theory and social network theory provided the conceptual background for the development of a nomological network to frame our study of social networks in school teams. Under the headings 'nature, antecedents, and consequences', we identified several elements that were expected to be related to social networks in school teams, and we designed eight studies to assess these elements.

The studies in this dissertation are conducted in two settings. The first sample included 53 Dutch elementary schools that together formed the Avvansa School District[1] located in a southern province of the Netherlands. This region has in recent years been marked for its continuing low school performance in comparison to other regions in the Netherlands. Currently, the

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[1] All names are pseudonyms

district serves about 11,000 students in kindergarten (age of students 4 years) through sixth grade (age of students 12 years). While the population of students is relatively homogeneous and the region is typified by few second language learners compared to Dutch standards, the district is faced with challenges related to students from low income families and language deficiencies due to strong influences of local dialects. The district participated in the study as the implementation of a district-wide program for school monitoring and professional development offered the opportunity for large-scale simultaneous data collection among principals, teachers, support staff, students, and parents.

The second sample consisted of five elementary schools located near San Diego, California USA. The five sample schools were part of the Esperanza School District, an urban fringe district in its third year of sanction from the federal government for underperformance. The district serves about 19,000 students in kindergarten (age of students 5 years) through eighth grade (age of students 14 years) in 24 schools. The five sample schools were selected as they reflected the district's socio-economic background and academic performance levels. The five schools differed from the district's average as they were larger than the other schools in the district, and involved in a University partnership that provided additional professional development to support ongoing reform efforts. As such, the sample schools served as a 'best case' laboratory to test out the extent to which social networks constrain or support the district's efforts at reform implementation.

Main findings

Together, the eight studies of this dissertation provide a rich contribution to the nomological network that was presented in the Introduction of this dissertation. In this nomological network, we identified various concepts that would be assessed to provide increased understanding of the nature, antecedents, and consequences of social networks in school teams. We will now summarize the studies' main findings in order to review our acquired understanding and the current state of the nomological network of social networks in schools.

The nature of social networks in schools

Distinction between instrumental and expressive social networks
The opening study of the dissertation built on the idea that the structure of social networks may differ according to the content that is exchanged within its relationships. In the study, seven types of networks were compared and contrasted using social network analysis, QAP correlations, multidimensional

scaling, and network visualizations of the social networks in an exemplary sample school.

Results suggest that social networks in school teams can be categorized according to their content in instrumental or expressive social networks. Instrumental networks exchange content that is purely aimed at achieving organizational goals, and are therefore referred to as work related networks. Expressive social networks are not directly aimed at fulfilling organizational needs, and are more affective by nature than instrumental relationships. On average, expressive networks of friendship relationships and contact outside work were considerably less dense than work related networks. Findings further indicate that a second categorization may be based on mutual in(ter)dependence between the individuals exchanging the content. The distinction between social networks in school teams is not clear-cut, and the amount of overlap between social networks is dependent on the network questions used to delineate the content that is exchanged in the networks.

Social networks are mainly shaped by individual demographics and tendencies towards homophily

The second study focused on the extent to which social relationships are in part dependent on demographic characteristics of educators and schools. In the study, we conducted advanced social network modeling to predict the probability of relationships from various individual, dyadic, and school demographics.

Differences in the extent to which educators send and receive ties were found to be partly explained by individual demographics such as gender, age, grade level, working hours, and experience at school. In general, upper grade teachers and female teachers tended to send more ties than lower grade and male teachers, while the reception of ties was lower for full-time, female, older, and more experienced educators. Also, results indicated homophily effects for grade level and gender, supporting the notion that 'birds of a feather flock together' within grade levels and among teachers with the same gender. In addition, the study provided evidence that relationships among teachers were more likely when the school team was operating in the same configuration for a longer time. Other characteristics of schools, such as the percentage of female to male educators, school size by number of students, team size, socio-economic background, and average age did not affect the relational pattern among educators in the sample schools. In sum, individual variation among educators appeared to affect the pattern of social relationships to a larger extent than school characteristics.

Antecedents of social networks in schools

Teachers' social networks are not substantially affected by helping behavior
An important underlying assumption in social network literature is that individuals' behavior may affect the shape and size of their social network. The third study was conducted to examine the influence of teachers' organizational citizenship behavior in the form of helping behavior on their pattern of collegial relationships. In particular, we examined whether helping behavior increased the probability of having friendship and work related relationships with colleagues. We used a recent multilevel expansion of *p2* models to estimate the probability of ties across multiple levels of interest.

Findings from the *p2* models replicated results from the second study that on average, friendship networks were less dense than work related networks. While in both networks, relationships tended to be reciprocated, the tendency to reciprocate relationships was stronger for friendship than for work related relationships. Helping behavior did not affect the amount of work related relationships that teachers send out, but teachers who displayed more helping behavior had a slightly higher likelihood of receiving work related relationships than teachers with less helping behavior. For friendship, we found the opposite pattern. Helping behavior appeared to slightly increase the amount of friendship ties that teachers sent out, but displaying helping behavior did not affect the likelihood of receiving friendship relationships. While these results were significant, the size of the results suggested that helping behavior only plays a trivial role in shaping the pattern of relationships among teachers.

A principal's position is shaped by transformational leadership
An expanding avenue within social network research is the importance of the social network position of formal leaders for organizational performance. The fourth study therefore examined the significance of occupying the principal position for schools' innovative climate, and the extent to which school principals' network positions are shaped by transformational leadership behavior. Social network analyses, multiple regression analyses, multilevel analyses and network visualizations were combined to examine the data.

Results suggested that principals who were recognized by their teacher team as transformational leaders were sought out more often for advice on work related and personal matters than principals that enacted less transformational leadership. Transformational principals were also more closely linked to all teachers in their team. Moreover, principals' network

position affected the innovativeness of their schools' climate. The more principals were sought out for work related and personal advice and the more closely connected principals were to their team, the more willing teachers were to invest in change and the creation of new knowledge and practices. In contrast, the more principals occupied a 'brokerage' positioning in which they were the only link between unconnected teachers, the less innovative teachers perceived their school's climate.

Consequences of social networks in schools

Social networks impact teacher trust

Social capital theory poses that social networks and trust are associated with the availability of social resources. Since Putnam (2000) suggested that norms of reciprocity and trust may arise from social networks, our fifth study was aimed at investigating the extent to which social relationships affect levels of trust. Social network analyses and multilevel analysis were conducted to examine the relationship between social network properties and teacher trust.

The study demonstrated that the more relationships educators maintain, the more they perceive their team as characterized by trust. Above and beyond this effect of individual level relationships, the school's social network also appeared to affect teachers' perceptions of trust. The more densely connected teachers were in their schools' social networks, the more they perceived trust to prevail in their school team. In contrast, school teams with high levels of reciprocity among teachers were characterized by lower trust than teams with lower levels of reciprocity. This implies that the pattern of social relationships in the school team as a whole is *as* important to teacher trust as individual relationships. It also implies that certain network configurations may be less favorable for nurturing trust among teachers.

Social networks affect shared decision-making and schools' innovative climate

In debates on school change and reform implementation, a growing focus on the potential of social networks can be noticed. The sixth study in this dissertation was aimed at examining the potential of ties to support schools' innovative climate through increased teacher involvement in decision-making. This examination was conducted using social network analyses and a multilevel framework and analyses.

Densely connected work related and personal advice networks were found to be supportive of school climates that were innovation-oriented and open to change. Highly dense work related networks were also associated with

increased teacher involvement in the decision-making process. Findings thus suggest that schools with dense networks are more change-oriented since teachers in dense networks perceive greater involvement the school's decision-making process.

Schools' advice networks influence perceived collective efficacy, and in turn, student achievement

Social network studies in education often suggest that social networks among educators may ultimately affect student achievement. In the seventh study, we aimed to substantiate this suggestion by investigating the extent to which schools' social networks affect student achievement, as potentially mediated by teachers' collective efficacy beliefs. Social network analysis and multiple regression analyses were conducted to study the data.

Findings did not support a direct relationship between teachers' advice networks and student achievement. Instead, we found that being embedded in dense networks around work related and personal advice increased teachers' perceptions of the collective capacity of their team, which in turn was strongly positively associated with students' language achievement. As such, this study offers insights in a potential mechanism that could translate the potential of ties into increased student achievement.

Social networks support and constrain the implementation of reform

Social networks are increasingly being studied as important facilitators or inhibitors of organizational change. The final study in this dissertation aimed to shed light on the social forces among educators that may support or constrain the implementation of school reform. In addition, we aimed to substantiate findings of the previous studies by conducting a study in a different setting, namely Californian elementary schools, and using a different methodological approach. We designed a mixed-method exploratory case study, triangulating data from quantitative sources, such as social network analysis and teacher work measures; qualitative data, gathered through interviews with educators from representative grade levels; and the visualization of social networks in representative sample schools.

The study suggests that reform-related social networks in the Californian sample schools varied greatly both within and between schools, thereby reflecting the variation in social network properties within and between the Dutch sample schools found in chapter 1. The importance of principal centrality for innovative climates, as described in chapter 4, was substantiated with triangulated data supporting the principal as the central 'hub' for the diffusion

of change-related information. The finding that densely connected teacher teams also perceived greater involvement in shared decision-making, reported first in chapter 6, was confirmed in the US sample. Also, the relationship between dense Dutch teacher teams and the schools' open orientation towards innovation was mirrored by the collaborative learning orientation towards the reform, a sense of collective action and a professional focus on teaching and learning related to the reform that characterized dense US grade level teams. Finally, densely connected grade levels were associated with increased perceptions of grade level efficacy in the US sample, a finding that closely resembles results described in chapter 7. Overall, this study substantiated findings from the previous studies and deepened our understanding of the extent to which the structure of reform-related networks support and constrain the uptake, depth, and spread of the reform implementation in the schools.

Contributions to social network research

Conceptual contribution to social network research
As elaborated in the introduction of this dissertation, our aim was to explore three main elements of a nomological network, namely the nature, antecedents, and consequences of social networks in school teams. Besides the contextual importance of studying these elements, several additional aspects highlight the conceptual contribution of this dissertation to social network research.

The nature of social networks in school teams
The first conceptual contribution of this dissertation is that social networks in school teams are shaped by their content and demographic composition. As such, we validate earlier suggestions from organizational literature (Scott, 2000; Ibarra, 1993; Lazega & Pattison, 1999; McPherson, Smith-Lovin, & Cook, 2001) for the context of education. The structure of social networks in school teams, and the extent to which teachers are socially embedded, are dependent on the content that is exchanged, such as friendship, advice, or work related communication. This dissertation also confirmed that the extent to which individuals are actively engaged in relationships is shaped by their demographic characteristics. Certain regularities appear to affect work related communication in school teams, such as a tendency towards homophily and structural balance with regard to reciprocity. Findings also underline the importance of stable, low-turnover school teams for the nurturing of strong relationships among team members. As such, this dissertation has increased our

understanding of different types of networks that weave the social fabric of school teams.

Antecedents of social networks in school teams

The second conceptual contribution of this dissertation is that social networks in school teams are affected by transformational leadership, but not by helping behavior. The extent to which principals attend to the school's vision, tailor to teachers' individual needs and provide intellectual stimulation affects their centrality in the advice network. It may be that transformational leaders themselves are more actively pursuing the dissemination of advice (Coburn, 2005b), but it may also be that transformational leaders are more central because they are sought out more often for advice than less transformational leaders. Yet, in chapter 2, we did not find significant differences in the probabilities of teachers and principals of sending or receiving work discussion relationships. Since the network content of both studies is not similar (advice and work related discussion), and the statistical methods used to arrive at the findings differ for both studies, comparing the studies post-hoc can merely feed the suggestion that transformational principals may be more central because they occupy a more strategic network position in regard to the whole network, and not simply because they might have more dyadic relationships. Future research should provide more insights in the position of school leaders in their school's social network and the mechanisms through which transformational leaders achieve and utilize their principal position.

An equally interesting finding is that individual helping behavior did not significantly affect social relationships among school team members. The size of the effects suggests that helping behavior only trivially contributed to having relationships, and that the amount of relationships that individuals maintain may be explained by other mechanisms than helping behavior. This finding arguably requires the most attention in further research, since social networks studies until now have are only scarcely aimed at exploring potential antecedents of relationships within and between organizations.

Consequences of social networks in school teams

The third key finding of this dissertation is that social networks in school teams hold valuable potential for beneficial school outcomes. As such, the studies all emphasize the potential of ties to positively impact educational practice. Relational linkages were found to foster trust among teachers, contribute to teachers' willingness to innovate, and boost teachers' efficacy beliefs. The social embeddedness of teachers in their school team appears to facilitate or constrain

the exchange of information, knowledge, and social support in such a way, that it affects teacher practice and school organizational conditions. What is an even more important find is that teachers' social embeddedness affects their beliefs in collective efficacy, which in turn affects student achievement. Finally, the results of the Dutch studies were largely substantiated by the findings from a U.S. study. This study underlined the significance of attending to the social relationships to which reform efforts are targeted, and increased our understanding of the way in which reform implementation is facilitated and constrained by the social network configurations in schools.

The dark side of social networks

Besides underlining the advantages of relational linkages, we found several clues to suggest that some configurations of social relationships in social networks may be less favorable than others. Since social capital is often examined for its positive outcomes for individuals, organizations, and communities, it is important to note that the social structure in which resources are exchanged may also take unfavorable forms to prevent a normative standpoint from which social capital is interpreted as an 'unmixed blessing' (Portes, 1998). Two of our studies provide examples of the 'dark side' of social network configurations.

A first counterproductive outcome of social network configurations pertains to principals who span structural holes in the social network of their school team. Findings indicated that school teams in which a leader is spanning structural holes by occupying a brokerage position are often characterized by less innovative school climates (see Chapter 4). Confirming previous research, it appears that principals who occupy an in-between position constrain the generation of new knowledge and practice by reducing the opportunity for teachers to exchange knowledge and share experiences (Hargadon, 2003; Obstfeld, 2005). While this brokerage position may be beneficial to the principal in terms of control over the flow of information and influence over what knowledge and materials are distributed among team members (Burt, 2000), this situation may inhibit the school team to capitalize on the potential of relationships for teacher development and school improvement. As such, our study provides an illustrative example of undesirable collective outcomes that may result from the potential individual gain of spanning structural holes.

A second negative outcome of social network configurations relates to the downside of strong social relationships, or strong bonding, within groups. Social capital literature suggests that social capital can have at least four downsides: exclusion of outsiders, free-riding within groups, strong social

control resulting in restrictions on individual freedom, and downward leveling norms that socialize group members into accepting lower standards (Field, 2003; Portes, 1998). Social psychologists have identified several mechanisms that are negatively associated with strong relationships within groups, such as group think (Janis, 1982), in-group out-group differentiation (Tajfel, 1981; Tajfel & Turner, 1979), and social loafing (Karau & Williams, 1993; Latané, Williams, & Harkins, 1979).

Results from this dissertation indicate that high levels of reciprocity among teachers are associated with lower levels of trust among teachers (see Chapter 5). It appears that social networks may be characterized by a high number of one-to-one reciprocal relationships, and that too much dyadic bonding may harm the development of trust among teachers. Apparently, for trust to flourish there has to be a certain 'healthy' spread of relationships among the team. The more social relationships are clustered in pairs of team members, the lower the trust that school team members perceive in their school team. Highly clustered teams, therefore, may be at a disadvantage because they cannot operate from a solid trust base. It may be that the relationship between trust and clustering is circular, and that because of lower trust, teachers tend to concentrate their relationships on those colleagues, with whom they already have a (strong) relationship. An opportunity for building trust could lie in the diffusion of relationships through increased contact among teachers.

Methodological contribution to social network research

This dissertation comes to light in a defining decade for social network research. The popularization of the study of networks in various research fields, such as sociology, organizational science, psychology, and educational research, is supported by the emergence and development of more sophisticated and widely accessible statistical tools for social network analysis (e.g., Monge & Contractor, 2003). While the significance of this dissertation from a contextual and conceptual perspective is evident, there are several additional aspects with regard to methodology that make this dissertation a valuable contribution to the research base of social networks in education.

Advanced social network analysis techniques combined with 'traditional' statistical methods

A recent upsurge in the availability of advanced statistical methods to study social networks has expanded and advanced the field of social network research tremendously. A particularly interesting recent development is the introduction of *p2* and *p** (exponential random graph) models, that provide opportunities to

study the influence of covariates (such as behavior or individual and school demographics) on the probability of ties on multilevel and longitudinal network to gain insights in network dynamics (Goodreau, 2007; Robins, Pattison, Kalish, & Lusher, 2007; Robins, Snijders, Wang, Handcock, & Pattison, 2007; Snijders, 2002; Van Duijn, Snijders, & Zijlstra, 2004; Zijlstra, 2008).

This dissertation combined various techniques that are specifically developed for the analysis of social network data with statistical methods that can be considered more 'traditional'. For instance, in Chapter 1, the Quadratic Assignment Procedure (QAP; Krackhardt, 1987) is used in combination with multidimensional scaling to study multiplexity among social networks. Chapter 2 and 3 both demonstrate applications of multilevel *p2* models to examine how demographics and helping behavior affected the probability of relationships in a network. In addition to these advanced social network analysis techniques, studies in this dissertation use 'traditional' statistical procedures, such as correlation analysis, multiple regression analysis and hierarchical linear modeling (HLM, multilevel modeling) to study derived social network data (Chapters 3 to 8).

Diverse palette of methods

The studies in this dissertation employ a variety of methods to analyze social network data, including visualizations of networks (chapters 2, 4, and 8), raw network data (chapters 1, 2, 5, 8), and derived (calculated) network characteristics, for instance the density, reciprocity, and/or centralization of relationships within a network (all chapters) or the centrality of individuals within a network (chapters 4 and 8). While most studies apply social network analysis in a quantitative manner, Chapter 8 is the exception to this rule. This chapter capitalizes on the diversity of social network methods through the employment of a mixed-method design. Conclusions are drawn from a combination of graphical representations of social networks, raw network data and derived network properties (such as density, reciprocity, and centrality), and interviews with educators that occupy different structural positions in the social network of their school. By triangulating data acquired through multiple methods, this work represents additional advances in how scholars may come to better understand the supports and constraints that are posed by social networks.

Multilevel analysis

An important contribution of this dissertation concerns the examination of teacher relationships at multiple levels of analysis. The need for multilevel studies is evidenced by the multilevel nature of (most) educational research data (Raudenbush & Bryk, 2002; Snijders & Bosker, 1999). Data is said to have a 'multilevel' structure when the data is hierarchically structured. The multilevel structure of data in this dissertation can be exemplified when examining teachers in schools: when teachers work at the same school, they may share some similarity that is defined by teaching at the school. For instance, teachers' individual perceptions of their school's innovative climate may be partially determined by the extent to which the school's policy is aimed at innovation. Therefore, these 'individual perceptions' cannot be considered entirely independent. Other examples of the multilevel character of the dataset underlying this dissertation are; students from the same school in the same district; and multiple dyadic relationships from a single teacher (since these relationships, similarly, share this single teacher as a common characteristic) Multilevel analysis techniques such as hierarchical linear modeling (HLM) for linear data and *p2* models for network data allow researchers to take this interdependency into account.

Until recently, most social network studies only examine social networks and related concepts at a single level of analysis, for instance the individual, the dyadic, *or* the network level. Social networks, however, 'are complex systems composed of components and properties that exist and can be explained at all levels' (Monge & Contractor, 2003, p. xii). Therefore, all chapters in this dissertation explicitly address the importance of studying social relationships at multiple levels of analysis and, if possible, apply multilevel techniques to account for the interdependence of hierarchically nested data.

Limitations

Although we see the potential of this paper for a unique conceptual and methodological contribution to social network research in education, we acknowledge its limitations. Five general limitations to this dissertation will be discussed in more detail.

Test of the complete nomological network

This dissertation was guided by a nomological network of the nature, antecedents, and consequences of social networks in schools. The studies describe various individual and school level elements in relation to social networks. As such, the nomological network is developed by examining parts

of the nomological network separately. Yet, the integral chain of variables that lead from antecedents to consequences of social networks has not been explored. The reason for this is that the employed statistical techniques (*p2* models and 'traditional' methods) could not be combined into a structural equation model to assess causal paths among the elements of the nomological network. It would have been possible to study antecedents of social networks without accounting for the multilevel interdependency of the data (also using 'traditional' methods), for instance by considering network properties of individuals as 'individual attributes' rather than relational properties. Yet, this would only be possible from an ego-network perspective. An example of such an approach is given in chapter 4, where we studied transformational leadership behavior as an antecedent of principals' network centrality. Doing so for all individuals in a network simultaneously, however, would have ignored the interdependency of the individuals in the network and as such violated basic assumptions about social networks (see the Introduction and chapter 2). We acknowledge that this is a limitation that requires attention in the near future. The history of leadership literature (e.g., Yukl, 1981) teaches us that the call for integral frameworks often originates when an idea is gaining momentum. Considering the dramatic increase in social network studies over the past decade (see chapter 1), we expect that scholars will voice the need for such integral models more often, and with more emphasis.

Network measures
Although the studies in this dissertation clearly underline the relevance of relationships among educators, results have mainly focused on the density of social networks and the amount of relationships shared among school team members. Less explicit attention has been paid to the frequency and intensity of network contacts, thereby limiting our opportunities to provide insights in the importance of strength of weak ties. Future research in this direction would certainly contribute to a more detailed understanding of the importance of social networks in school teams for various school outcomes. Also, the study in this dissertation only address 'basic', fairly comprehensible network measures. Currently, social network studies are including more detailed and intricate measures to gain fuller understanding of the complexities of social network structure and its relation to behavior. Often, these network measures are based on characteristics of 'relationships-of-three', that is, patterns of relationships among three individuals, such as triads, triplets, and three-cycles (see for an extensive discussion Degenne & Forsé, 1999; Wasserman & Faust, 1997). A detailed examination of such network configurations would potentially yield

more insights in the intricate pattern of relationships and behavior in school teams.

Generalizability

Another limitation to this dissertation is posed by the extent to which our findings can be generalized to other settings. Our final study validated many of the findings from the Dutch sample in a different context, namely five larger elementary schools in California USA, and our findings resemble results from similar recent studies all over the world (Baker-Doyle & Yoon, in press; Cole & Weinbaum, 2007; Hite, Williams, & Baugh, 2005; Lima, 2009; McCormick, Fox, Carmichael, & Procter, in press). Nevertheless, we acknowledge that our findings may not be generalizable to other countries, as well as other educational settings, such as secondary, vocational, or higher education. It would be interesting to compare and contrast recent findings from various international contexts to explore potential culture differences in relation to social network structure.

Causality

The concept of social capital is often criticized for its logical circularity. Social capital is often interpreted as simultaneously a cause and an effect; leading to positive outcomes and being inferred from the same outcomes (Portes, 1998). In this dissertation, causality between the relationships under study and the elements of the nomological network were funded by suggestions from reviewed literature. However, our research design was not aimed at assessing the causality of the relationships under study. The empirical literature base for social networks in education is small, and studies testing causality in regard to social networks in education are even more scarce. Yet, readers are advised to proceed with caution when inferring causal conclusions from our findings. Thus, in future empirical studies more attention should be given to the examination of causality, attempting to break through its logical circularity.

Network dynamics

Social networks are dynamic and change over time (Kilduff & Tsai, 2003). Unfortunately, the cross-sectional data of this dissertation only allowed for a static examination of social networks in school teams. Therefore, longitudinal studies are indicated to enhance our understanding of the exchange of different types of content in social networks, the implementation of change strategies, and resulting outcomes over time. A promising lens on the interplay between individual behavior and social structure that has remained largely empirically

untouched is Burt's structural theory of action in a longitudinal perspective (Leydesdorff, 1991).

In general, the dissertation emphasizes that individual and collective action is embedded in a social context and that we should attend to the structure of this social context as it poses opportunities, as well as delimiters, for individual and collective action. To explain how social structure and individual action are intertwined, Burt (1982) views social structure as a dynamic response to individual interactions that simultaneously poses constraints for interaction to occur. His structural theory of action poses that individuals act to achieve goals in line with their personal interests, and that both interests and the resulting actions are constrained by existing social structure. By adding a temporal dimension, Leydesdorff (1991) highlights the circular character of the theory, illustrating that social structure is both an antecedent and a consequence of individual social action (see Figure 1). Since this longitudinal extension to Burt's (1982) theory is potentially meaningful for further research, scholars would be advised to methodically explore the interplay between network dynamics, individual action and preferences in future research.

Figure 1. Burt's (1982) structural theory of action, plotted over time
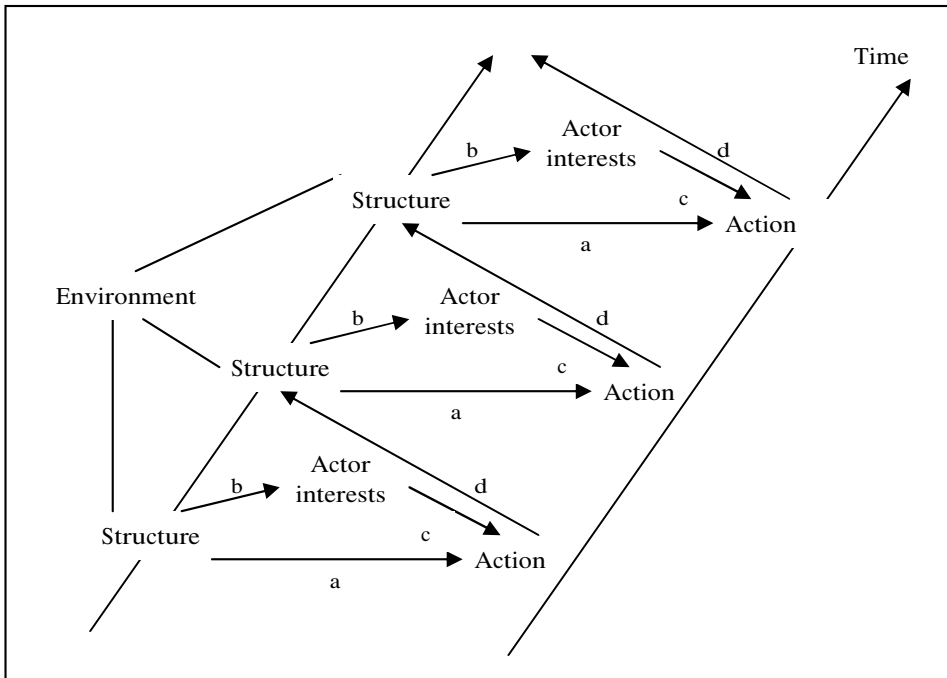
Suggestions for future research

Taken together, this dissertation provided deepened understanding of social networks in school teams and the individual and organizational conditions that shape, and result from, the pattern of social relationships that may support or constrain school outcomes. Various other questions remain to be answered.

Connecting ties to other phenomena

In addition to the elements that were included in our nomological network, there may be other variables that can be studied in relation to social networks. As a valuable addition to the nomological network, future research would be advised to include teacher level variables that may explain mechanisms through which relational linkages affect student achievement. One such element is teachers' instructional practice. This dissertation has provided insights in how teachers' social networks affect team level characteristics, such as collective efficacy, perceptions of shared decision-making and innovative climate. What remains unaddressed, however, is how relational linkages affect teachers' instructional practice and their professional development. Although we assume that our measure of trust is related to teacher learning, and our assessment of innovative climates reflect a fertile ground for innovations to flourish, we do not actually examine teacher learning or the development and implementation of actual innovations. Further investigations, preferably through mixed-method analyses, are therefore required to provide deepened understanding of the potential of ties in relation to particular innovations and efforts to change instructional practice (McCormick et al., in press)[2].

Other elements that are suggested to be related to relational linkages, but have not yet been scrutinized in an educational context, are organizational attachment (cf. Tsui, Egan, & O'Reilly, 1992), solidarity (Koster & Sanders, 2006; Koster, Stokman, Hodson, & Sanders, 2007), social identity, and social identification (cf. Mehra, Kilduff, & Brass, 1998; Van Dick & Wagner, 2002).

Moreover, it would also be interesting to study the extent to which certain configurations may impact variables that are at the core of human resource management interest, such as job satisfaction, stress, burnout, absenteeism, motivation, turnover, mobility, and employability (e.g., Brass, 1984, 1995; Mossholder, Settoon, & Henagan, 2005; Sanders, 2004; Sanders & Hoekstra, 1998; Sanders & Nauta, 2004; Van Emmerik & Euwema, 2003). While this type of studies is popular in organizational literature (Collins & Clark, 2003;

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[2] See McCormick et al. (in press) for an interesting discussion on our findings, as well as findings from related social network studies in education

Kaše, Paauwe, & Zupan, 2009; Kinnie, Swart, & Purcell, 2005; Lengnick-Hall & Lengnick-Hall, 2003), knowledge in educational settings is missing.

Ties and leadership

Another field that has been touched by this dissertation, but deserves a closer examination of its relationship with social linkages, is the field of leadership. A number of leadership studies focus on social networks in relation to formal and informal leadership (Coburn, 2005b; Pitts & Spillane, 2008; Spillane, Hunt & Healey, 2008b), distributed leadership (Spillane, 2006; Spillane, Camburn, Pustejovsky, Pareja, & Lewis, 2008a), and how school leaders use their networks for acquiring resources (Hite, Williams, Hilton, & Baugh, 2006b). Yet, we expect that the study of the flow of resources in teachers' social networks can provide extensive insights in how leadership is distributed among educators, what kind of leadership is distributed, and how various patterns of distribution affect school outcomes such as the implementation of reform and student achievement. Research in this direction is currently being conducted in the greater Chicago area by Spillane and his research team (e.g., Pitts & Spillane, 2008; Spillane, 2006; Spillane, Camburn, & Pareja, 2007; Spillane, et al., 2008a; Spillane et al., 2008b; Spillane & Zuberi, 2009) and in California and New York by Daly and Finnigan (e.g., Daly & Finnigan, 2009; Daly, Moolenaar, Bolivar, & Burke, in press; Daly, in press).

Ties with other stakeholders

Outside the scope of this dissertation, but worth investigating in relation to social networks in education, are teachers' relationships with other stakeholders outside the boundaries of their school team (e.g., Bidwell, 2001; Hite et al., 2006b; Lieberman, 2000; Veugelers & Zijlstra, 2002). Research suggests that external ties, or ties that span organizational boundaries to other organizations and individuals, are important for innovation and the development of new knowledge, ideas, and practices (Hansen, 1999) since these ties may provide access to information and knowledge that may not be available within the organization (Adler & Kwon, 2002; Reagans & McEvily, 2003). In the Netherlands, relationships with stakeholders outside the school are becoming more and more important (Hofman & Dijkstra, 2007; Leenheer, Vrieze, Van Kuijk, & Kwakman, 2003; Netherlands Ministry of Education, 2009c; Veugelers & Zijlstra, 2002; Vrieze & Van Kuijk, 2004). For instance, schools are getting involved in local partnerships with preschools, companies that offer pre- and after-school care (often located in the same building, so-called 'brede scholen'), schools for children with special needs, school support service centers,

university partnerships, Ministry partnerships, networks of similar schools from the same district, and companies that offer teacher professional development.

As such, in addition to teachers' social embeddedness in their schools, another form of embeddedness applies to schools; future research will have to address the institutional embeddedness of schools in their local community. Schools may play an important role in fostering social cohesion in their community and citizenship of their students (Moolenaar, 2007; Westheimer & Kahne, 2004). Social capital theory may provide a suitable lens for explaining differences between schools that have strong ties with external stakeholders ('bonding social capital') and actively pursue new contacts with external stakeholders ('bridging social capital') and schools that are poorly embedded in their institutional context. Schools' external relationships and institutional embeddedness may thus offer valuable potential for the exchange and diffusion of information, knowledge, and expertise that may facilitate schools' ability to achieve desired goals. The need for increased insights in the potential of these relationships to support schools functioning is therefore evident.

Implications for educational leadership, policy, and reform
This dissertation offers unique insights in the pattern of social relationships that make up the social fabric of Dutch elementary schools. We elaborate on several implications of this dissertation for educational leadership, reform, and policy to translate the potential of this dissertation for educational practice.

Encourage dense teacher networks
One route through which educational leaders and policy-makers may increase the potential of ties is by stimulating the development of densely connected teacher networks, especially with regard to work related discussions and communication. An illustration of a successful effort to stimulate dense networks is Spillane's example of a principal who set up a 'breakfast club' (Wassink, Mioch, & Van Veen, 2009). By initiating a morning meeting once a week in which teachers discussed a recent article on teacher practice, this principal created an opportunity for teachers to discuss recent developments, share experiences, and get engaged in a continuous process of teacher and school development. When teachers discuss their work and exchange advice, best practices may be shared through their discussion, which in turn affect teachers' instructional practice (Little, 2003b; Stoll & Louis, 2007). Initiatives like this 'breakfast club' are currently scarce in Dutch educational practice, but leaders and policy-makers are encouraged to engage in ideas to stimulate work

related teacher networks in support of beneficial school outcomes as discussed in this dissertation.

Consider relationships in reform

In relation to reform, educational leaders and policy-makers would be wise to look beyond the technical aspects of the reform and enactment of transformational leadership behavior (Spillane, Reiser, & Gomez, 2006; Wassink, Mioch, & Van Veen, 2009). Reform efforts are often socially co-constructed (Coburn, 2003; Datnow, Lasky, Stringfield, & Teddlie, 2006). Besides attention to the technical aspects of reform to which current policy instruments are often directed, it is also crucial to consider the social forces upon which the reform efforts are layered, since these social forces may support or constrain the flow of information, knowledge, and expertise necessary to the successful implementation of reform (Tsai, 2001). Insights in the importance of social linkages for reform implementation may provide policy-makers with a valuable starting point for tailoring reform efforts to the underlying social structures to which the reform is targeted in order to optimize the potential of ties for improving school practice. Our findings also point to the need for extensive support for principals when implementing specific reforms. Principals are the primary conduits through which reforms are disseminated, and the way in which principals act upon the formal reform mandate is often crucial to the way in which the reform is subsequently understood and enacted in the school.

Combine leadership behavior and position

Our findings suggest that teachers who perceive their school's climate as innovative are often guided by leaders that both display transformational leadership *and* occupy a position close to their teachers. Leaders who aim to create a school climate that is conducive to the implementation of innovations are thus advised to not only enact transformational leadership behaviors, but also occupy a strategically close position to all teachers to ensure that they maximize the impact of their attention to vision building, individual consideration, and intellectual stimulation. Our findings point to the value of a strategic leadership position and being a central 'hub' in advice networks. However, leaders should also be aware not to find themselves in a brokerage position, in which they are the only link between otherwise unconnected teachers. Such a position, while advantageous in regard to the potential of controlling the flow of information, is negatively associated with innovative climates. Apparently, principals' control of the flow of information inhibits

teachers' perceptions of the school team's willingness and ability to invest in innovations and create new knowledge and practices.

Use social network data

Using social network data in practice may also be a way to improve change efforts. Social network data may provide valuable information about which individuals occupy the most strategic positions for a successful dissemination of reform information and knowledge (Daly & Finnigan, 2009). The likelihood of successful reform implementation may be increased by a more targeted effort at molding the social structure in support of the flow and uptake of reform information (Daly et al., in press; Coburn & Russell, 2008; Kogut & Zander, 1996; Smylie & Evans, 2006).

Ties with Potential

In conclusion, this dissertation contributes to educational research, policy, and practice by exploring the nature, antecedents, and consequences of social networks in school teams. The results demonstrate how the nature of relationships defines the social fabric in school teams, and how individual behavior of educators shapes their school team's social networks. In addition, findings indicate that a social network perspective on school teams can add to our understanding of how social networks in school teams impact a variety of school and teacher outcomes, as well as suggest direction for more relationally oriented educational policy instruments.

Acknowledging the importance of social relationships and its interplay with behavioral antecedents and organizational outcomes has important implications for educational research, and the social sciences in general. There is a growing urge to integrate social network theory in traditional, mainstream research in advancing our understanding of the embeddedness of individuals and their behavior in a social milieu. The recent upsurge of social network research in a multitude of settings and scientific disciplines reflects a promising indication towards this integration. By building a nomological network around social networks in schools, this dissertation validates social network theory as an autonomous research area as well as a valuable addition to the current perspectives on educational organization and management. While many avenues still remain open to exploration, the main road appears to be signed with the adage that 'relationships matter'. It is through these ties with potential that strong communities turn individual efforts into collective action in realization of powerful school outcomes.

*If the study of all these sciences which we have enumerated, should ever bring us to
their mutual association and relationship, and teach us the nature of the ties
which bind them together, I believe that the diligent treatment of them
will forward the objects we have in view, and that the labor,
which otherwise would be fruitless, will be well bestowed*

Plato

*Words are but symbols for the relations of things to one another and to us;
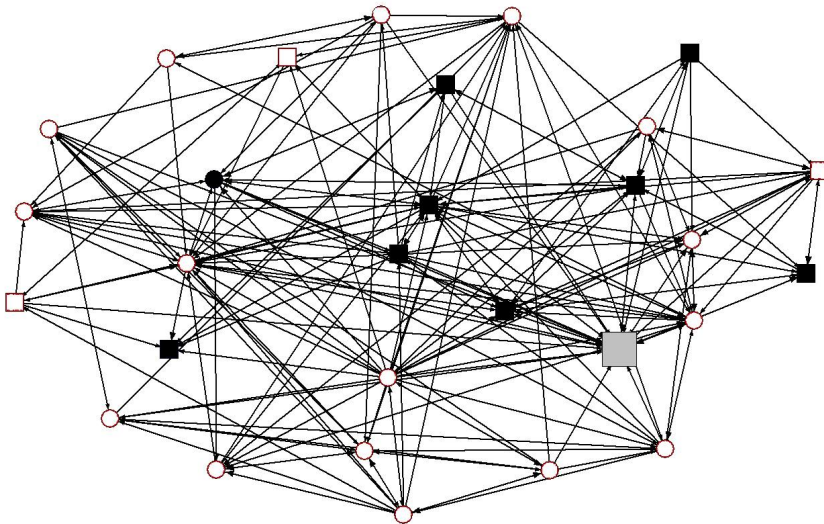nowhere do they touch upon absolute truth.*

Friedrich Nietzsche

Appendix

Visualizations of the seven networks at
St. Michael Elementary School[1]

### Discussing work at St. Michael[2]

[1] All names are pseudonyms
[2] Female educators are represented in white, male educators in black; lower grade level educators are represented by circles, upper grade level educators by squares; and the (male) principal is represented by the big grey square in the lower right corner.
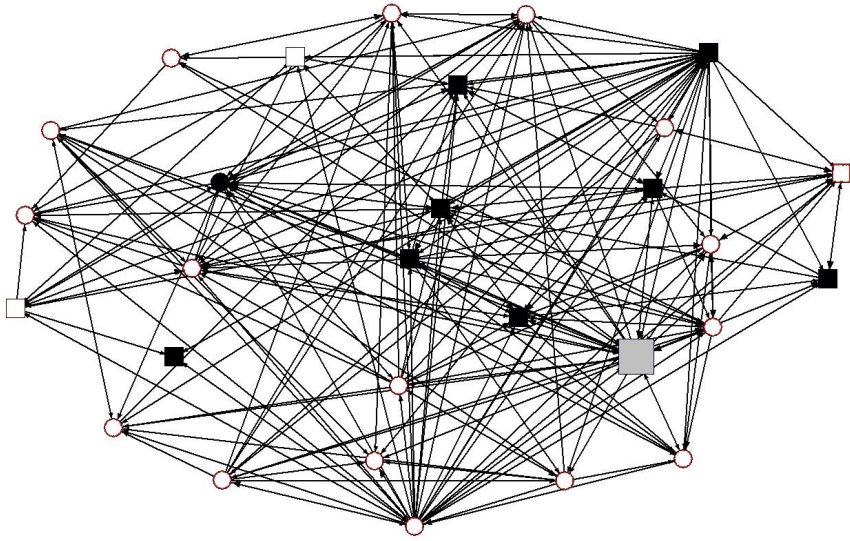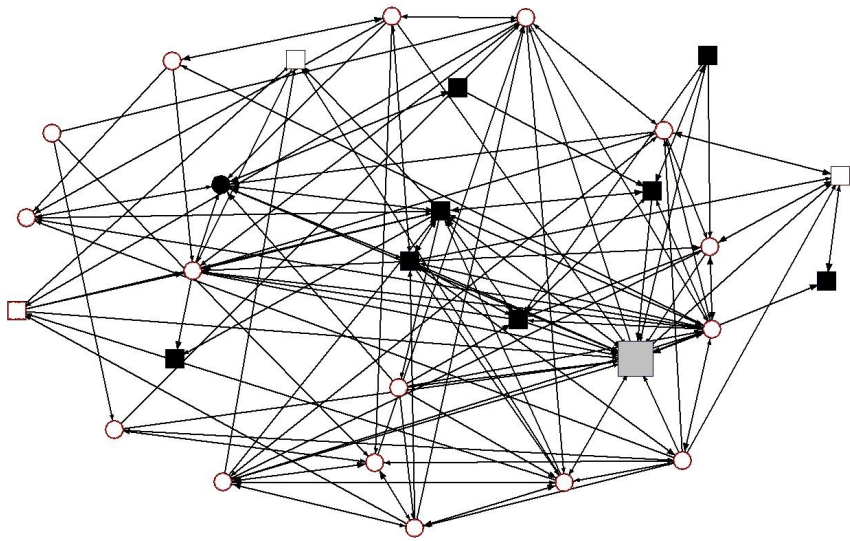
Collaboration at St. Michael
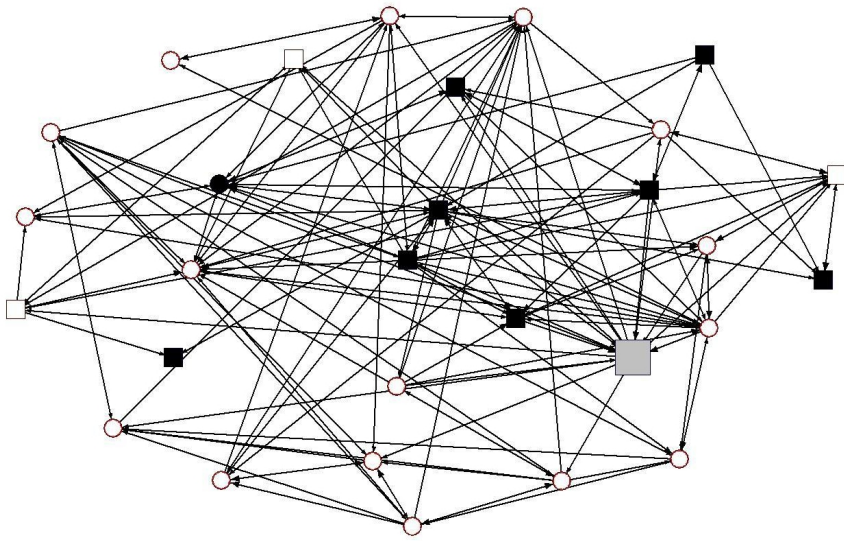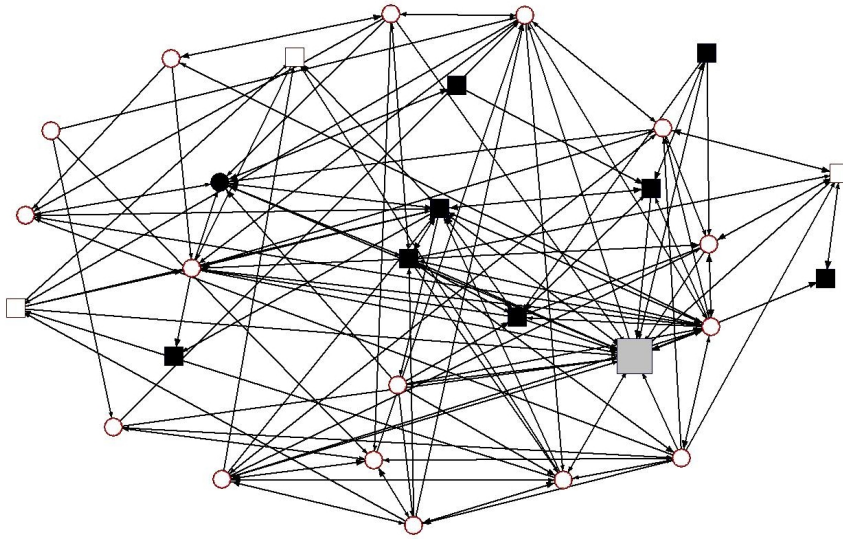

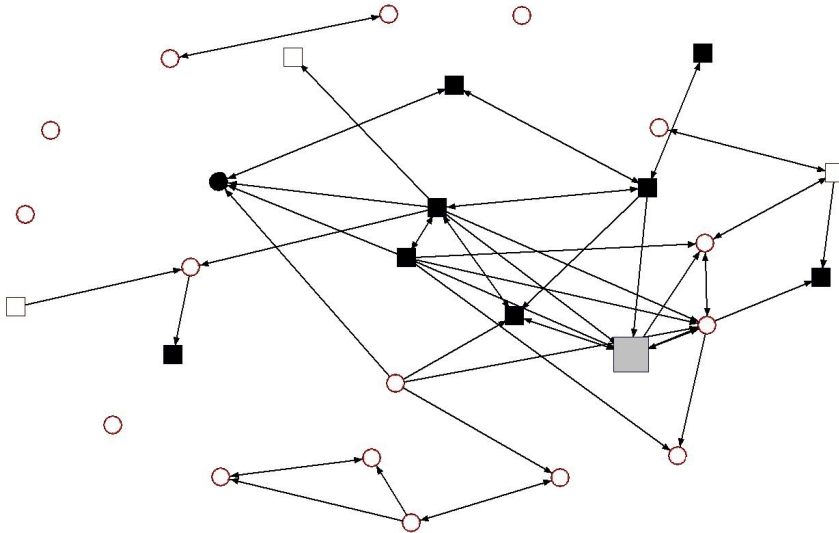# Asking work related advice at St. Michael
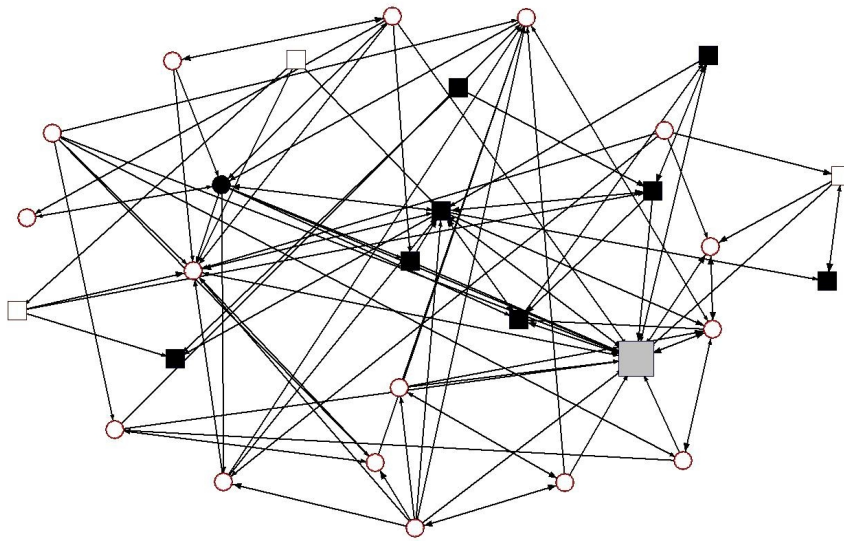
Spending breaks at St. Michael

Personal guidance at St. Michael

Contact outside St. Michael

Friendship at St. Michael

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About the author

Nienke Moolenaar studied Organizational Psychology at the University of Groningen, The Netherlands. During her study, she worked at the University of Groningen and Erasmus University Rotterdam as an assistant teacher and developer of undergraduate and graduate courses on career counseling, personnel selection and coaching. At the management consultancy firm GITP International she wrote her master thesis on the differences between novice and experienced job interviewers' use of heuristic strategies for personality assessment. After finishing her study, she worked in personnel selection at Accenture before starting a PhD. project at the University of Amsterdam in 2005. A six-month stay at the University of California, San Diego in 2009 highlighted the finalization of her dissertation. Nienke is currently employed as a post-doc researcher at the University of Twente. She is working on various research projects including a study into the effects of a two-year intervention program in elementary schools under stringent sanction to improve, and a study into the longitudinal and experimental effects of a dynamic light system on the concentration, well-being, motivation, and cognitive achievement of students in elementary education. Both research projects combine longitudinal field studies with experimental random field trials. Nienke's research interests include social networks and social network analysis, organizational behavior, trust, leadership, and quantitative research methodology.

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Samenvatting

De werkrelaties tussen leerkrachten worden vaak gezien als belangrijke bouwstenen van een sterk schoolteam. Wanneer leerkrachten een hecht sociaal netwerk vormen, dat ruimte biedt aan een continue uitwisseling van informatie, kennis en expertise, kunnen leerkrachten en leerlingen hier profijt van hebben. Onderzoek naar sociale netwerken onder leerkrachten is echter schaars. Dit proefschrift beschrijft een onderzoek naar de aard, antecedenten en consequenties van sociale netwerken in school teams in het basisonderwijs.

De resultaten bevestigen de voordelen van hechte netwerken. In scholen met hechte school teams heerst meer onderling vertrouwen. Ook worden deze teams gekenmerkt door meer gezamenlijke besluitvorming en een meer innovatief klimaat dan teams waarin leerkrachten minder hecht verbonden zijn. De uitkomsten van het onderzoek wijzen erop dat verbindingen tussen leerkrachten een positieve invloed hebben op leerkrachten en daarmee indirect ook op leerprestaties van leerlingen. Deze 'verbindingen met potentie' [Ties with Potential] vormen een krachtig fundament voor het ontstaan van nieuwe kennis en gedeelde ervaringen die kunnen bijdragen aan solide schoolontwikkeling.

Inleiding

Overal ter wereld werken onderwijsprofessionals aan het verbeteren en verfijnen van onderwijsbeleid, de organisatie van scholen en de kwaliteit van onderwijs. Vaak gebeurt dit omdat er aanleiding toe is: een school presteert ondermaats, de leerresultaten van kinderen blijven achter bij het landelijk gemiddelde, of er is onrust in een schoolteam waardoor de school niet optimaal functioneert. In deze gevallen is er vaak een sterke externe druk tot schoolverbetering, bijvoorbeeld van het bovenschools management, de Inspectie van het Onderwijs en het gemeentebestuur. Even zo vaak kunnen scholen van binnenuit de urgentie voelen om vernieuwingen door te voeren. Een voorbeeld hiervan is een verandering van onderwijskundig kader (bijvoorbeeld 'passend onderwijs' of 'breinvriendelijk leren') wanneer het huidige kader niet goed bevalt of onvoldoende mogelijkheden biedt om tegemoet te komen aan de behoeften van specifieke groepen leerlingen.

     De laatste tijd krijgen onderwijsexperts steeds meer oog voor het belang van sociale relaties tussen leerkrachten voor het functioneren van school teams. Men vermoedt dat deze sociale relaties een belangrijke rol spelen in zowel de dagelijkse onderwijspraktijk als de invoering van onderwijsvernieuwingen.

Daarom wordt steeds meer onderzoek verricht naar concepten, die verwijzen naar verbondenheid tussen leerkrachten, zoals professionele leergemeen-schappen en 'communities of practice'. Deze concepten bouwen voort op de aanname dat sociale relaties tussen leerkrachten belangrijk zijn omdat ze toegang verschaffen tot informatie, kennis en expertise, het oplossen van problemen vergemakkelijken en het onderling vertrouwen bevorderen.

Ondanks de populariteit van deze concepten in onderwijsbeleid, -praktijk en -onderzoek is er nog weinig empirisch onderzoek verricht naar sociale relaties tussen leerkrachten. Dit proefschrift beschrijft de sociale relaties tussen leerkrachten in termen van sociale netwerken in school teams. Een sociaal netwerk is een weergave van een verzameling van individuen, die door relaties aan elkaar verbonden zijn. In figuur 1 wordt een voorbeeld van een sociaal netwerk weergegeven[1]. Onderzoek naar de invloed van sociale netwerken in school teams op onderwijsvernieuwing en leerprestaties is schaars. Bovendien weten we nog weinig van de manier waarop sociale netwerken beïnvloed worden door antecedenten, zoals hulpvaardigheid en leiderschap.

Figuur 1. Voorbeeld uit hoofdstuk 1. Sociaal netwerk van relaties rondom werk-gerelateerd advies op basisschool St. Michael[2].
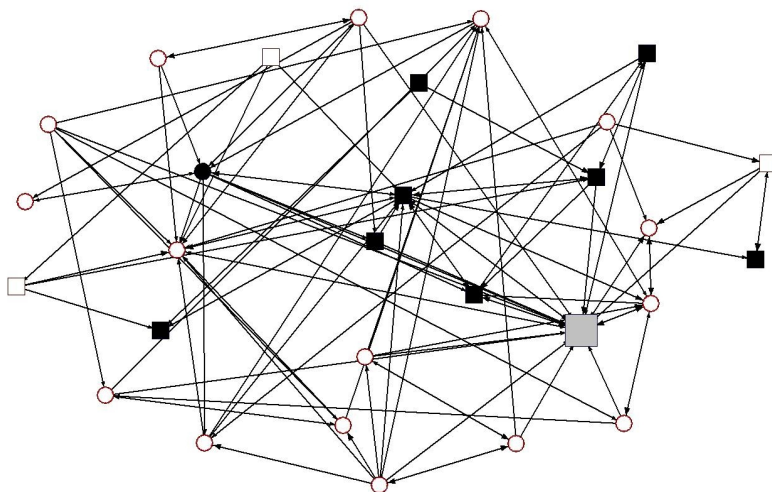
[1] In dit netwerk worden de relaties tussen de leerkrachten van een representatieve school getoond door middel van lijnen, die de leerkrachten met elkaar verbinden. Pijlen geven de richting van de relatie aan. De vrouwelijke leerkrachten zijn aangegeven in het wit, de mannelijke leerkrachten in het zwart. Een leerkracht is weergegeven door middel van een bolletje (voor een leerkracht die voornamelijk lesgeeft aan de onderbouw) of een vierkantje (voor de bovenbouw).
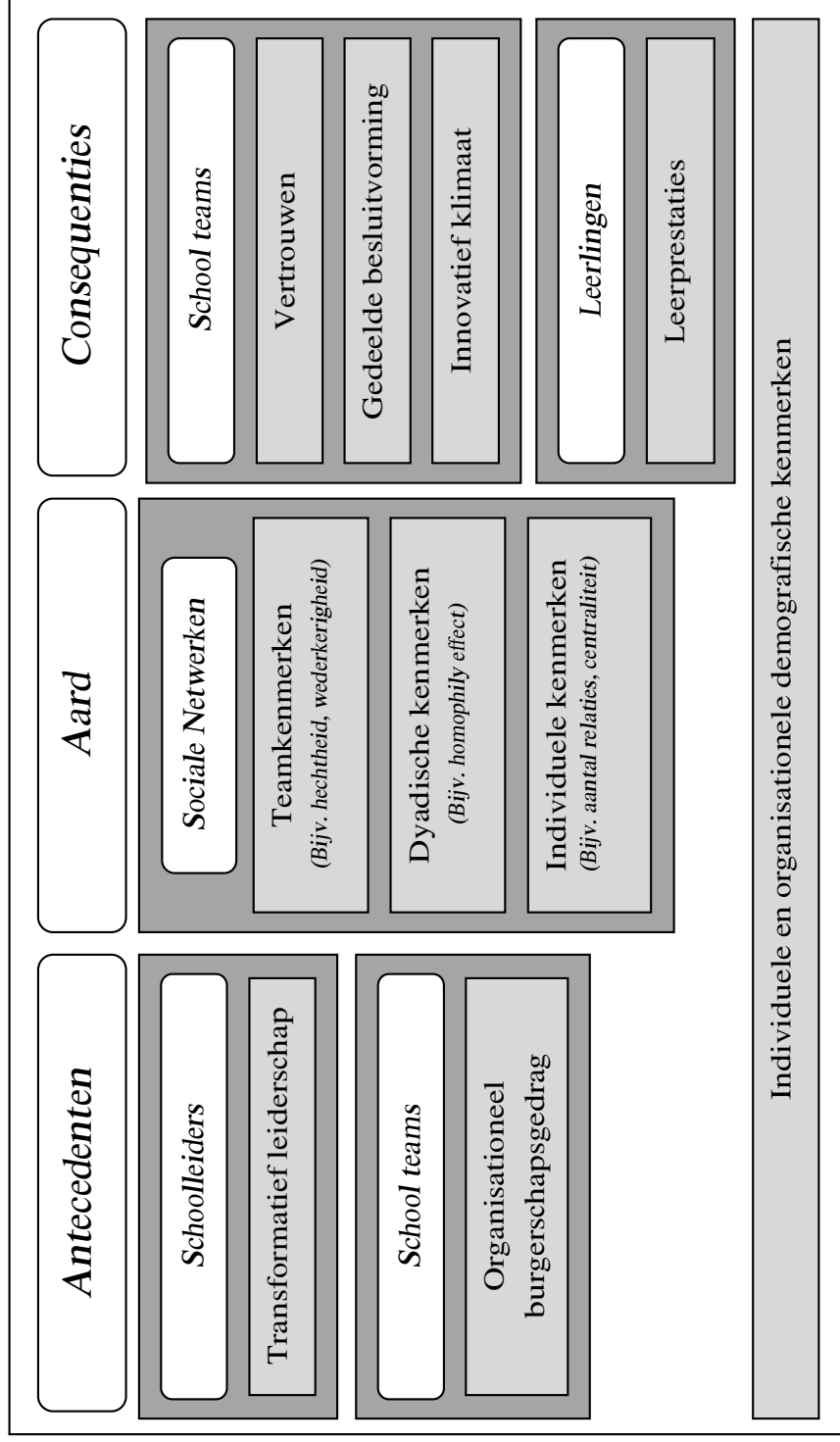[2] pseudonym

Naar een nomologisch netwerk van sociale netwerken in school teams

Het doel van dit proefschrift is om meer inzicht te verschaffen in de aard, antecedenten en consequenties van sociale netwerken in school teams. Met het onderzoek, dat in dit proefschrift wordt beschreven, wordt een bijdrage geleverd aan de ontwikkeling van een nomologisch netwerk. In dit nomologisch netwerk wordt beschreven hoe het concept 'sociaal netwerk' zich verhoudt tot andere concepten die met sociale netwerken in verband worden gebracht (antecedenten en consequenties). Dit nomologisch netwerk wordt weergegeven in figuur 2. Twee theorieën vormen de kern van het onderzoek: de theorie van sociaal kapitaal en sociale netwerk-theorie.

Theorie van sociaal kapitaal. De grondgedachte van dit proefschrift is dat sociale netwerken toegang bieden tot bronnen, die gebruikt kunnen worden om individuele en gezamenlijke doelen te bereiken. Dit is de grondgedachte van de theorie rondom sociaal kapitaal. Sociaal kapitaal gaat uit van de mogelijkheden die sociale relaties bieden. 'Het gaat niet om wie je bent, maar wie je kent.' Dit gezegde treft de kern van sociaal kapitaal. Wie herkent het niet? Een vriend die je om advies kan vragen over je belastingaangifte, een collega die je even snel uit de brand helpt… Sociaal kapitaal is een vorm van vermogen dat belangrijke deuren kan openen in het onderwijs. Denk hierbij aan het sociaal kapitaal van leerlingen en hun ouders. Maar ook het sociaal kapitaal van school teams zou kunnen bijdragen aan een sterke schoolgemeenschap en goede leerprestaties. Of dat zo is, wordt onderzocht in dit proefschrift.

Sociale netwerktheorie. Een waardevol aangrijpingspunt om te begrijpen hoe sociaal kapitaal wordt gegenereerd in sociale relaties is sociale netwerktheorie. Sociale netwerk-theorie rust op drie belangrijke aannames. Ten eerste; individuen zijn afhankelijk van elkaar door verbondenheid in een sociale structuur. Door deze sociale inbedding hebben individuele keuzes in relaties ook direct gevolgen voor het hele netwerk. Ten tweede; relaties kunnen worden gezien als 'geleiders' van allerlei bronnen door een sociaal netwerk, zoals informatie, kennis, opvattingen en materialen. De toegang tot deze bronnen is afhankelijk van de netwerkpositie van een individu. Ten derde; constellaties van sociale relaties kunnen daarom beperkingen en mogelijkheden bieden voor de individuen in het netwerk. Sociale netwerktheorie beschrijft verschillende netwerkkenmerken die de 'stroom' van bronnen binnen een netwerk kunnen verklaren, zoals de hechtheid van een netwerk, wederkerigheid van relaties, 'network homophily' en 'structural holes'. In de acht deelstudies van dit proefschrift worden deze en meerdere kenmerken uit de sociale netwerktheorie onderzocht met behulp van sociale netwerkanalyse.

Figuur 2. Belangrijkste elementen van dit proefschrift: antecedenten, aard en consequenties van sociale netwerken in school

Antecedenten	Aard	Consequenties
Schoolleiders	*Sociale Netwerken*	*School teams*
Transformatief leiderschap	Teamkenmerken *(Bijv. hechtheid, wederkerigheid)*	Vertrouwen
School teams	Dyadische kenmerken *(Bijv. homophily effect)*	Gedeelde besluitvorming
Organisationeel burgerschapsgedrag	Individuele kenmerken *(Bijv. aantal relaties, centraliteit)*	Innovatief klimaat
		Leerlingen
		Leerprestaties

Individuele en organisationele demografische kenmerken

Context van het onderzoek

De deelstudies zijn, met uitzondering van de laatste deelstudie, gebaseerd op vragenlijstonderzoek onder Nederlandse schoolleiders en leerkrachten. Het onderzoek werd in 2006 uitgevoerd op 53 basisscholen van de Stichting Avvansa[1] in het zuiden van Nederland. De scholen participeerden in het onderzoek als onderdeel van een beleidsprogramma voor het vaststellen en volgen van medewerkerstevredenheid en schoolverbetering. Aan alle schoolleiders en leerkrachten van de deelnemende scholen werden vragen voorgelegd over verschillende onderwerpen, waaronder hun sociale relaties in het team, hulpvaardigheid, vertrouwen, het innovatief klimaat op school en schoolleiderschap. Van de 53 scholen hebben in totaal 775 respondenten aan het onderzoek deelgenomen.

Om de bevindingen uit de Nederlandse deelstudies te toetsen in een andere omgeving, werd de laatste deelstudie uitgevoerd op vijf basisscholen van het Esperanza School District[1] in het zuiden van Californië, Verenigde Staten. Het district was ten tijde van het onderzoek bezig met het invoeren van meerdere onderwijsvernieuwingen op alle scholen. De vijf geselecteerde scholen waren betrokken bij een partnerschap tussen het Esperanza School District en de University of California, San Diego. Van de vijf scholen hebben in totaal 196 schoolleiders, leerkrachten en coaches meegewerkt aan het onderzoek.

De deelstudie is opgezet volgens een mixed-method design. Dat betekent dat de informatie voor het onderzoek op meerdere manieren is verkregen. In deze deelstudie werden naast vragenlijsten voor alle schoolleiders en leerkrachten van de deelnemende scholen ook interviews afgenomen. Door het combineren van resultaten uit vragenlijsten en interviews krijgen we beter zicht op de manier waarop informatie en kennis over onderwijsvernieuwingen zich verspreidt via de sociale netwerken in school teams.

Resultaten

In dit proefschrift worden acht deelstudies beschreven, die samen inzicht geven in sociale netwerken in school teams. Het boek is opgedeeld in drie delen, die achtereenvolgens gewijd zijn aan de aard, antecedenten en consequenties van sociale netwerken in school teams.

[1] pseudoniem

De aard van sociale netwerken

Terwijl de aandacht voor sociale netwerken in school teams enorm toeneemt, is er eigenlijk nog weinig bekend over de aard en structuur van deze sociale netwerken in school teams. Deel 1 van het proefschrift begint daarom met een uitgebreide verkenning van sociale netwerken onder leerkrachten in het basisonderwijs in twee deelstudies.

'The social fabric of elementary school teams'

Sociale netwerken kunnen worden beschreven aan de hand van de soort relatie die het doel van het netwerk weergeeft. Hierbij valt te denken aan een sociaal netwerk van vriendschap, een adviesnetwerk, of een netwerk gericht op samenwerking. In de deelstudie in *hoofdstuk 1* worden zeven verschillende soorten sociale netwerken in school teams beschreven. Het doel is om op zoek te gaan naar mogelijke onderliggende dimensies, die de gelijkenissen en verschillen tussen de zeven netwerken kunnen verklaren.

Een veelgebruikte dimensie om sociale netwerken te onderscheiden is de dimensie van instrumentele (werk-gerelateerde) en expressieve (niet-werkgerelateerde, persoonlijke) sociale netwerken. Deze dimensie is echter nog niet gevalideerd in de context van school teams. Mogelijk zijn er ook nog andere dimensies, die onderscheid kunnen maken tussen verschillende sociale netwerken in school teams. Met behulp van sociale netwerkanalyse, QAP correlaties, multidimensional scaling en visualisaties van de netwerken in een representatieve school zijn de gelijkenissen en de verschillen tussen de netwerken onderzocht.

De resultaten van de studie valideren het onderscheid tussen instrumentele (werk-gerelateerde) en expressieve (niet-werkgerelateerde, persoonlijke) sociale netwerken in school teams. Een voorbeeld van een duidelijk expressief netwerk in het schoolteam is het vriendschapsnetwerk, terwijl het 'praten over het werk' leerkrachten verbindt in een duidelijk instrumenteel netwerk. Instrumentele netwerken zijn veel hechter en verbinden meer leerkrachten in een schoolteam dan expressieve netwerken.

Een tweede dimensie waarmee sociale netwerken in school teams te classificeren zijn, is de dimensie van wederzijdse (on)afhankelijkheid. Voorbeelden van sociale netwerken waarin leerkrachten wederzijds afhankelijk van elkaar zijn voor de uitvoering van hun taken, zijn het adviesnetwerk en het netwerk van samenwerkingsrelaties. Deze relaties kunnen de individuele autonomie van leerkrachten onder druk zetten omdat er gezamenlijk werk, initiatief en gedeelde verantwoordelijkheid mee gemoeid is. Het sociale netwerk rondom het doorbrengen van pauzes is veel meer vrijblijvend. Relaties

rondom het doorbrengen van pauzes respecteren de traditionele instructie-autonomie en worden gekenmerkt door een wederzijdse *on*afhankelijkheid. Bijzonder is dat deze tweede dimensie een empirische sociaal netwerk-theoretische validering biedt van eerder beschrijvend onderzoek naar vormen van samenwerking tussen leerkrachten. De studie levert een waardevolle bijdrage aan inzichten in de 'sociale stof' waaruit school teams zijn geweven.

'The social forces in elementary school teams'
Hoe een sociaal netwerk eruit ziet, zou deels kunnen afhangen van stabiele eigenschappen van de mensen die het netwerk vormen. Uit eerder onderzoek is gebleken dat mensen vaak een voorkeur hebben voor netwerkrelaties met mensen die op hen lijken, bijvoorbeeld met betrekking tot leeftijd, haarkleur, opvattingen, of hobby's (het zogenoemde 'network homophily'-effect). In *hoofdstuk 2* onderzoeken we de mate waarin demografische kenmerken van leerkrachten (geslacht, leeftijd, formele positie, functie-omvang, ervaring en onder- of bovenbouw) en kenmerken van school teams (aantal leerlingen, teamgrootte, team samenstelling, team ervaring, gemiddelde leeftijd en de socio-economische status van leerlingen) de kans op sociale relaties te voorspellen. Op deze manier kunnen we uitvinden in hoeverre sociale netwerken in school teams getypeerd worden door bepaalde netwerkkenmerken, zoals 'network homophily'. De resultaten van deze studie zijn verkregen met behulp van sociale netwerkanalyse en in het bijzonder multilevel p2 modeling.

De resultaten laten zien het netwerk van een school team inderdaad gevormd worden door individuele kenmerken. Zo is de kans op het *aangaan* van een werkrelatie groter voor vrouwelijke leerkrachten en leerkrachten die lesgeven aan de bovenbouw. Aan de andere kant hebben vrouwelijke leerkrachten minder kans op het *ontvangen* van werkrelaties dan hun mannelijke collega's. Ook leerkrachten die full-time werken, meer ervaring hebben en ouder zijn, hebben minder kans op het ontvangen van werkrelaties. Uitkomsten van de deelstudie bevestigen dat ook dyadische kenmerken van invloed zijn op de vorm van een sociaal netwerk. Dyadische kenmerken zijn kenmerken die twee individuen in een relatie 'delen', bijvoorbeeld dezelfde haarkleur. Zo vinden we een homophily effect voor geslacht. Dat wil zeggen dat vrouwelijke leerkrachten eerder kiezen voor een werkrelatie met andere vrouwelijke leerkrachten en mannelijke leerkrachten meer neigen naar werkrelaties met mannelijke leerkrachten. Daarnaast vinden we ook een homophily effect voor bouw. Dit houdt in dat de kans op een werkrelatie met iemand van dezelfde bouw (onderbouw/bovenbouw) groter is dan een

werkrelatie met iemand van de andere bouw. Ten slotte blijkt dat de kans op werkrelaties toeneemt naarmate het team langer in dezelfde samenstelling functioneert. Opvallend is dat leerkrachten een even grote kans hebben op werkrelaties als schoolleiders. Een belangrijke bevinding van de studie is dat een sociaal netwerk onder leerkrachten sterker gevormd wordt door individuele en dyadische kenmerken en dan door teamkenmerken. Aangezien deze individuele kenmerken nauwelijks te veranderen zijn, zullen studies en interventie-programma's rondom thema's als sociale netwerken, professional learning communities en communities of practice rekening moeten houden met de mate waarin vooral individuele en dyadische 'sociale krachten' van invloed zijn op een sociaal netwerk.

Antecedenten van sociale netwerken
Naast stabiele eigenschappen van individuen en teams kunnen sociale netwerken ook in belangrijke mate gevormd worden door het gedrag van de individuen die deel uitmaken van het netwerk. Er is echter nog weinig onderzoek verricht naar mogelijke antecedenten die van invloed zijn op de structuur van sociale netwerken in school teams. In deel 2 van dit proefschrift gaan we op zoek naar gedrag van leerkrachten en schoolleiders dat van invloed zou kunnen zijn op de vorming van sociale netwerken in school teams.

'Helping to build bridges?'
In *hoofdstuk 3* onderzoeken we gedrag dat vaak in verband wordt gebracht met het ontstaan van sociale relaties, namelijk organisationeel burgerschapsgedrag. Organisationeel burgerschapsgedrag is gedrag van individuen, dat buiten hun formele taakomschrijving valt en dat bijdraagt aan het functioneren van de organisatie. Voorbeelden van zulk burgerschapsgedrag zijn hulpvaardigheid, loyaliteit, het accepteren van kleine tegenslagen en vrijwillige inzet om de organisatie vooruit te helpen. Meerdere studies hebben aangetoond dat burgerschapsgedrag bijdraagt aan het functioneren van organisaties. Eerder onderzoek heeft organisationeel burgerschapsgedrag in verband gebracht met sociaal kapitaal en de vorming van sociale relaties in organisaties. De achterliggende gedachte is dat burgerschapsgedrag het ontstaan van sociale relaties vergemakkelijkt en de uitwisseling van kennis stimuleert, waardoor een organisatie beter kan functioneren. Een vorm van organisationeel burgerschap die centraal staat in deze studie is hulpvaardigheid. De centrale vraag is of de kans op sociale relaties in een schoolteam ook daadwerkelijk wordt beïnvloed door de hulpvaardigheid van een leerkracht. Bovendien gaan we na of hulpvaardigheid mogelijk een verschillende uitwerking heeft op werkrelaties

en vriendschapsrelaties. De analyses zijn wederom uitgevoerd met behulp van sociale netwerkanalyse en multilevel p2 modeling.

De resultaten tonen aan dat hulpvaardige leerkrachten een iets grotere kans hebben op sociale relaties met betrekking tot gesprekken over het werk en vriendschap dan leerkrachten die minder hulpvaardig zijn. Hoewel deze effecten significant zijn, zijn ze erg zwak. Dit doet vermoeden dat er andere individuele eigenschappen zijn, die wellicht een veel grotere rol spelen bij het 'bouwen van bruggen' dan hulpvaardigheid. In deze deelstudie is alleen gekeken naar de algemene hulpvaardigheid die leerkrachten ten opzicht van al hun collega's vertonen. Hulpvaardigheid zou echter ook gericht kunnen zijn op specifieke collega's en op die manier alleen de kans op, of de sterkte van, specifieke relaties kunnen beïnvloeden. Dit onderzoeksterrein is nog nauwelijks ontgonnen en vraagt daarom om gedegen vervolgstudies.

'Occupying the principal position'
In *hoofdstuk 4* verleggen we de focus naar de specifieke positie die de schoolleider in het sociale netwerk van de school inneemt. Ook kijken we of deze 'principale' positie afhangt van het leiderschapsgedrag dat de schoolleider vertoont. Onderzoek heeft aangetoond dat bepaald leiderschapsgedrag, namelijk transformatief leiderschap, een positieve invloed kan hebben op innovatie in scholen. Een schoolleider vertoont transformatief leiderschapsgedrag wanneer hij of zij een duidelijke visie uitstraalt, voldoende individuele aandacht geeft aan alle leerkrachten en zorgt dat zij zich intellectueel uitgedaagd blijven voelen door hun werk. Een mechanisme dat zou kunnen verklaren waarom dit leiderschapsgedrag leidt tot een meer innovatief klimaat op scholen, is de netwerkpositie van schoolleiders. In deze deelstudie wordt daarom onderzocht of transformatief leiderschapsgedrag van invloed is op de positie die schoolleiders innemen in het adviesnetwerk op hun school. Vervolgens wordt gekeken of de netwerkpositie van de schoolleider een verklaring kan bieden voor de invloed van transformatief leiderschap op het innovatieve klimaat van scholen. De data is bestudeerd met behulp van sociale netwerkanalyse, multiple regressie analyse en multilevel analyse.

Uit de resultaten blijkt dat de centraliteit van de netwerkpositie van de schoolleider inderdaad samenhangt met transformatief leiderschap. Hoe meer transformatief leiderschap een schoolleider toont, hoe meer de schoolleider benaderd wordt voor advies over persoonlijke en werk-gerelateerde zaken. Ook kunnen transformatief schoolleiders leerkrachten sneller bereiken met werk-gerelateerd advies omdat ze 'dichter bij' alle leerkrachten staan in het sociale netwerk dan schoolleiders die minder transformatief leiderschap vertonen. De

netwerkpositie van schoolleiders blijkt ook van invloed op het innovatief klimaat op scholen. Hoe meer een schoolleider benaderd wordt voor advies en dicht bij de leerkrachten staat, hoe meer de leerkrachten bereid zijn om nieuwe dingen te proberen en continu te werken aan het verbeteren van hun lessen.

Er is echter ook een vorm van centraliteit die dit innovatieve klimaat juist tegenwerkt. Hoe meer schoolleiders een 'bemiddelingsrol' [structural hole] innemen in hun school, door twee (groepen) leerkrachten te verbinden die zelf niet met elkaar verbonden zijn, hoe minder het team openstaat voor verandering en innovatieve ideeën. Deze bemiddelingsrol, ook wel aan te duiden met het motto 'verdeel en heers', biedt schoolleiders de mogelijkheid om de stroom van informatie en kennis te beheersen en te controleren, maar remt daarmee de innovatieve groei van de school. Schoolleiders worden daarom geadviseerd om vooral ruimte te geven aan dit innovatieve klimaat, dat tot stand komt wanneer leerkrachten in direct contact met elkaar tot nieuwe kennis en inzichten kunnen komen.

Consequenties van sociale netwerken

Een belangrijke aanname van sociaal netwerkonderzoek is dat de sociale inbedding van individuen in een sociaal netwerk het gedrag van individuen en de uitkomsten van organisaties kan beïnvloeden. Empirisch onderzoek naar de consequenties van sociale netwerkstructuur voor schoolorganisaties is echter schaars. Het laatste en tevens meest uitgebreide deel van dit proefschrift, deel 3, gaat dieper in op de mogelijke consequenties van de structuur van sociale netwerken op individueel en schoolniveau.

'Linking social networks and trust'

Vertrouwen wordt, naast sociale netwerken, vaak genoemd als een belangrijk ingrediënt van sociaal kapitaal. De veronderstelling dat vertrouwen en sociale netwerkstructuur aan elkaar zijn gelinkt, is echter zelden aan diepgaand onderzoek onderworpen. *Hoofdstuk 5* is daarom gewijd aan de samenhang tussen vertrouwen onder leerkrachten en de mate waarin zij een hecht sociaal netwerk vormen. Bijzonder aan de studie is de hiërarchische aanpak, waarbij de mate van vertrouwen onder leerkrachten wordt voorspeld uit zowel de individuele netwerkpositie als de sociale netwerkstructuur op schoolniveau. Om de data te analyseren, is gebruik gemaakt van sociale netwerkanalyse en multilevel analyse.

De uitkomsten van de studie laten zien dat zowel individuele relaties als het patroon van relaties op schoolniveau samenhangen met het vertrouwen dat leerkrachten in elkaar hebben. Hoe meer relaties een individu onderhoudt, hoe

meer vertrouwen hij/zij waarneemt in het team. Opmerkelijk is dat school teams, waarin veel wederzijdse relaties voorkomen, juist gekenmerkt worden door minder onderling vertrouwen dan school teams waarin minder wederzijdse relaties voorkomen. In een omgeving waarin weinig vertrouwen heerst, is blijkbaar een grotere voorkeur voor 'veilige' relaties, die bestendigd zijn door wederzijdsheid. Deze voorkeur voor wederzijdse relaties zou daarmee echter het onderling vertrouwen in school teams in de weg kunnen staan. Deze bevinding duidt erop dat er bepaalde netwerkvormen bestaan, die wellicht minder positieve consequenties hebben voor het functioneren van teams en professionele leergemeenschappen.

'Ties with potential'
Recent onderzoek in bedrijven toont aan dat sociale relaties een belangrijke rol spelen bij de ontwikkeling en invoering van innovaties. Ook in discussies over schoolverbetering en onderwijsvernieuwing wordt steeds meer belang gehecht aan professionele relaties tussen leerkrachten. De deelstudie in *hoofdstuk 6* is gericht op de potentie van sociale relaties voor onderwijsvernieuwing. In deze studie onderzoeken we in hoeverre de sociale netwerkstructuur van school teams samenhangt met het innovatief klimaat op school. Ook gaan we na of deze samenhang te verklaren valt door de mate waarin leerkrachten zich betrokken voelen bij de gedeelde besluitvorming in hun school. Onderzoekstechnieken zijn wederom sociale netwerkanalyse en multilevel analyse.

Uit de resultaten blijkt dat school teams met hechte sociale netwerken rondom werkgerelateerd en persoonlijk advies gekenmerkt worden door een schoolklimaat dat open staat voor vernieuwingen. In deze hechte teams voelen leerkrachten zich ook meer betrokken bij de beslissingen die in hun school worden gemaakt over bijvoorbeeld lesmateriaal en didactische doelen. Deze bevindingen doen vermoeden dat hechte teams meer gericht zijn op innovatie en verandering omdat leerkrachten in deze teams het gevoel hebben dat ze invloed kunnen uitoefenen op de besluitvorming op hun school.

'Yes, we can!'
In *hoofdstuk 7* wordt een voor het onderwijs zeer belangrijke vraag beantwoord: is de sociale netwerkstructuur van een basisschool gerelateerd aan de prestaties van de leerlingen op de school? Eerder onderzoek heeft aangetoond dat het sociaal kapitaal van leerlingen kan bijdragen aan hun leerprestaties. In deze studie testen we of het sociaal kapitaal van een school team, in de vorm van sociale netwerken, van invloed is op leerprestaties. Tevens onderzoeken we of

de relatie tussen de structuur van sociale netwerken en leerlingprestaties verklaard zou kunnen worden door het collectieve zelfvertrouwen dat leerkrachten hebben in het presteren van hun team. Sociale netwerkanalyse en multiple regressie analyse zijn gebruikt om de data te analyseren.

De resultaten tonen aan dat de sociale netwerkstructuur van school teams niet direct samenhangt met de leerprestaties van leerlingen op schoolniveau. Daarentegen blijkt dat hoe hechter het sociale netwerk van een school team is, hoe meer vertrouwen de leerkrachten hebben in de kracht van hun team om gezamenlijk de leerlingen te motiveren en te beïnvloeden. Dit 'collectief zelfvertrouwen' hangt vervolgens weer samen met de leerprestaties van leerlingen. Daarmee biedt deze deelstudie inzicht in een mogelijk mechanisme dat kan verklaren waarom hechte sociale netwerken van leerkrachten de potentie hebben om leerprestaties te verbeteren.

'With a little help from my friends'

Hoofdstuk 8 beschrijft een studie uitgevoerd op vijf basisscholen in California, Verenigde Staten. Centraal staat de rol die sociale netwerken spelen bij de invoering van onderwijshervormingen. Het doel van de laatste studie van dit proefschrift betreft de validatie van de bevindingen uit de eerdere studies in een andere context en met gebruik van aanvullende onderzoeksmethoden. De deelstudie bevat daarom vele elementen van de vorige studies, zoals de samenhang van sociale netwerken met schoolleiderschap, de gezamenlijke besluitvorming, het onderling vertrouwen tussen leerkrachten en het collectieve zelfvertrouwen van het team. De studie is opgezet als een exploratieve case study met data triangulatie en het gebruik van verschillende analysetechnieken, zoals sociale netwerkanalyse, correlaties, QAP correlaties, interviews en de visualisatie van sociale netwerken in representatieve scholen.

Bijzonder aan de studie is de toevoeging van het perspectief van het grade-level. Basisscholen in California zijn vaak vele malen groter dan in Nederland. Samenwerking en professionele ontwikkeling tussen leerkrachten vindt dan ook vooral plaats op het grade-level. Een grade-level team bestaat uit leerkrachten van dezelfde jaargroepen, bijvoorbeeld groep zes, waarvan er dan bijvoorbeeld vijf zijn. Elk grade-level heeft een grade-level leider, die vaak fungeert als het 'doorgeefluik' van de directie. In de studie staan daarom niet alleen sociale netwerken op school-niveau centraal, maar ook de sociale relaties binnen het eigen grade-level en tussen het grade-level en het onderwijsondersteunend personeel, zoals de directeur en coaches (hier vergelijkbaar met de functie van intern begeleider). Ook bijzonder aan de studie

is de combinatie van vragenlijstonderzoek en interviews, waarmee diepgang kan worden gegeven aan de bevindingen uit de eerdere studies.

De resultaten bevestigen de bevindingen uit de eerdere Nederlandse studies. De sociale netwerken in de Californische scholen vertonen een vergelijkbare mate van variatie tussen en binnen de school teams, zoals gevonden in hoofdstuk één. Het belang van de centrale positie van een schoolleider, zoals beschreven in hoofdstuk vier, wordt onderstreept door data triangulatie in deze studie, waaruit blijkt dat de schoolleider vaak gezien kan worden als de 'spin in het web' als het gaat om de verspreiding van kennis en informatie over onderwijsvernieuwing. De bevinding uit hoofdstuk zes, dat leerkrachten in hechte teams zich meer betrokken voelen bij de besluitvorming in hun school, wordt eveneens gestaafd in de Californische studie. De resultaten wijzen er ook op dat hechte school teams in Californië gekenmerkt worden door een vergelijkbaar innovatief klimaat. Tenslotte blijkt ook dat hoe hechter Californische school teams zijn, hoe meer 'collectief zelfvertrouwen' de leerkrachten hebben in hun kracht om de leerlingen te motiveren en te beïnvloeden. Samengevat kunnen we stellen dat de bevindingen uit de Nederlandse studies ondersteund worden door resultaten uit deze laatste deelstudie.

Conclusie

Dit proefschrift levert een belangrijke bijdrage aan het onderzoek naar de aard, antecedenten en consequenties van de sociale netwerken. In aanvulling op de theoretische en praktische relevantie van de onderzoeksresultaten, blijkt de waarde van de bevindingen uit de multilevel aanpak en het gebruik van zowel traditionele statistische methoden als specifieke geavanceerde technieken voor de analyse van sociale netwerken. De validering van de Nederlandse resultaten met een Amerikaanse mixed-method case study onderstreept het belang van de resultaten in meerdere contexten. Door bij te dragen aan de ontwikkeling van een nomologisch netwerk rondom sociale netwerken in school teams levert dit proefschrift unieke inzichten voor beleidsmakers, schoolleiders, leerkrachten, onderwijsprofessionals en allen die geïnteresseerd zijn in verbindingen met potentie [*Ties with Potential*] voor schoolverbetering.

IOUs: The Favor Bank

'What is this Favor Bank?'

'You know. Everyone knows.'

'Possibly, but I still haven't quite grasped what you're saying.'

'It was an American writer who first mentioned it. It's the most powerful bank in the world, and you'll find it in every sphere of life.'

'Yes, but I come from a country without a literary tradition. What favors could I do for anyone?'

'That doesn't matter in the least. Let me give you an example: I know that you're an up-and-coming writer and that, one day, you'll be very influential. I know this because, like you, I too was once ambitious, independent, honest. I no longer have the energy I once had, but I want to help you because I can't or don't want to grind to a halt just yet. I'm not dreaming about retirement, I'm still dreaming about the fascinating struggle that is life, power, and glory.

I start making deposits in your account – not cash deposits, you understand, but contacts. I introduce you to such and such a person, I arrange certain deals, as long as they're legal. You know that you owe me something, but I never ask you for anything'.

'And then one day…'

'Exactly. One day, I'll ask you for a favor and you could, of course, say "No", but you're conscious of being in my debt. You do what I ask, I continue to help you, and other people see that you're a decent, loyal sort of person and so they too make deposits in your account – always in the form of contacts and nothing else. They too will one day ask you for a favor, and you will respect and help the people who have helped you, and, in time, you'll have spread your net worldwide, you'll know everyone you need to know and your influence will keep on growing'.

(From: Paulo Coelho, The Zahir, pp. 34-35)

I wish to express my sincere gratitude and appreciation to all who have invested their intellectual, financial, and social capital in my Favor Bank:

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Thank you!!

Relationships among teachers are increasingly regarded as important building blocks of a strong school community. A dense teacher network that reflects a common exchange of information, knowledge, and social support is often believed to benefit both teachers and students. Yet, research on social networks among teachers is scarce. This book describes a study that offers valuable insights in the nature, antecedents, and consequences of social networks in school teams.

Results provide support for the premise that 'relationships matter'. Dense school teams are characterized by higher levels of trust, increased shared decision-making, and a more innovation-oriented climate than less dense school teams. Findings suggest that strong relationships among teachers affect a variety of teacher outcomes that may ultimately impact student achievement. It is through these ties with potential that the creation and development of new knowledge and practices flow and hold the promise of building capacities toward improvement.

TIES WITH POTENTIAL NIENKE MOOLENAAR