

NORTHWESTERN UNIVERSITY

Information Seeking, Trust, and Turnover:
Three Essays Examining Middle School Instructional Advice Networks

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Field of Learning Sciences

By

Enrique C. Orlina

EVANSTON, ILLINOIS

June 2010

© Copyright by Enrique C. Orlina 2010
All Rights Reserved

ABSTRACT

Information Seeking, Trust, and Turnover: Three Essays Examining Middle School Instructional Advice Networks

Enrique C. Orlina

This dissertation comprises three essays that employ social network analysis and network data from a set of middle schools to examine the role of social networks in processes linked to the organizational adjustment of incoming teachers. Taken together, the essays contribute to a richer understanding of an organizational cycle that begins and ends with teacher turnover.

The first essay employs a framework of newcomer information-seeking to investigate the integration of incoming teachers into schools' instructional advice networks. Using a cross-nested multilevel p_2 model, I examine the pattern of advice-seeking relationships among teachers and find that incoming teachers with prior experience are more effectively integrated into schools' social networks than incoming novices because experienced newcomers possess general knowledge about teaching that is valuable to incumbents. In contrast, novices occupy a peripheral position in schools' advice networks, which may impede their socialization process.

The second essay investigates the relationship between the composition and structure of teachers' advice networks and the relational trust they feel for colleagues. Using a social influence model, I confirm a learning mechanism for teacher-teacher trust and for teacher-principal trust, suggesting that both depend not on the total number of

relationships teachers share with colleagues, but on the levels of trust reported by colleagues with whom teachers interact. The outcome suggests a challenge for schools in which levels of trust are low and apt to be transmitted to newcomers, who may subsequently decide to leave.

The third essay addresses the fact that teacher turnover entails changes in schools' social networks, thus suggesting that networks be studied across time. Examining longitudinal network data from one school that, on the surface, appears stable, I find that the composition and structure of the school's advice network change substantially in one year. I then employ an evolutionary model of network change to examine factors that explain the network's transformation. In contrast with the cross-sectional model of network structure in the first essay, I find that the dynamics of change in the advice network are strongly driven by structural factors, particularly the tendency for teachers to initiate new advice-seeking ties with their advisors' advisors.

ACKNOWLEDGEMENTS

I extend my deepest thanks to Jim Spillane, who has been my advisor, committee chair, and friend since I embarked on this journey. Jim provided immeasurable support — helping me pursue my intellectual passions and keeping me focused when difficult challenges arose. This project would not have been possible without him.

I am immensely grateful to my esteemed committee: Larry Hedges, Jeannette Colyvas, and Ken Frank. Their insights and feedback gave me confidence and inspired me to work harder. Their kindness and good humor made the process truly enjoyable.

I thank my family for their unyielding support: My mother, Virginia Orlina, has always believed in me and my pursuit of new opportunities. My in-laws, Nehemia and Anat Geva — accomplished scholars in their own right — welcomed me into their home and family. Nehemia's guidance and encouragement — and his willingness to lock me in his office — were instrumental in helping me finish.

Finally, words cannot express the debt I owe to my incredible wife, Roni Geva Orlina, and our amazing son, Ilan. Roni and I met early in my graduate career. Since signing on for this adventure, she has been my partner in all things. Ilan is our light.

This research was made possible by the Distributed Leadership Studies, funded by a grant from the National Science Foundation (RETA Grant # EHR-0412510), and by the Interdisciplinary Training for Education Research, Practice and Policy program (Department of Education Award # R305B040098). All opinions and conclusions expressed in this work are my own and do not reflect the views of any funding agency.

DEDICATION

I dedicate this dissertation to my father, Dr. Armando R. Orlina, MD. Although he never knew that I chose to pursue these graduate studies, his life and career were my inspiration. I can only hope to contribute as much to this world and to affect as many lives as he did.

TABLE OF CONTENTS

Abstract	3
Acknowledgements	5
Dedication	6
Table of Contents.....	7
List of Tables.....	10
List of Figures	12
Chapter 1.....	13
Introduction	13
Chapter 2.....	24
Fitting In: Novice and Experienced Newcomers in the Social Network Structure of Schools.....	24
Organizational Newcomers, Incumbents, and the Search for Information	26
Placing Novice and Experienced Newcomers Into Context.....	29
Information Seeking in Teacher Networks	31
Summary and Hypotheses	39
Methods.....	42
Measures.....	48
Dependent Variable.....	48
Independent Variables	49
Analysis	57
The p_2 Model.....	60
Results.....	66
Advice-Seeking in School Staff Networks.....	66

Modeling the Likelihood of Advice Relationships in School Staff Networks	71
Discussion and Conclusion	79
Chapter 3.....	88
Never Disconnected: Social Networks and Trust Among Middle School Staff	
Members.....	88
Trust in Schools	91
A Framework for Understanding Trust	94
Referents of Trust.....	96
Phases of Trust	98
Mechanisms of Trust	101
Summary and Hypotheses	103
Method.....	108
Data and Sample	108
Measures.....	114
Dependent Variables	114
Independent Variables	118
Analysis: Network Influence Modeling.....	126
Results.....	129
Modeling Teacher-Teacher Trust.....	132
Modeling Teacher-Principal Trust.....	134
Discussion	140
Limitations	144
Implications and Conclusion.....	147
Chapter 4.....	151
Unfreeze the Moment: A Longitudinal Analysis of a Middle School Instructional	
Advice Network.....	151
Teacher Turnover and Changes in Schools' Social Networks.....	152
Methods.....	159
Data and Sample	159
Measures.....	163

Dependent Variable	163
Independent Variables	164
Analysis	167
Results.....	174
Indications of Network Dynamics.....	174
Network Evolution	192
Discussion and Conclusion	206
Chapter 5.....	212
Conclusion	212
References.....	224
Appendix A	235
2007 and 2008 network survey instrument	235

LIST OF TABLES

Table 1.1: Network survey response rates for 10 participating schools.....	17
Table 1.2: Demographic profile of sample across 10 participating schools.....	18
Table 1.3: Experience and attitude descriptive statistics for full sample.....	18
Table 2.1: Descriptive statistics for study sample and full sample.....	48
Table 2.2: Experience profiles of the integrated professional experience categories	50
Table 2.3: Mean number of ties sent and received by members of each integrated professional experience category.....	67
Table 2.4: Density of directed ties between integrated professional experience categories (average over six schools).....	68
Table 2.5: Parameter estimates of an unconditional multilevel p_2 model predicting instructional advice relationships among members of the school staff.....	71
Table 2.6: Parameter estimates of a multilevel p_2 model predicting advice relationships as a function of individuals' integrated professional experience	73
Table 2.7: Expected dyad probabilities of instructional advice relationships assuming same-subgroup dyads.....	77
Table 3.1: Descriptive and summary statistics for sample schools.....	111
Table 3.2: Rasch scale of teacher-teacher trust (TTTR)	115
Table 3.3: Rasch scale of teacher-principal trust (TPTR)	117
Table 3.4: Descriptive statistics and correlations for continuous variables.....	124
Table 3.5: Descriptive statistics for the analytic sample of teachers.....	125
Table 3.6: Comparison between organizational newcomers and incumbents.....	126

Table 3.7: Regression analyses of 2008 teacher-teacher trust (TTTR).....	131
Table 3.8: Regression analyses of 2008 teacher-principal trust (TPTR), with school dummy variables and interactions.....	135
Table 4.1: Means and standard deviations from 2007 WMS network surveys.....	175
Table 4.2: Means and standard deviations from 2008 WMS network surveys.....	177
Table 4.3: Turnover at WMS between 2007 and 2008	178
Table 4.4: Frequency weights of advice-seeking ties linking people on staff in both years	182
Table 4.5: Advice network cohesive subgroups in WMS, 2007 network survey data ...	186
Table 4.6: Advice network cohesive subgroups in WMS, 2008 network survey data ...	188
Table 4.7: SIENA model, matched parameters from p_2 selection model (Ch. 2), estimates and standard errors for advice network evolution.....	194
Table 4.8: SIENA model, fully specified parameters from p_2 selection model (Ch. 2), estimates and standard errors for advice network evolution	198
Table 4.9: SIENA model estimates and standard errors for advice network evolution	200
Table 4.10: Contribution of gender to the value of the objective function	203

LIST OF FIGURES

Figure 2.1: Instructional advice network sociogram for Washington Middle School	56
Figure 2.2: Formation of dyads in a group of four actors	59
Figure 4.1: Network closure effects: Three-cycles and transitive ties	171
Figure 4.2: Washington Middle School 2007 cohesive subgroups.....	184
Figure 4.3: Washington Middle School 2008 cohesive subgroups.....	185
Figure 4.4: Washington Middle School 2007 leavers and 2008 newcomers	191

CHAPTER 1

Introduction

Although scholars have been investigating teacher turnover for well over 40 years (see, for example, Charters, 1970; Heyns, 1988; Mark & Anderson, 1978), interest in the issue has not diminished. The problem of how to retain teachers continues to capture attention because turnover among teachers negatively impacts the stability, coherence, and morale of school organizations, leading to disruptions in professional development, a loss of teacher leadership, and the risk of an overall drop in teacher quality (Allensworth, Ponisciak, & Mazzeo, 2009; Johnson, Berg, & Donaldson, 2005; Smith & Ingersoll, 2004). Yet, despite an express goal of improving teacher retention (Johnson et al., 2005), data from the National Center for Education Statistics indicate that the rate of teacher turnover, which includes teachers moving from one school to another as well as teachers switching to another profession, was unchanged at 16% between 2000 and 2004 (Luekens, Lyter, & Fox, 2004; Marvel, Lyter, Peltola, Strizek, & Morton, 2006), and up from 12.4% in 1991 (Bobbitt, Leich, Whitener, & Lynch, 1994). Teacher turnover imposes a cost on schools through the loss of teaching talent and the need to hire new teachers and integrate them into the organization. This cost may be considerable, as 20% annual turnover can lead to more than 50% of a school's staff being replaced within four years (Allensworth et al, 2009).

For teachers going to work in a new school, the period of organizational entry presents significant challenges. Incoming teachers need to quickly figure out how to do their jobs and what it means to be productive and successful in their new schools. They

engage in an information-seeking process to facilitate their transition into the organization (Miller & Jablin, 1991). Colleagues are an important source of information for organizational newcomers (Morrison, 1993, 2002a), and the activity of seeking information from colleagues leads to the formation or strengthening of relationships between newcomers and their co-workers. Furthermore, the number and quality of those relationships may impact the amount and quality of information that newcomers are able to acquire (Morrison, 2002b). Because intra-organizational relationships are critical to newcomers' socialization into their schools, with long-term implications for job performance, job satisfaction, organizational commitment, and — crucially — intentions to remain (Bauer, Bodner, Erdogan, Truxillo, & Tucker, 2007; Saks & Ashforth, 1997), it is important to understand with whom among their colleagues newcomers interact and how those relationships emerge.

Interactions with colleagues are not important just because they represent an opportunity for information exchange. Relationships among co-workers may affect the trust teachers feel for other teachers and for principals. Trust is an important asset in school organizations, and has been found to be positively associated with teacher retention, the success of school improvement efforts, and students' academic success (Allensworth et al., 2009; Bryk & Schneider, 1996, 2002). Positive interactions with colleagues reinforce relational trust (Ferrin, Dirks, & Shah, 2006). However, a person's trust may depend on more than isolated interactions with individual co-workers. Trust may also depend on the overall pattern of interactions that a person shares with members of the school staff and on the levels of trust felt by the colleagues with whom a person interacts.

The above discussion depicts a cycle of processes that begins and ends with teacher turnover and highlights the importance of relationships among teachers in a school. Turnover begets organizational newcomers, who engage their schools' social networks in a search for information to assist in adjusting to their new jobs. The network of interactions with co-workers may, in turn, affect teachers' trust in colleagues and the long-term success of the socialization process, both of which are linked to retention.

This dissertation, comprising three separate essays, investigates the relationships teachers form while seeking information from school colleagues and the effect teachers' relationships have on the trust they feel for other teachers and for principals. Using data collected in 2007 and 2008 as part of the Distributed Leadership Study, techniques of social network analysis are used to examine the instructional advice networks of a set of middle schools from a Midwestern, mid-sized, urban school district. Social network analysis offers a means to examine two important and interdependent dimensions of social processes: the structure of social ties in which people are embedded, and the attitudes and behaviors people develop through their interactions in social networks. Both of these dimensions are explored in this work.

Each study in this dissertation uses a subset of data drawn from a full set of longitudinal data collected from ten participating middle schools. Web-based social network surveys were administered to the teaching and administrative staffs of all ten middle schools in the collaborating school district during February and March of 2007, and again in March and April of 2008. The surveys comprised five sets of questions covering demographics, attitudes and opinions, professional roles, informal advice

networks, and qualifications/professional activities. The network portion of the survey explored three different informal advice networks, which captured advice about teaching reading/writing/language arts (RWLA), advice about teaching mathematics, and advice about teaching in the respondent's primary subject (if not mathematics or RWLA). For each kind of advice network, respondents could nominate up to 15 people to whom they turned for advice about teaching "during this school year." (See Appendix A for a complete list of the survey questions.)

To obtain high response rates, schools were offered an honorarium of \$400 for a response rate of 80% or higher, and an honorarium of \$500 for a response rate of 90% or higher. In addition, teachers who completed the survey received a \$25 gift certificate to a national bookstore chain. To encourage participation from all members of the participating schools' staffs, principals were contacted and informed of their schools' response rates periodically during the four weeks that the web-based surveys were available. Table 1.1 presents response rate data from the 10 schools across the two years of the study. Among the ten participating middle schools, each of which offered sixth, seventh, and eighth grade instruction, response rates to the 2007 survey ranged from 63% to 91%, with an overall response rate of 82%. In 2008, response rates fell in nine of the ten schools, ranging from 43% to 93%, with an overall response rate of 64%. Low participation in the second wave has been attributed in part to participants' own beliefs that little had changed over the course of one year and that completing the survey a second time would be unnecessary.

Table 1.1: Network survey response rates for 10 participating schools

	2007			2008		
	Roster Size	Responses Received	Response Rate	Roster Size	Responses Received	Response Rate
Adams	60	52	86.7%	66	54	81.8%
Harrison	70	49	70.0%	73	38	52.1%
Jackson	80	50	62.5%	81	40	49.4%
Jefferson	65	51	78.5%	69	37	53.6%
Madison	60	54	90.0%	61	32	52.5%
Monroe	78	64	82.1%	74	32	43.2%
Quincy	76	69	90.8%	77	53	68.8%
Tyler	76	64	84.2%	75	53	70.7%
Van Buren	65	59	90.8%	72	60	83.3%
Washington	61	54	88.5%	61	57	93.4%
TOTAL	691	543	81.9%	709	456	64.3%

Note: All school names are pseudonyms

Tables 1.2 and 1.3 present additional descriptive statistics about the full sample of teachers and administrators in the participating schools. In 2007, the mean age of respondents in the 10 schools is 45 years, the mean number of years of teaching experience is 16.1 years, and the mean number of years working in their current school is 9.0 years. In the collaborating school district, the middle school staffs are predominantly female (only 24% are male) and almost entirely white (just 3.9% are nonwhite). Table 1.3 shows the mean and standard deviation of four attitude measures for the full sample; these attitude measures are discussed in detail in subsequent chapters.

Table 1.2: Demographic profile of sample across 10 participating schools

	n = 682
Age (in 2007)	44.9 (10.8)
Male	24%
White	96.1%
African American	1.4%
Hispanic/Latino	1.7%
Other race	0.8%

Note: Sample of 682 individuals described here is based on combining responses across the two years of the survey for variables that change predictably with time (*e.g.*, age) or are time invariant (*e.g.*, race).

Table 1.3: Experience and attitude descriptive statistics for full sample

	MEAN (SD)	
	2007	2008
Years teaching experience	16.1 (10.4)	16.4 (10.4)
Years working in current school	9.0 (7.9)	8.7 (7.2)
Self-assessed collective responsibility	1.99 (1.57)	1.92 (1.51)
Peer collective responsibility	3.53 (2.41)	3.41 (2.35)
Teacher-teacher trust and respect	3.92 (2.75)	3.63 (2.67)
Teacher-principal trust and respect	4.12 (3.26)	3.64 (3.36)

The first essay, entitled “Fitting In: Novice and Experienced Newcomers in the Social Network Structure of Schools”, uses network data collected in the spring of 2007 to investigate the patterns of relationships between pairs of individuals working together in middle schools, including teachers, principals, and other staff members. A framework for newcomer information seeking is presented that separates technical information — information about how to teach — into a school-specific component that is associated with teaching in a particular school, and a general component that is associated with the broader occupation of teaching (Brown & Duguid, 2001). Based on

this distinction, newcomers are divided into two subcategories: experienced newcomers, who enter an organization needing school-specific technical information while being able to contribute general technical information, and novice newcomers, who enter the school needing both and offering neither.

Using a multi-level p_2 model (Van Duijn et al., 2004; Zijlstra, Van Duijn, & Snijders, 2006), the investigation found that the structure of instructional advice relationships differed among novice newcomers, experienced newcomers, and incumbents. Specifically, the findings suggest that individuals entering a school organization with more than 6 years of prior teaching experience attract more information-seeking relationships from incumbents than individuals who were new to the school and new to the profession. Structurally, experienced newcomers appear to gain an advantage over novice newcomers by virtue of their possession of general technical information about teaching. The study posits that experienced newcomers' advantage in technical information exchange may afford an additional advantage over novice newcomers with regard to access to other kinds information that are needed in the socialization process (Morrison, 1993).

The second essay, entitled "Never Disconnected: Social Networks and Trust Among Middle School Staff Members", uses network data collected in the spring of 2008 to investigate the association between advice networks and respondents' trust toward teachers in their school and trust toward their principals. In this study, trust is defined as an expectation, assumption, or belief that the future actions of another person or group "will be beneficial, favorable, or at least not detrimental to one's interests" (Robinson, 1996, p. 576), and a willingness to be vulnerable and risk that the

person or group will not fulfill that expectation (Mayer, Davis, & Schoorman, 1995). Building on this definition, the study presents a framework for relational trust that distinguishes between the collective trust teachers feel for other teachers as a whole and the individualistic trust teachers feel for the principal. The framework also specifies two mechanisms by which trust may be affected by social networks: a learning mechanism and a control mechanism (Buskens & Raub, 2002; Frank & Yasumoto, 1998). Measures of trust are regressed on measures derived from the social network data, including degree, egocentric density, and a measure of social influence based on peers' prestige and reported levels of trust. The investigation reveals that a person's trust in teachers and the principal are both related to the levels of trust reported by the colleagues with whom the person interacts in the advice network. This finding is consistent with the learning mechanism of trust. Support is not found for the control mechanism of trust, in which individuals base trust decisions on their perception that it is possible to sanction a colleague's violation of trust through mutual embeddedness in a dense social network. The null finding for the control mechanism may be related to the fact that individuals in the advice networks are connected to few colleagues whose interconnectedness is thought to mediate the control mechanism.

The two studies described above offer valuable insights into middle school advice networks, identifying factors related to the structure of teachers' network ties and the link between those ties and teachers' trust in their colleagues. However, the analyses in both studies share a central feature that warrants additional consideration: they assume that the structure of the instructional advice networks is fixed. Specifically, the first study uses only network data collected in 2007, while the second study uses

only network data collected in 2008. While network studies based on such cross sectional data are valuable and yield new knowledge, they may fail to capture features of processes that evolve over time, such as the diffusion of information (Moody, 2002).

Because teacher turnover virtually ensures that schools' social networks will change from year to year, a full understanding of network-related phenomena in schools requires an understanding of how much change occurs, whether networks change independently of turnover, and what factors explain how networks evolve. The third essay, entitled "Unfreeze the Moment: A Longitudinal Analysis of a Middle School Instructional Advice Network", extends the analysis of network structure by closely examining the changes in one school between 2007 and 2008. The school in this study, Washington Middle School (WMS), is a strategic choice; on the surface, little appears to have changed at WMS over the course of one year. The school experienced 13% turnover at the end of the 2006-07 school year — below the national average — and every position that was vacated was filled. Hence, the size of the school's staff did not change and the distribution of professional roles was similarly unchanged.

Two analyses are presented in the third essay. In the first analysis, the 2007 advice network is compared with the 2008 advice network according to attributes of the staff members in the school, the number of advice-seeking relationships they maintain, and the structure of subgroups into which people can be sorted according to the interactions they report. Upon closer inspection, it becomes clear that due to the effects of turnover and the instability of personal advice-seeking networks among people who were on staff both years, both the composition and structure of the instructional advice network at WMS changed between the spring of 2007 and the spring of 2008. The

second analysis presents an evolutionary SIENA model (Snijders, van de Bunt, & Steglich, 2009) of the changes in the WMS advice network between 2007 and 2008. The analysis investigates the extent to which parameters that explain the cross-sectional structure of the 2007 advice networks, as presented in Chapter 2, are able to explain the evolutionary dynamics of the network between 2007 and 2008. The key finding of this analysis is that whereas newcomer status is a significant predictor of the static structure of the advice network, the evolution of the network is better explained by its structural characteristics, particularly the tendency for people to initiate advice-seeking relationships with their advisors' advisors. The results of the analyses in the third essay confirm the early intuition that there is much to be learned by examining the social networks in schools longitudinally, and that findings from such analyses can complement cross-sectional investigations of static networks.

Methodologically, these studies illustrate a promising approach to conducting network analyses when longitudinal network data are available. Specifically, the findings reported in Chapter 2 and Chapter 4 suggest that new insights may be possible when a cross-sectional analysis of the structure of a network at a moment in time is combined with an evolutionary analysis of what drives changes in the network across time. Taken together, the three essays of this dissertation contribute to building a richer understanding of an organizational cycle that begins and ends with teacher turnover. Although the studies presented here examine only a portion of that cycle, they find evidence that supports the logic of the connection from newcomers who enter a school as a result of teacher turnover, to the relationships they form with incumbents while seeking information that they need to adjust to their new surroundings, to the trust that

develops among teachers as a consequence of their network of relationships. The work points to opportunities for future research into subsequent phases of the cycle to establish a link between the information teachers exchange, the trust they develop through early experiences in their schools' social networks, and the decisions they later make about whether to remain with the organization.

CHAPTER 2

Fitting In: Novice and Experienced Newcomers in the Social Network Structure of Schools

When individuals join an organization, they encounter an environment inhabited by incumbents who operate in established networks of social and information-exchange relationships (Brass, 1995; Brass, Galaskiewicz, Greve, & Tsai, 2004; Morrison, 2002b, 2002b). One of the challenges newcomers face upon entering that realm is to establish ties within the existing network and thereby gain access to technical, referent, and normative information that are necessary for adapting to the new work setting (Miller & Jablin, 1991; Morrison, 2002b). In some instances, newcomers may find that there are openings to exploit, as their arrival may have been preceded by someone else's departure such that those who remain in the organization are engaged in reconfiguring their networks to compensate for lost relationships (Shah, 2000). Whether or not a newcomer can take advantage of such an opportunity, the network ties newcomers form with their colleagues play an important role in helping newcomers learn about and adjust to their new environment (Morrison, 2002b).

The period of organizational entry is a critical time. Newcomer adjustment has been linked to long-term outcomes that are important to employees and employers, such as job performance, job satisfaction, organizational commitment, and intentions to remain (Bauer, Bodner, Erdogan, Truxillo, & Tucker, 2007; Saks & Ashforth, 1997). It is therefore important to understand how newcomers adjust and how their relationships

with incumbents contribute to the adjustment process. Issues related to those relationships include how they are formed and what newcomers receive from them. For example, while individuals often form relationships based on similarities they share with colleagues, including race and gender (McPherson, Smith-Lovin, & Cook, 2001), another factor that may play a role in the process is the amount of previous professional experience that newcomers bring to the organization. Newcomers with prior experience may be perceived by incumbents as having something of value to contribute, and may therefore attract ties from incumbents more easily than newcomers who are simultaneously new to the organization and new to the profession.

This study examines the process of information seeking among organizational newcomers in schools by investigating the relationship between previous professional experience and the pattern of relationships that emerge when teachers turn to their colleagues for technical information about teaching. Drawing on data from a collection of middle schools from a mid-size Midwestern urban school district, the study applies techniques of social network analysis to examine the pattern of relationships among novice newcomers (individuals who are new to the organization and new to the profession), experienced newcomers (individuals who arrive at the organization with previous experience), and incumbents. In the first section of the paper, I discuss issues associated with teacher turnover, and present a framework for understanding the organizational entry process and the role that information-seeking plays in the formation of new teachers' relationships with colleagues. While the framework comprises three types of information that newcomers seek, the present investigation focuses on interactions that occur when individuals seek technical information about

teaching through direct inquiry. Because technical information can be linked to both the specific context of the school organization and to the general profession of teaching (Brown & Duguid; 2001; Morrison, 1993), the framework distinguishes between organizational incumbents and two categories of newcomers, those who have no prior experience at organizational entry and those who have worked elsewhere and bring that experience to their new organization. In the second section of the paper, I describe the set of middle schools from which the social network data for this study were obtained, the measures that are used in the analysis, and the analytic procedure that is used to model the structure of the observed social networks. The final sections of the paper present the results of the analysis and a discussion of the implications of the results.

Organizational Newcomers, Incumbents, and the Search for Information

The period of entry into a new organization presents challenges for newcomers faced with the task of delivering adequate job performance while learning how to do their jobs, determining the scope their roles in the organization, and understanding the social norms within which members of the organization are expected to operate (Morrison, 2002a). During such times, organizational newcomers may experience surprise, role shock, and uncertainty (Louis, 1980; Teboul, 1994). In response to these challenges, many new employees actively engage in the socialization process through information seeking and acquisition (Miller & Jablin, 1991; Morrison, 2002a). Such individual proactive efforts complement programs that organizations offer to help new employees make the adjustment into the workplace, such as orientation and induction

(Bauer et al., 2007; Saks & Ashforth, 1997). Newcomer information seeking has been observed in a variety of settings, including accounting firms (Morrison, 1993), engineering firms and universities (Ostroff & Kozlowski, 1992), and health facilities (Adkins, 1995). Whether by direct inquiry or more covert monitoring of their surroundings, organizational newcomers engage in information-seeking behaviors to learn how to function and succeed in an unfamiliar environment.

In educational research, recent investigations of newcomer adjustment focus on novice teachers, for whom the challenges of transitioning to a new organization while simultaneously entering the profession are particularly acute (Kardos, Johnson, Peske, Kauffman, & Liu, 2001). Novice teachers need to overcome personal insecurities, reconcile their beliefs about effective instruction with the realities and time pressures of day-to-day classroom management, and learn to navigate the uncertain environment of the school and the community in which it operates (Kardos et al., 2001). At the same time, novice teachers are often expected to be independent and to teach at an expert level from very early in their careers (Kardos & Johnson, 2007). Working under these conditions is difficult, and novice teachers express a need for practical and logistical information about the school, supportive relationships with their colleagues, and access to resources and organizational structures that support student learning (Chubbuck, Clift, Allard, & Quinlan, 2001; Johnson & Birkeland, 2003; Kardos & Johnson, 2007). To satisfy these needs, new teachers turn to their more-experienced colleagues for information and support (Kardos et al., 2001).

Novice teachers' ability to successfully acquire the knowledge and skills that enable them to adjust to the teaching profession and the working environment of their

schools is a major concern to educators and policy makers. Mobility and attrition rates among early-career teachers are striking. An analysis of data from the 1999-2000 School and Staffing Survey (Smith & Ingersoll, 2004) reveals that 15% of all novice teachers left their schools at the end of their first year, while another 14% of those teachers left the profession altogether. By comparison, a separate analysis of the same data revealed an overall turnover rate among teachers of 13.2% — 7.2% due to migration and 6.0% due to attrition (Ingersoll, 2001). It is important to note that some teachers leave their schools for personal reasons, such as getting married or starting a family, while others are released due to district or school staff downsizing (Johnson, Berg, & Donaldson, 2005). However, regardless of the reasons for teachers' departure or whether they are novice or veteran, when teachers leave a school, replacements must be found. Those replacements will confront the challenge of adjusting to the new organization, and their success in that process will impact their job performance, their commitment to the organization, and their future decision about whether to stay (Bauer et al., 2007).

Given the level of turnover among teachers — particularly among novice teachers — and the impact of their adjustment to the organization on their commitment to staying, it is important to understand how newly arriving teachers acquire information and establish their positions in school organizations. Though recent educational research has focused on novice teachers and their adjustment to working in schools (Kardos et al., 2001; Kardos & Johnson, 2007), experienced teachers also have informational needs when joining a new school. In other words, novice teachers can be characterized as a special case of organizational newcomers. Novices' lack of professional experience, in addition to their lack of organizational experience, creates a

larger information deficit than that of more experienced newcomers and tends to exacerbate the difficulties of adjusting to the organization (Adkins, 1995). By drawing a distinction between novice newcomers and experienced newcomers, a more nuanced understanding of information acquisition during the organizational entry process can be obtained.

Placing Novice and Experienced Newcomers Into Context

Because organizational adjustment impacts new employees' performance and long-term commitment, it is important to understand how novice and experienced teachers engage in information seeking and adjust to the organizational setting when they join a new school. To fully understand the process, newcomers' information-seeking efforts must be examined in their organizational context. Co-workers, including organizational incumbents, are a primary source of information to newcomers. However, colleagues are not passive reservoirs of information that newcomers can access at will, and not all colleagues are equally articulate when sharing what they know. Information exchange involves an interaction between two individuals, and those interactions are embedded within a larger social network. When seeking information from colleagues, one chooses from among many alternatives. One's colleagues also choose from among many alternatives when responding to information requests and when deciding where to turn to meet their own informational needs.

If information exchange is characterized as involving two individuals interacting within a larger social context, as it is here, then an analysis that focuses on only one person in the relationship fails to account for inherent dependencies in social network

data (Carrington, Scott, & Wasserman, 2005; Wasserman & Faust, 1994). For example, does a newcomer turn to a colleague for advice because the colleague has more years of experience, or is it also important for the colleague to teach the same subject? When examining information-seeking interactions in a networked environment, one must consider not only the characteristics of the seeker, but also the characteristics of the target and the degree of similarity between the seeker and target.

New methods in the field of social network analysis make it possible to model the dependencies among the relationships between individuals in a social network. For example, exponential random graph models, also known as p^* models, are statistical models that were developed not simply to describe observed network data, but to explore hypotheses about social processes that influence relationship formation and generate the observed networks (Robins, Pattison, Kalish, & Lusher, 2007; Snijders, Pattison, Robins, & Handcock, 2006). By treating an observed network as one realization from a set of possible networks that could occur among a group of individuals who possess some combination of important characteristics, p^* models allow investigators to test hypotheses about stochastic processes that might explain the observed data. A second approach, the p_2 model, employs a multilevel framework to analyze the pattern of relationships observed between pairs of individuals (Van Duijn, Snijders, & Zijlstra, 2004). In the p_2 model, dyads — a unit of analysis that comprises two individuals and the ties between them — are the level-one unit of analysis. At level two are the individuals who make up the dyad. Dyads are cross-nested within both of the individuals who make up the dyad. This framework allows the pattern of relationships between two people to be modeled on the individual characteristics of each person as

well as on the shared properties of the dyad. To understand how professional experience affects the probability that an individual entering an organization forms ties with colleagues, the p_2 framework is used to examine the pattern of advice relationships among teachers and administrators working in middle schools.

Information Seeking in Teacher Networks

As noted previously, newcomers in an organization experience an information deficit and engage in information seeking to gain knowledge. Such knowledge feeds into an organizational socialization process that comprises four elements: task mastery, role clarification, acculturation, and social integration (Morrison, 1993). In other words, newcomers seek information to improve their job performance and to improve their organizational fit. In this section, I describe a framework for understanding information seeking activity in schools. While the foundation of the framework is drawn from research on newcomer information seeking during organizational socialization, consideration is also given to the role organizational incumbents play in information exchange. In addition, although the framework comprises three different types of information that newcomers seek, the discussion highlights information-seeking activity associated with one of the three types — technical information — which is the focus of the present study. I begin by defining three types of information that newcomers seek and then develop the framework based on the following questions: To what extent are the different types of information local versus general? Who in the organization tends to need each type of information and who tends to possess it? What are the mechanisms by which each type of information is acquired? What, besides

information, is exchanged between information seekers and their information sources, and how do information seekers choose their information sources? Throughout the framework described below, a distinction is drawn between technical information on one hand, and referent and normative information on the other. After presenting the framework, I summarize the rationale for focusing on technical information seeking in the present investigation.

Scholars studying organizational socialization identified three types of information that newcomers seek during organizational entry: technical information, referent information, and normative information (Miller & Jablin, 1991, Morrison, 1993). *Technical information* refers to information about how to perform specific aspects of the job. In teaching, technical information includes such things as how to write a lesson plan, how to present instructional materials, and how to evaluate student work. *Referent information* refers to information about what the organization expects of people in their jobs, including expectations about job performance. In teaching, referent information includes such matters as what topics must be covered in a given instructional unit and how much academic progress a teacher's students are expected to make during the academic year. Thus, whereas technical information comprises information about how to perform job-related tasks, referent information comprises information about what it means to perform such tasks well. *Normative information* refers to the behaviors and attitudes the organization values and expects from its members. In teaching, normative information includes such matters as what responsibilities a teacher must fulfill outside of the classroom (such as committee memberships or professional development), the

importance teachers are expected to place on standardized tests, and the amount of support teachers are expected to provide to their peers.

In the case of teachers joining school staffs, technical information can be distinguished from referent and normative information by the extent to which it is linked to the practice of teaching rather than to the experience of working in a particular school organization. This distinction reflects the fact that teachers working in a school can be characterized as “simultaneously members of that organization and members of a larger, dispersed occupational group” (Brown & Duguid, 2001, p. 203). Technical information, as defined above, includes information about teaching in general as well as information about teaching in a particular school setting, while referent and normative information, as defined, are more strongly tied to a specific organization. To the extent that technical information is associated with the teaching profession in general, it can be shared by teachers from different organizations because the teachers participate in a shared teaching practice (Brown & Duguid). In other words, technical information establishes a teachers’ identity as a member of the occupational group. Referent and normative information, acquired during organizational socialization, establish a teacher’s identity as a member of a specific school organization. Although the distinction drawn here is not absolute — there are instances in which technical information about teaching may be more strongly linked to a specific organization than to the “dispersed occupational group,” such as when a school is implementing a novel instructional paradigm — the fact that technical information includes information associated with the general practice of teaching suggests that newcomers who enter an organization with previous professional experience have a head start in the

socialization process. Specifically, an experienced newcomer can be viewed as an established member of the occupational group of teachers, possessing technical information that will be recognized by incumbent teachers in the new organization. In contrast, novice newcomers are new to both the profession and the organization.

Technical information can also be distinguished from referent and normative information according to who in the organization is most in need of acquiring the information and who is most likely to possess the information. People's need for information is related to the link between their sense of information deprivation and their feelings of uncertainty about their place in the organization (Morrison, 1993; Saks & Ashforth, 1997). The extent to which teachers in a school need technical, referent, and normative information varies according to how much teaching experience they have and how long they have been working in the school. For example, novice-newcomer teachers and experienced-newcomer teachers share an information deficit relative to incumbents with regard to referent and normative information about their schools. They engage in information-seeking activity to improve the extent to which they feel like they fit into the organization. As they spend more time working in the school, they become increasingly familiar with their role demands and their social obligations, and their demand for referent and normative information decreases (Miller & Jablin, 1991). In contrast, because teaching is a dynamic profession, with new students in the classrooms each year and periodic changes to curricula and instructional materials, all teachers are likely to have a need for technical information. However, while novice-newcomer teachers and experienced newcomer teachers both have a need for referent and normative information, experienced newcomers are likely to possess technical

information that novice newcomers lack, particularly if the experienced newcomers' previous experience is comparable to the job they perform in their new schools. In fact, by virtue of their established membership in the occupational group of teachers, experienced-newcomer teachers should be comparable to incumbents with regard to their need for technical information that is associated with general teaching practice. To the extent there exists both general technical information and school-specific technical information, incumbents will possess the most technical information, followed by experienced newcomers and then novice newcomers.

A third distinction between technical information and the other two types of information is based on the tactics that newcomers employ for information seeking. Professional colleagues, including supervisors and co-workers, are a primary source of technical, referent, and normative information for newcomers, (Miller & Jablin, 2001, Morrison, 1993). Morrison (1993) investigated how and from whom newcomers seek different kinds of information and found that newcomers tend to acquire technical information through direct inquiry while gathering referent and normative information through covert monitoring and observation. In other words, when newcomers want information about how to do the job, they ask their colleagues directly. In contrast, when newcomers want information about how they are expected to perform or to behave, they draw inferences from observing their surroundings. In addition, Morrison found that although monitoring can be used to gather information from anyone, inquiry is targeted and tends to be directed at peers rather than supervisors. Because the acquisition of technical information involves direct inquiry rather than passive observation and monitoring, information seeking that targets technical information

manifests in a perceptible interaction between the information seeker and the information supplier. The interaction is perceptible in that the newcomer seeking information takes deliberate action to acquire that information and the information supplier is aware that an interaction occurs. (In the case of monitoring and observation, it is possible for a newcomer to acquire referent and normative information without information suppliers realizing that their actions are being monitored.) Thus, in the case of direct inquiry, it is important to consider how a person chooses who to approach for technical information and what, besides technical information, may be exchanged during the interaction.

Direct inquiry in the search for technical information requires a person to choose a colleague to approach for information, and to engage in an exchange as part of the information-seeking interaction. These two issues are not independent, as the decision about who to approach for technical information depends on expectations about the content and quality of the exchange (Frank & Maroulis, 2009). When seeking technical information in a school, an individual's primary goal is to acquire information that is new and that contributes to improving teaching practice (*e.g.*, Kardos & Johnson, 2007). However, that is not the end of the exchange. Along with the desired information, an individual may experience pressure to conform to the position held by the person who provides help (Frank, Zhao, & Borman, 2004). Moreover, information may be accompanied by evaluative feedback, and a newcomer may weight whether a colleague's feedback is likely to be supportive and helpful or damaging to the information seeker's self-esteem (Morrison, 2002a). Thus, in exchange for receiving information, an individual may be pressured to provide a resource to the colleague in

the form of conformity. In addition, to the extent that the interaction and its outcomes are known to others in the organization, the information seeker confers status on the information supplier in the form of recognition of the latter's expertise. For the individual seeking technical information, the information-seeking exchange involves gain, in the form of access to a colleague's expertise, and cost, in the form of pressure to conform with the information that is provided. Frank and Maroulis (2009) argue that the decision about who to turn to for technical information can be described in terms of a utility function, and that the decision turns on the expected gains from the exchange and the expected cost of the exchange. Hence, a potential supplier of information is attractive if that person is perceived to be able to provide useful information (high gain), and if the pressure to conform is expected to be low or if the seeker perceives that conforming will not be too difficult (low cost). However, a potential supplier of technical information would be less attractive if either the quality of information is expected to be low relative to the seeker's needs or if the pressure to conform is expected to be high. Consistent with this utility perspective, Teboul and Cole (2005) found that when choosing who to approach for technical information, newcomers tend to approach individuals who are most similar, in terms of shared demographic characteristics, attitudes, and experiences (potentially minimizing the pressure to conform), as well as individuals who have the most unique and relevant information to provide (potentially maximizing the knowledge gained).

As noted at the beginning of this section, the present study investigates only technical information seeking activity. The framework described above suggests three reasons for proceeding with this restriction. First, because of the dynamic nature of

teaching, everyone in a school — not just newcomers — can be expected to have some need for technical information.¹ An investigation of technical information seeking can therefore consider the activities of all members of an organization and compare the behaviors of newcomers with those of incumbents. Second, because technical information includes information that is part of the broader occupational group of teachers, an investigation of technical information seeking can explore differences in the behaviors of newcomers who enter a school with no previous teaching experience and newcomers who enter a school as established members of the teaching profession. Third, because technical information is acquired through direct inquiry, an investigation of technical information seeking can examine perceptible interactions between information seekers and information suppliers and explore how information seekers choose who to turn to for technical information.

In addition to these three points, there is a fourth issue that may be illuminated by investigating technical information seeking before examining information seeking that targets referent and normative information. As noted above, newcomers employ the tactic of monitoring and observation when seeking referent and normative information from their more-experienced colleagues. It may be that monitoring and observation are conducted imperceptibly while newcomers interact with colleagues during direct inquiries about technical information. Moreover, this tactic for acquiring information might take place independent of who initiated the direct inquiry for technical information. Thus, an understanding of how technical information seeking occurs in the organization may serve to guide a future investigation of referent and normative information-seeking activity.

Summary and Hypotheses

The conceptual framework outlined above suggests that information seeking that targets technical information, which can be linked to the broader occupation of teaching as well as the job of teaching in a particular school, is distinct in several ways from information seeking that targets referent and normative information, which are more tightly bound to a specific organizational context. With regard to technical information seeking, the framework differentiates teachers in a school according to the amount and type of experience they possess — experience in the profession and experience working in the school — and the extent to which they are likely to need and to possess technical information about teaching. The framework suggests that while all members of a school staff will have a need for technical information about teaching, novice newcomers will have a greater need for technical information than either experienced newcomers, who possess technical information from previous experience working in the broader occupation of teaching, or incumbents, who possess both general and local technical information about teaching. This reasoning suggests the following hypothesis:

Hypothesis 1: Experienced newcomers will be more likely than incumbents to seek technical information from colleagues, while novice newcomers will be more likely than both experienced newcomers and incumbents to seek technical information from colleagues.

A utility perspective, applied to the direct inquiry tactic for acquiring technical information, suggests that individuals will choose who to turn to for technical information about teaching by balancing the potential information gained from an

information supplier against the potential costs incurred from pressure to conform. Higher gains may be achieved by seeking technical information from individuals who have more experience working in the teaching profession and more years working in the organization. At the same time, lower pressure to conform may be achieved by seeking technical information from others who are similar with regard to the technical information they possess, such as those who have a comparable level of professional experience. These arguments suggest the following hypotheses:

Hypothesis 2: Experienced newcomers will be less likely than incumbents to be sought by colleagues for technical information, while novice newcomers will be less likely than both experienced newcomers and incumbents to be sought by colleagues for technical information.

Hypothesis 3: The likelihood of a technical information-seeking relationship between two individuals will be positively associated with the individuals being in the same professional experience category.

These hypotheses represent a basic test of the information-seeking framework described above, particularly with regard to the claim that technical information comprises a general component and a school-specific component, and the implication of that claim on the expected pattern of information-seeking activity among individuals with different levels of professional experience. One indication of the extent to which these intuitions hold true is the frequency with which relationships are realized between individuals with different experience levels. Novice newcomers are expected to be the most active individuals in the school when it comes to seeking technical

information, as they have the greatest information deficit. Hence, the frequency of observed relationships in which the advice seeker is a novice newcomer should be higher than the frequency of observed relationships in which the advice seeker is either an experienced newcomer or an incumbent. For the same reason, novice newcomers are expected to be sought out as information suppliers less often than either experienced newcomers or incumbents; the frequency of observed relationships in which advice is sought from a novice newcomer should be low. Similarly, experienced newcomers are expected to be sought out as information suppliers more often than novice newcomers because they possess general technical information about teaching, while incumbents should be targeting most often because they possess both general and local technical information.

When considering both the information seeker and the information supplier, the highest proportion of information-seeking relationships should be between incumbents and other incumbents, not only because incumbents outnumber newcomers, but also because incumbents have had more time in the organization to establish relationships with their colleagues (Blau, 1977). At the same time, because newcomers may bring new information into the school and because newcomers may not have sufficient status in the organization to enforce conformity with the information they provide, incumbents may also seek information from newcomers. However, the frequency of observed information-seeking relationships between incumbents and newcomers should be lower than the frequency of observed relationships between two incumbents. Finally, all other things equal, the frequency of observed relationships in which incumbents seek advice from experienced newcomers should be higher than the frequency of observed

relationships in which they seek advice from novice newcomers. This is because experienced newcomers are expected to enter the organization with technical information associated with the broader occupation of teaching — information that novice newcomers lack — and thus are more likely to be able to contribute technical information about teaching in exchanges with incumbents.

Methods

The data for this investigation were collected as part of the Distributed Leadership Study. The data were collected during a longitudinal investigation of an NSF-sponsored, university-based program to improve middle school mathematics instruction, conducted in collaboration with a mid-size Midwestern urban school district. The principal goal of the Distributed Leadership project has been to develop instruments, including social network surveys used to collect the data reported here, for identifying and documenting instructional leadership practice. Because this work is grounded in a distributed perspective on leadership, the instruments that were developed and the data that were collected focus on all members of a school's staff, including formally-designated leaders, informal leaders, and teachers. The collection of sociometric network data in schools (as opposed to data collection focusing only on formal leaders or only on math teachers) makes it possible to use these data to investigate how novice-newcomer and experienced-newcomer teachers form ties with the established social networks of their schools.

Web-based social network surveys were administered to the full teaching and administrative staffs of all ten middle schools in the collaborating school district during

February and March of 2007, and again in March and April of 2008. The surveys comprised five sets of questions covering demographics, attitudes and opinions, professional roles, informal advice networks, and qualifications/professional activities. The network portion of the survey investigated three different informal advice networks: advice about teaching reading/writing/language arts (RWLA), advice about teaching mathematics, and advice about teaching in the respondent's primary subject (if not mathematics or RWLA). For each kind of network, respondents could nominate up to 15 people to whom they turned for advice about teaching "during this school year." (See Appendix A for a complete list of the survey questions.)

The social network surveys included a question asking respondents to describe the advice sought from a named colleague as either (a) "deepening your content knowledge," (b) "planning or selecting course content and materials," (c) "approaches for teaching content to students," (d) "strategies specifically to assist low-performing students," (e) "assessing students' understanding of the subject," or (f) "other." Although responses to this item are not used in the present analysis, the five descriptions explicitly listed in the survey, together with the open-ended responses provided by respondents, suggest advice-seeking that targets technical information about teaching — information about how to perform job-related tasks rather than information about what it means to perform such tasks well or about general organizational expectations. This characteristic of the advice network data is consistent with Morrison's (1993) finding that people tend to seek technical information through direct inquiry, and indicates that the advice-seeking data from the network surveys can

be used to investigate how people in these schools engage in information-seeking activity that targets technical information.

To obtain high response rates, schools were offered an honorarium of \$400 for a response rate of 80% or higher, and an honorarium of \$500 for a response rate of 90% or higher. In addition, teachers who completed the survey received a \$25 gift certificate to a national bookstore chain. To encourage participation from all members of the participating schools' staffs, principals were contacted and informed of their schools' response rates periodically during the four weeks that the web-based surveys were available. Among the ten participating middle schools, each of which offered sixth, seventh, and eighth grade instruction, response rates to the 2007 survey ranged from 63% to 91%, with an overall response rate of 82%. In 2008, response rates fell in nine of the ten schools, ranging from 43% to 93%, with an overall response rate of 64%. Low participation in the second wave has been attributed in part to participants' own beliefs that little had changed over the course of one year.

The objective of the social network survey is to obtain relationship data that can be used to build network representations of the social interactions among colleagues in participating schools. In the present study, the interactions of interest comprise exchanges of information about teaching. The interactions are directed in the sense that information-exchange interactions are initiated by an information-seeker who turns to colleagues for advice or information about teaching. Thus information-seeking ties are directed from the survey respondent (the nominator) to the named information source (the nominee). An important challenge in network survey research relates to the validity of the network representations that are inferred from these network data

(Ferligoj & Hlebec, 1999). In other words, one must be concerned about the extent to which the network representations inferred from the data reflect the actual pattern of information-seeking interactions. Several factors may contribute to validity issues. A chief concern in social network survey research is the possibility that respondents fail to name all the alters in their networks, either because they forget about interactions with individuals that should be included in the network or because they only mention alters with whom interactions are particularly strong or recent (Pustejovsky & Spillane, 2009). In addition, the design of the network survey instrument — such as the order in which questions are presented, whether alters are solicited using a recall-based or roster-based method, and whether respondents are asked to characterize a tie on a binary or ordinal scale — may exacerbate these issues and thereby affect the quality of the network data (Ferligoj & Hlebec; Pustejovsky & Spillane).

Two studies examined the validity of early versions of the social network surveys that were used to collect the data in the present research, providing guidance for improving the final design of the survey instruments. First, Pustejovsky and Spillane (2009) examined question-order effects — how the ordering of name generator questions for different types of networks affects the information provided by respondents. The social network surveys capture multiplex data reflecting three different kinds of information-seeking networks: an RWLA advice network, a mathematics advice network, and a ‘primary subject’ advice network. Question-order effects impact the validity of the obtained network data insofar as “the network as measured by the second name generator differs substantially from the network that would have been produced by the second name generator, if the first name generator

were not asked” (Pustejovsky & Spillane, p. 222). The study found evidence of two question-order effect mechanisms, satisficing and question-scope redefinition.² In both cases, the primary implication of the order of the name generators was to introduce bias when comparing two networks, such as the RWLA and mathematics network. To mitigate question order effects for the 2007 and 2008 surveys, the order of the subject-specific network prompts was randomized. In addition, for the present study, data from the different networks are combined to create a single, comprehensive representation of information-seeking relationships among teachers and administrators. Although question-order effects can be expected to impact the characteristics of the combined network, the problems associated with comparing constituent networks is not expected to pose a problem to this investigation.

Second, using a series of interviews and cognitive “think-aloud” interviews, Pitts and Spillane (2009) investigated how respondents interpreted and understood the network survey items, whether their understandings were consistent with the intentions of the survey designers, and whether the survey was ultimately able to identify leadership operationalized as social influence interactions in organizations. While they found that the network surveys were, in fact, able to identify leadership operationalized as social influence interactions, they also identified several limitations to the survey as a instrument for measuring leadership. For example, respondents generally tended to underreport instances of acquiring information through observations and the informal “bouncing around” of ideas. Respondents also tended to under report instances of unsolicited advice-giving by colleagues, as well as instances of advice-seeking around aspects of teaching that cross subjects. Finally, although the

survey prompted respondents to consider interactions over the previous year, respondents appeared to focus on people who were in their support networks at the time the survey was administered. While these findings point to limitations in the context of measuring leadership operationalized as social influence interactions, they may be seen as strengths in the context of the present study. Specifically, because the goal of the present investigation is to examine teachers' information-seeking networks based on direct inquiry, the fact that respondents underreport observations, informal dialogues, and unsolicited advice-giving is an advantage. The social network survey instrument appears to be effective at soliciting information about the kinds of interactions that are of interest here.

The present study is a cross sectional analysis using only data from the 2007 surveys. The study sample includes six schools with 2007 response rates above 85%, yielding an overall sample response rate of 88.4%. The data contain a total of 396 unique individuals working in the six sample schools, including two teachers who each worked in two of the sample schools during the 2007 school year. These two teachers were included in the networks of both schools in which they worked, omitting ties that extended between the two schools. Table 2.1 presents descriptive statistics of the study sample used in this investigation and of the full 2007 sample. There are no significant differences between the study sample and the full 2007 sample.

Table 2.1: Descriptive statistics for study sample and full sample

	MEAN (SD)	
	Study Sample	Full Sample
Male	0.26 (0.44)	0.24 (0.43)
Age (years)	45.2 (10.7)	44.9 (10.8)
Non-white	0.06 (0.24)	0.04 (0.20)
Years teaching experience	17.3 (9.8)	16.1 (10.4)
Years working in current school	9.0 (7.7)	9.0 (7.9)
Self-assessed collective responsibility	2.02 (1.56)	1.99 (1.57)
Consulting curricular materials	3.81 (1.16)	3.77 (1.19)
Reviewing district academic standards	3.08 (1.05)	3.04 (1.05)
Participating in web-based professional discussion groups	1.38 (0.78)	1.36 (0.75)
N (teachers, staff, and administrators)	396	682

Measures

Dependent Variable

Advice relationships. In the present analysis, information-seeking activity is operationalized as a network of advice relationships. Data on the three different advice networks — advice about mathematics instruction, advice about RWLA instruction, and advice about instruction in the respondent’s primary subject if the respondent’s primary subject was not RWLA or math — were integrated to provide a comprehensive profile of advice seeking activity in the schools. For every pair of individuals i and j , the

value of the $i \rightarrow j$ relationship was assigned a value of 1 if i turned to j for advice about instruction in any of the three areas specified in the network survey, and 0 otherwise. Thus, if i nominated j for both math advice and RWLA advice, the dependent measure for the (i, j) relationship would be 1, capturing the basic fact that i turns to j for instructional advice. The reduction of relationships across the three different advice-seeking networks to a simple binary measure, ignoring the number of times a person sought advice from a given colleague and the importance the person attributed to the colleague's advice, was a technical constraint. At present, the software for estimating p_2 models, part of the StOCNet analysis package (Boer, Huisman, Snijders, Steglich, Wichers, and Zeggelink, 2006), cannot handle valued relational data.

Independent Variables

Professional experience. Information-seeking is a behavior that scholars have identified among newcomers during the organizational adjustment process. As such, the primary measure for understanding individuals' tendency to engage in information-seeking activity in conjunction with organizational socialization is organizational tenure, or how long the individual has been working in the organization. In this study, a distinction is drawn between novice newcomers, who are new to a school and new to the teaching profession, and experienced newcomers, who are new to a school but who have previous teaching experience. The categorical variable that identifies respondents as either novice newcomer, experienced newcomer, or incumbent is called *integrated professional experience (IPE)*, as it represents both experience in the teaching profession as well as experience in a specific school. It is expected that experienced newcomers will

be more integrated into the structure of their schools' advice networks than novice newcomers, and that this difference will be evident when examining dyads in the schools.

Table 2.2: Experience profiles of the integrated professional experience categories

	MEAN (SD)		
	Novice Newcomers	Experienced Newcomers	Incumbents
Years of teaching experience	2.9 (1.5)	17.3 (8.2)	19.6 (8.8)
Years working in current school	2.0 (0.9)	1.9 (0.8)	11.4 (7.5)
N (teachers, staff, and administrators)	44	50	268

To investigate the distinction between novice newcomers and experienced newcomers, a categorical variable was created to separate respondents into one of three groups. *Novice newcomers* comprise individuals who have been working in their schools for three or fewer years and have six or fewer years of teaching experience. *Experienced newcomers* comprise individuals who have been working in their schools for three or fewer years and have more than six years of teaching experience. *Incumbents* comprise individuals who have been working in their schools for more than three years. The experience profiles of these three groups are summarized in Table 2.2. Note that a fourth category of *novice incumbents* — those who have six years or fewer of teaching experience and who have been working in their schools for more than three years —

included only 13 individuals across the six schools in the study sample, and has been combined with the incumbents category for these analyses. This is a conservative choice. The expected impact of including novice incumbents with incumbents is to reduce the apparent attractiveness of incumbents in the context of advice-seeking networks (in other words, it makes the incumbents category more similar to the novice newcomer category) and thus to increase the substantive significance of any difference that may be found in the pattern of ties between incumbents and the other categories. In addition to dummy variables to test the effect of the experience categories on sending and receiving advice ties, a dyadic variable is included in the analysis to test the hypothesis that being in the same experience category is positively related to the likelihood of forming an advice relationship.

Across the study sample, the number of years of teaching experience ranged from 1 to 40 years, with a mean of 17.3 years teaching experience. The number of years working in one's present school ranged from 1 to 37 years, with a mean of 9.0 years. In the study sample, novice newcomers had, on average, 2.9 years of teaching experience and had been working in their schools for 2.0 years. Experienced newcomers had, on average, 17.3 years of teaching experience and had been working in their schools for 1.9 years. Incumbents had, on average 19.6 years of teaching experience and had been working in their schools for 11.4 years. These numbers suggest that experienced newcomers are similar to novice newcomers with regard to organizational tenure, but are similar to incumbents with regard to professional experience.

Behaviors and attitudes. Educators who exchange instructional advice with colleagues may do so as part of a general desire to improve instructional practices. To

control for this general tendency, behavior and attitude measures are included in the analyses as sender and receiver covariates.³ Two behavioral measures control for individuals' general tendency to seek information about teaching. They are the frequency with which respondents reported reviewing district academic standards and the frequency with which respondents reported consulting curricular materials. Each of these was measured with a single survey item on a five-point scale (1 = never, 2 = a few times per year, 3 = once or twice per month, 4 = once or twice per week, 5 = daily or almost daily). One attitude measure — self-assessed collective responsibility for student learning — controls for the extent to which individuals internalize responsibility for student learning, believe that they have the power to teach all students, are willing to adapt their teaching methods to students' success or failure, and feel efficacious in teaching (Lee & Smith, 1996). As a measure of professional community, the average collective responsibility among teachers has been shown to be positively associated with high levels of staff cooperation (Lee & Smith). In this study, collective responsibility is used as an individual measure to capture people's attitudes about their ability to improve their instructional practices and thereby affect student outcomes. The self-assessed collective responsibility measure was constructed as a Rasch-equated composite from a seven-item scale (Cronbach's alpha = 0.73 for the full 2007 sample).

Professional role. The utility perspective suggests that individuals will attempt to maximize the gain from an information-seeking interaction by turning to others who are most likely to provide useful information. One implication of this perspective is that individuals will seek information from others who perform the same professional role or teach in the same subject area. To control for this tendency while testing the effect of

experience levels on information-seeking activity, a similarity measure of professional role are included at the dyadic level. For the purpose of these analyses, the sample was divided into eleven professional roles: English and ESL teachers, math teachers, foreign language teachers, social sciences teachers, natural science teachers, health and PE teachers, arts teachers (including art, music, and drama), enrichment teachers (including specialty courses such as business, computers, and high-ability education), special education teachers, self-contained classroom teachers (which is identical to specifying 6th-grade teachers in the six participating middle schools), and administrators (which includes principals, assistant principals, and other non-teaching members of the schools staff). Note that although members of the administrator category nominated relatively few colleagues as targets of advice-seeking (and, in fact, 24% of all non-responses came from the administrator category), these individuals were included in the network analyses to ensure that all instances in which a respondent indicated seeking advice from an administrator (or a non-respondent) could be taken into account when analyzing the overall pattern of respondents' network ties. In addition, because the survey instrument explicitly asked all respondents who they consulted for advice about teaching RWLA and mathematics, dummy variables for being an RWLA or math teacher are included as receiver covariates to control for an expected overall tendency for those individuals to receive relatively more advice-seeking ties than individuals in other professional roles.

Cohesive subgroups. This study examines the patterns of advice relationships that emerge between pairs of individuals in a social network. However, an essential feature of social networks is that ties between a given pair of individuals are not independent of

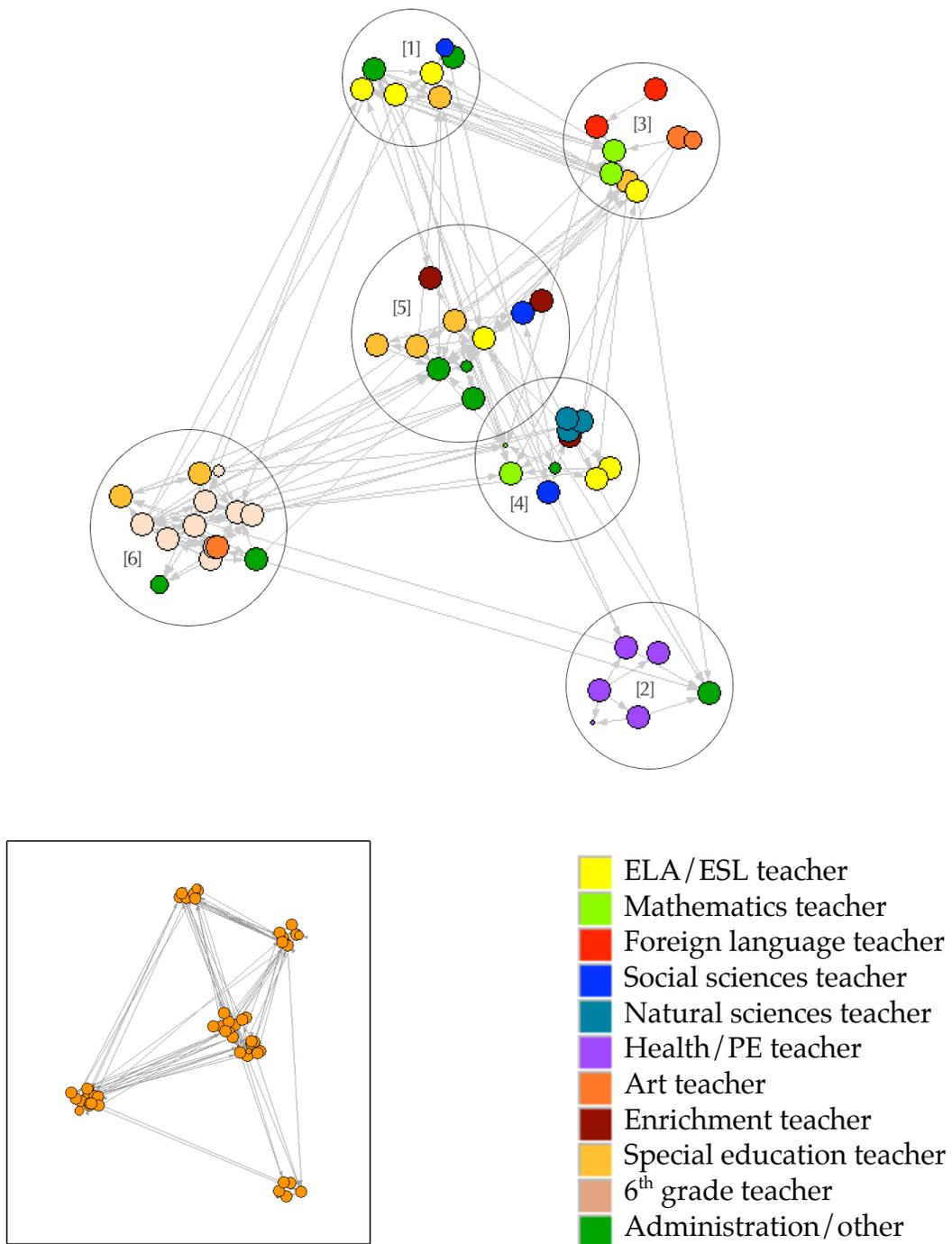
the ties they have with other members of the network. For example, the likelihood of a relationship between person *A* and person *B* may be affected by whether *A* and *B* have relationships with a third person, *C*. A variety of mechanisms may lead to this phenomenon of transitivity among sets of three people in a network (Snijders et al., 2006). To maintain a focus on dyads while accounting for the embeddedness of dyads in the larger network, the network data are analyzed to identify the informal subgroups in which network ties are concentrated (Frank, 1995, 1996). Informal subgroups can be characterized as meso-level network entities that structure social interactions (Frank & Zhao, 2005). A dyadic similarity variable that indicates whether two individuals are members of the same informal subgroups is used in the analysis to control for this meso-level structure.

Figure 2.1 illustrates the subgroup structure for one of the six sample schools.⁴ Two features of the sociogram are worth noting. First, although there is some tendency for subgroups to form around a common subject area in Washington Middle School, where there is one subgroup dominated by sixth-grade teachers and another dominated by health/PE teachers, the diagram reveals that advice-seeking interactions take place between individuals with different roles and different experience levels, both within and between subgroups. This is not surprising, since the data on which these networks were based reflect all respondents' advice-seeking about RWLA and math instruction. Second, novice newcomers generally tend to be positioned near experienced newcomers or incumbents with the same professional role, even when the overall subgroup contains individuals with different roles. This observation suggests that a

model of advice-seeking ties should control for shared roles separately from shared subgroup membership.

Demographic characteristics. Individuals may choose to seek advice from colleagues who share similar physical traits or demographic characteristics. Factors that would contribute to this tendency among educators include gender and race. A similarity measure for gender is included in the model, but because the study sample is almost perfectly homogeneous with regard to race, a similarity measure for race is not included in the analysis.

Figure 2.1: Instructional advice network sociogram for Washington Middle School



Analysis

This study focuses on whether the pattern of ties involving experienced newcomers differs from the pattern of ties involving novice newcomers. To understand how the analysis is structured, it is useful to elaborate on the logic of network selection modeling. In each of the sample schools, there are a number of teachers, administrators, and staff. During the process of running the school and delivering instruction to students, the individuals working in the school interact with one another on a variety of issues, including curriculum design, instructional practices, school-wide goals (such as improving overall test scores), and personal matters. Teachers in mid- to large-sized schools rarely, if ever, interact with all of their colleagues on any particular matter, so it is instructive to investigate what factors are associated with the interactions that do take place. Moreover, to the extent that different teachers (or administrators) have different needs with respect to interactions with colleagues, the contributions of factors that determine whether two teachers interact will vary across the staff. The information-seeking mechanism suggests that educators are more likely to seek advice about instruction from individuals who, because of their professional experience and school tenure, are likely to be able to satisfy the advice-seekers need for technical information.

One way to investigate the interactions that take place among the members of a school staff is to examine the interactions between every possible pair of individuals in the system. In network analysis, a dyad is a unit of analysis that comprises a pair of individuals and the ties that define their interactions. Consider a group of four people: *A*, *B*, *C*, and *D* (see Figure 2.2). For such a group, there are six unique pairings: *AB*, *AC*,

AD, *BC*, *BD*, and *CD*. Within each pair, there are four possible interaction patterns. For example, *A* could initiate contact with *B* while *B* does nothing (an asymmetric outbound tie with respect to *A*), *B* could initiate contact with *A* while *A* does nothing (an asymmetric inbound tie with respect to *A*), both *A* and *B* could initiate contact with each other (mutual ties), or *A* and *B* could both do nothing (a null dyad). Because a null dyad can be characterized as *mutually* null, both mutual and null dyads are examples of the more general category of reciprocal dyads (thus it is sometimes necessary to explicitly specify non-null reciprocal dyads). The objective of a selection model is to predict the likelihood of observing a particular pattern of interactions in a dyad according to individual and dyadic properties.

Factors that are associated with the pattern of ties in a dyad fall into two categories: individual-level factors and dyad-level factors. Individual-level factors are measures of each of the individuals involved in the dyad. Individual-level factors include demographic measures, such as race, gender, and the number of years working in the school or the profession. Dyad-level factors are measures of the pair, typically reflecting similarities and differences among the two individuals, such as whether their gender or race is the same, or the difference in the number of years the two individuals have worked in the school or the profession. In any given social system, each of the factors discussed above may affect the formation of ties. In other words, the outcomes of network selection — the observed interaction patterns within the sample of potential dyads in the network — depend on a combination of individual attributes and dyadic measures of similarity or dissimilarity.

Figure 2.2: Formation of dyads in a group of four actors

Individuals (n = 4):	A	B	C	D
Unordered pairs (n = 6):	AB BC	AC BD	AD CD	
Dyads (n = 6):	{ (A→B), (A←B), (A↔B), (A B) }	{ (A→C), (A←C), (A↔C), (A C) }	{ (A→D), (A←D), (A↔D), (A D) }	{ (B→C), (B←C), (B↔C), (B C) }
	{ (B→D), (B←D), (B↔D), (B D) }	{ (C→D), (C←D), (C↔D), (C D) }		

While dyadic analysis yields valuable insights into the structure of ties between pairs of individuals in a social system, there are aspects of the overall social network that cannot be explained when the analysis is restricted to dyads. For example, consider the case of three people, *A*, *B*, and *C*. Dyadic analysis can provide insight into the factors associated with the pattern of ties between *A* and *B*, *A* and *C*, and *B* and *C*. However, some network scholars have argued that triads are an important unit of network

analysis, and that in networks of positive interpersonal relations, transitivity — when A interacts with B and B interacts with C , then A is found to interact with C — has been observed more often than could be explained by chance (Snijders et al, 2006). While dyadic analysis cannot explain social phenomena that operate on the level of triads, recent research found that “more than 90% of the triadic structure in a collection of diverse social networks [was] accounted for by lower-order properties” (Faust, 2007, p. 212), including network density, in-degree and out-degree distributions, and the distribution of mutual, asymmetric, and null ties. Such findings suggest that one can gain significant insight the overall structure of an observed social network by modeling the factors that explain the properties identified by Faust. Moreover, including a dyadic similarity covariate that specifies whether the two individuals in a dyad are members of the same cohesive subgroup effectively controls for higher-order network structures (Frank & Yasumoto, 1998, and personal communication). It is therefore expected that the dyadic analysis proposed here, which includes a similarity measure that captures the higher-order structural components defined by cohesive subgroups, will provide a meaningful description of factors associated with network selection among teachers in a school.

The p_2 Model

Network selection models examine a group of n individuals and attempt to explain the overall pattern of ties among them. One possibility for modeling network selection is to use logistic regression to estimate the probability of the existence of a tie from person A to person B as a function of the characteristics of A and B and of the dyad

AB. However, standard statistical models should not be applied to social network data because the data do not satisfy the assumption of independent observations (Van Duijn & Vermunt, 2006). At the most basic level, the aforementioned tie from *A* to *B* is not independent of a tie from *B* to *A*. Moreover, a tie from *A* to *B* is not independent of a tie from *A* to *C*, because both ties involve *A*. Nonstandard statistical techniques that have been designed to deal with the non-independence of social network observations include dyadic interaction models, exponential random graph models, and stochastic actor-oriented models (Van Duijn & Vermunt). While these non-standard techniques address the fact that one cannot assume the independence of observations in social network analysis, they introduce complexities that can be challenging for researchers accustomed to OLS regression models. The non-standard models may require specialized software to estimate model parameters, and care must be taken when interpreting the results of such analyses because standard goodness of fit tests may not be available.

The proposed network selection investigation uses a dyadic interaction model called p_2 (Van Duijn, Snijders, & Zijlstra, 2004). The p_2 framework models the pattern of observed ties within dyads on individual and dyadic covariates. The p_2 model can be described as a multi-level, cross-nested model. At level one are dyads comprising pairs of individuals. These pairings are cross-nested in senders and receivers at the second level (Crosnoe, Frank, & Mueller, 2008; Frank & Zhao, 2004). Like its predecessor, the p_1 model (Holland & Leinhardt, 1981), the p_2 model assumes dyadic independence conditional on nodal properties (Lubbers & Snijders, 2007), accounting for the dependencies in the relationships that make up a dyad as well as the interdependence

between the relationships to and from a given person (Lazega, Lemerrier, & Mounier, 2006). The p_2 model has been used to examine the advice, collaboration, and friendship networks of members of a law firm (Lazega & Van Duijn, 1997; Van Duijn et al., 2004), support networks of Dutch high school students (Zijlstra et al., 2006), the effect of ethnicity on friendship formation among high school students (Baerveldt, Van Duijn, Vermeij, & Van Hemert, 2004; Baerveldt, Zijlstra, de Wolf, Van Rossem, & Van Duijn, 2007), and the effect of body size on friendship formation among high school students (Crosnoe et al., 2008).

The p_2 model expresses the probability distribution for the pattern of directed ties within each dyad (Y_{ij}, Y_{ji}) . As outlined above, given two individuals, A and B , there are four possible dyadic outcomes. In a mutual outcome, there is a tie from sender A to receiver B and a tie from sender B to receiver A , $(Y_{ij}, Y_{ji}) = (1,1)$. In asymmetric (or non-reciprocated) outcomes, there is only a tie from A to B , $(Y_{ij}, Y_{ji}) = (1,0)$, or there is only a tie from B to A , $(Y_{ij}, Y_{ji}) = (0,1)$. In a null outcome, there are no ties between A and B , $(Y_{ij}, Y_{ji}) = (0,0)$. Like the p_1 model (Holland & Leinhardt, 1981), the p_2 model predicts dyadic outcomes in terms of a sender effect (α_i), receiver effect (β_i), density effect (μ_{ij}), and reciprocity effect (ρ_{ij}). The p_2 model starts with the following expression for the probability distribution of dyads (Lazega & Van Duijn, 1997; Van Duijn et al., 2004):

$$P(Y_{ij} = y_1, Y_{ji} = y_2) = \exp\{y_1(\mu_{ij} + \alpha_i + \beta_j) + y_2(\mu_{ij} + \alpha_j + \beta_i) + y_1 y_2 \rho_{ij}\} / k_{ij} \quad (1)$$

where $y_1, y_2 = 0, 1$ and k_{ij} is a normalization constant that depends on $\alpha_i, \beta_i, \mu_{ij}$, and ρ_{ij} . As noted previously, the main contribution of the p_2 model is its framework for using individual and dyadic attributes to predict dyadic outcomes. Thus, in the p_2 model,

sender and receiver effects are regressed on a set of individual covariates, X_{1i} and X_{2i} , with unexplained individual parameters modeled as random effects, A_i and B_i . Density and reciprocity parameters are modeled using dyadic covariates, Z_{1ij} and Z_{2ij} .

$$\begin{aligned}
 \alpha_i &= X_{1i}\gamma_1 + A_i \\
 \beta_i &= X_{2i}\gamma_2 + B_i \\
 \mu_{ij} &= \mu + Z_{1ij}\delta_1 \\
 \rho_{ij} &= \rho + Z_{2ij}\delta_2
 \end{aligned} \tag{2}$$

Zijlstra, Van Duijn, and Snijders (2006) introduced a multilevel p_2 model to allow multiple observations of social networks to be simultaneously modeled with a given set of individual and dyadic covariates. In the multilevel p_2 model, ties (Level 1) are cross-nested in individuals (Level 2) who are nested in networks (Level 3). Fixed regression parameters γ and δ are recast as random coefficients through the addition of Level 3 random effects, while network parameters μ and ρ also obtain random effects. For a system of K networks, the multilevel p_2 parameters are expressed as:

$$\begin{aligned}
 \alpha_{ik} &= X_{1ik}(\gamma_1 + G_{1k}) + A_{ik} \\
 \beta_{ik} &= X_{2ik}(\gamma_2 + G_{2k}) + B_{ik} \\
 \mu_{ijk} &= \mu + M_k + Z_{1ijk}(\delta_1 + D_{1k}) \\
 \rho_{ijk} &= \rho + R_k + Z_{2ijk}(\delta_2 + D_{2k})
 \end{aligned} \tag{3}$$

To evaluate the propositions in this study, the multilevel p_2 model is used to examine advice-seeking relationships among educators in six middle schools in terms of individual and dyadic attributes, focusing on the effects of integrated professional experience, as defined above. Note that a minimum of ten Level 3 units is necessary to estimate the variance of one Level 3 random effect in the multilevel p_2 model (Zijlstra &

Van Duijn, 2005). Because the study sample comprises only six middle schools, it therefore is not possible to estimate variances for the Level 3 random effects in the analysis reported below. It is believed that the advantages of using the multilevel p_2 model to simultaneously examine advice networks from the six sample schools mitigates the issue of having few newcomers in any single school and outweighs the shortcoming of being unable to estimate Level 3 variance parameters.

Because p_2 models are very different than traditional statistical models, such as ordinary least squares regression, it is useful to describe how the results are presented and how parameters estimates are interpreted. The parameters of the p_2 model cannot be computed directly, and instead are produced using a Markov Chain Monte Carlo (MCMC) estimation algorithm. The details of MCMC estimation are beyond the scope of this discussion (see Van Duijn et al., 2004; Zijlstra, Van Duijn, & Snijders, 2005, 2006 for discussion of MCMC estimation in the context of p_2 modeling), however, because of the estimation procedure, the standard errors reported with p_2 model parameters cannot be used to assess statistical significance with the same logic that one uses with ordinary least squares regression parameters. To assist in the interpretation of statistical significance, quantiles from the distributions of estimation samples are reported alongside each parameter estimate in the results tables. A 95% confidence interval is bounded by the 2.5 percentile and the 97.5 percentile values, while a 99% confidence interval is bounded by the 0.5 percentile and the 99.5 percentile values. When describing the results of the p_2 model below, the 2.5 percentile and 97.5 percentile values are reported and statistical significance is determined based on whether the percentile range overlaps zero.

The p_2 model can be characterized as a logistic regression model for dichotomous dyadic outcomes (the presence or absence of ties between two people) (Veenstra, Lindenberg, Zijlstra, De Winter, Verhulst, & Ormel, 2007). A positive effect for any given individual or dyadic characteristic can be interpreted as indicating that the characteristic increases the probability of a relationship (Baerveldt et al., 2004; Van Duijn et al., 2004; Veenstra et al., 2007). For example, a positive sender effect for *male* (where male respondents are coded as 1 and female respondents are coded as 0) would imply that males have a higher probability of seeking instructional advice than females. Similarly, a negative receiver effect for *male* would imply that males have a lower probability of being sought for instructional advice than females. A positive density effect for similarity with respect to gender (coded as 1 if both members of a dyad are male or if both are female) would imply that the probability of an advice-seeking relationship is higher in same-gender dyads than in mixed-gender dyads.

Reciprocity is a more difficult effect to interpret, as it must be understood as an interaction effect that depends on the main effects of sender, receiver, and density (Baerveldt et al., 2004). In order to distinguish the effect of a dyadic similarity measure on the occurrence of reciprocal relationships from its effect on the occurrence of any relationships, the measure must be included in the model as both a density effect and a reciprocity effect (Van Duijn et al., 2004). For example, given a positive density effect for similarity with respect to gender, a negative reciprocity effect for similarity with respect to gender implies that while the probability of advice relationships is higher for same-gender dyads than for mixed-gender dyads (as indicated by the positive density effect), the probability of reciprocal advice relationships in same-gender dyads is reduced

(Lazega & Van Duijn, 1997). Recalling that reciprocal dyads can either be mutual or null, this pattern of results would suggest that the increased probability of relationships in same-gender dyads would manifest as asymmetric dyads.

Results

Advice-Seeking in School Staff Networks

Table 2.3 presents network activity statistics for the three integrated professional experience categories. The average number of colleagues nominated by advice-seekers (outbound advice ties) and the average number of times individuals were nominated by their colleagues (inbound advice ties) were computed for each category.⁵ With regard to outbound advice ties, the results suggest that novice newcomers and experienced newcomers reported the same number of advice-seeking nominations, $t(92) = 0.05$, $p = 0.96$, and both groups reported more advice-seeking nominations than incumbents. However, the differences between novice newcomers and incumbents, $t(310) = 0.49$, $p = 0.62$, and between experienced newcomers and incumbents, $t(316) = 0.47$, $p = 0.64$, were not statistically significant.

Table 2.3: Mean number of ties sent and received by members of each integrated professional experience category

	Novice Newcomers	Experienced Newcomers	Incumbents
All Respondents & Schools			
Mean number of out-nominations	3.95 (3.00)	3.92 (2.81)	3.67 (3.58)
Mean number of in nominations	1.84 (2.03)	3.34 (3.66)	3.73 (3.75)
N (teachers, staff, and administrators)	44	50	268

Note: Standard deviations in parentheses.

The situation is quite different when examining inbound advice ties. When it came to being named by one's advice-seeking colleagues, novice newcomers received significantly fewer nominations than either experienced newcomers, $t(92) = -2.41$, $p = 0.02$, or incumbents, $t(310) = -3.26$, $p = 0.001$. Moreover, although the results indicate that experienced newcomers also received fewer advice-seeking nominations than incumbents, the difference was not significant, $t(316) = -0.68$, $p = 0.50$). The data also show that novice newcomers receive significantly fewer advice-seeking ties than they send, $t(40) = 3.67$, $p < 0.001$, while the difference between in-nominations and out-nominations is not statistically significant for experienced newcomers, $t(47) = 1.03$, $p = 0.31$, or incumbents, $t(260) = -0.22$, $p = 0.82$. With the exception of the mean number of outbound advice-seeking ties, experienced newcomers appear more similar to incumbents than to novice newcomers.

Table 2.4: Density of directed ties between integrated professional experience categories (average over six schools)

	Novice Newcomers	Experienced Newcomers	Incumbents	Experience Unknown
Novice Newcomers (n = 44)	2.93	5.17	6.09	3.76
Experienced Newcomers (n = 50)	2.35	4.46	5.42	2.24
Incumbents (n = 268)	2.67	4.83	6.47	2.97
Experience Unknown (n = 34)	0.00	0.00	0.12	0.00

Rows represent the senders of advice ties while columns represent the receivers of advice ties. The average overall network density for the six sample schools was 4.98%.

Table 2.4 shows advice-seeking activity within and between the three experience categories. In contrast with the degree measures in Table 2.3, which reflect ties at the individual level, Table 2.4 examines the frequencies with which advice relationships are observed between individuals in the three experience groups. The rows of the table represent the individuals who report sending advice-seeking ties, divided into the three experience categories. The columns of the table represent the individuals who receive advice-seeking ties, divided into the same three categories.⁶ Each cell of the table presents a network density measure that indicates the frequency of observed advice relationships in which individuals in the row category seek advice from individuals in the column category.⁷ For example, there were 88 possible directed ties from 11 novice newcomers (viewed as senders) to 8 experienced newcomers (viewed as receivers) in Van Buren Middle School (one of the sample schools). Of these potential ties, 5 were actually reported in the network survey. Thus, in Van Buren Middle School, the density of ties — the frequency with which advice relationships are observed — in which

novice newcomers seek advice from experienced newcomers was 5.68%. The mean frequency of directed ties from novice newcomers to experienced newcomers across all six sample schools was 5.17%, as reported in Table 2.4, while the mean frequency of directed ties from novice newcomers to incumbents was 6.09% and the mean frequency of directed ties between novice newcomers was just 2.93%. In comparison, the mean overall network density for the six sample schools was 4.98%. Thus, in general, the data suggest that novice newcomers target experienced newcomers and incumbents for advice-seeking at the expense of other novice newcomers rather than distributing their advice-seeking activity across the school staff without regard to their colleagues' level of integrated professional experience.

Table 2.4 shows that tie densities are lowest in the novice newcomers column, which represents advice ties received by novice newcomers, and highest in the incumbents column, which represents advice ties received by incumbents. Excluding the row and column for individuals whose experience was unknown, tie densities increase monotonically in each row of the table. In other words, for each category of senders, tie densities are higher for advice ties directed toward experienced newcomers than for advice ties directed toward novice newcomers, and higher still for advice ties directed toward incumbents. This pattern indicates that given the available options to seek advice from colleagues in each of the three integrated experience categories, individuals are more likely to seek advice from people with more integrated professional experience. As expected, the highest tie density occurs between incumbents who, unique among the experience categories, seek instructional advice from their same-category peers at a higher rate than they seek advice from members of

the other categories. In general, the pattern suggests that ties tend to be directed upwards in the experience hierarchy. These results are consistent with the hypothesis that novice newcomers will receive fewer advice-seeking nominations than their more-experienced colleagues, though they are equivocal with regard to the proposition that experienced newcomers are similar to incumbents in the advice-seeking network.

The results in Table 2.3 and Table 2.4 are generally consistent with Hypothesis 1 and Hypothesis 2. Novice newcomers are more likely than incumbents to send advice-seeking ties and less likely than either experienced newcomers or incumbents to receive advice-seeking ties. Further, although experienced newcomers appear as likely as novice newcomers to send advice-seeking ties, which is contrary to expectations, they are as likely as incumbents to receive advice-seeking ties, which was predicted. Although these results are suggestive, they do not account for any other individual characteristics of senders and receivers of advice-seeking ties, and they do not account for dependencies in the network data. The next section presents the results of the multilevel p_2 model, which is used to examine the role of integrated professional experience in schools' instructional advice networks while taking into account the dependency between senders and receivers of advice ties and controlling for individual and dyadic characteristics (Van Duijn et al., 2004; Zijlstra et al., 2006).

Table 2.5: Parameter estimates of an unconditional multilevel p_2 model predicting instructional advice relationships among members of the school staff

	Parameter estimates		Quantiles from sample sequence			
	Mean	SE	0.5	2.5	97.5	99.5
Structural factors						
Density fixed effect (μ)	-4.31	0.10	-4.59	-4.50	-4.12	-4.07
Reciprocity fixed effect (ρ)	2.94	0.14	2.59	2.68	3.21	3.30
Individual-level random effects						
Sender (nominator) variance (σ_A^2)	1.40	0.16	1.02	1.10	1.73	1.86
Receiver (nominee) variance (σ_B^2)	1.25	0.14	0.92	0.99	1.55	1.66
Sender-receiver covariance (σ_{AB})	-0.33	0.11	-0.61	-0.54	-0.13	-0.06

Burn-in length and sample size for the Markov Chain Monte Carlo estimation algorithm were 6,000 and 10,000 respectively. Significance levels are not indicated for density and reciprocity fixed effects or for sender and receiver variance effects because those parameters cannot be omitted from the p_2 model (Van Duijn, Snijders, & Zijlstra, 2004).

Modeling the Likelihood of Advice Relationships in School Staff Networks

Table 2.5 presents the results of an unconditional multilevel p_2 model, which includes no predictors for instructional advice relationships and thus provides baseline estimates for the density and reciprocity fixed effects (μ and ρ from equations 2 and 3, above) as well as the sender and receiver variance parameters (σ_A^2 , σ_B^2 , and σ_{AB}). The negative estimate for the density fixed effect indicates that network density across the sample schools was below 50%. The positive reciprocity fixed effect is consistent with expectations (Van Duijn et al., 2004) and reflects an overall tendency for dyads to be reciprocal (mutual or null). In the empty model, sender variance is slightly larger than receiver variance. The larger sender variance may reflect the fact that there are some respondents who, as senders, nominate many colleagues as targets for advice seeking

while non-respondents are included in the model as senders with zero outbound ties. This is in contrast with the lower receiver variance, which suggests that inbound advice nominations are more evenly distributed across individuals in the sample schools. The covariance of sender and receiver effects is negative, suggesting that the more a person seeks advice, the less likely it is that the person's advice will be sought by others.

The final p_2 model is presented in Table 2.6. Several predictors that were proposed as control variables for individuals' tendency to send or receive advice-seeking ties were not found to be statistically significant in preliminary models (not shown) and were omitted from the final model. Specifically, neither the frequency with which respondents reported reviewing district academic standards nor the frequency with which respondents reported reviewing curricular materials were associated with the tendency to send advice-seeking ties. In addition, neither the frequency with which respondents reported reviewing curricular materials nor respondents' self-assessed collective responsibility were associated with the tendency to receive advice-seeking ties.

Table 2.6: Parameter estimates of a multilevel p_2 model predicting advice relationships as a function of individuals' integrated professional experience

	Parameter estimates		Quantiles from sample sequence			
	Mean	SE	0.5	2.5	97.5	99.5
Nominator factors						
Novice newcomer	0.71**	0.21	0.11	0.29	1.07	1.29
Experienced newcomer	0.33*	0.18	-0.03	0.01	0.70	0.81
Self-assessed collective responsibility	0.05	0.04	-0.03	-0.02	0.16	0.18
Nominee factors						
Novice newcomer	-0.85**	0.26	-1.43	-1.32	-0.36	-0.28
Experienced newcomer	-0.28*	0.16	-0.65	-0.61	-0.02	0.05
Teaches English / language arts	0.22	0.12	-0.07	-0.01	0.50	0.55
Teaches mathematics	0.46**	0.12	0.16	0.23	0.68	0.72
Reviews district standards	0.30**	0.05	0.13	0.20	0.40	0.44
Dyadic density factors						
Same IPE category	0.21	0.11	-0.10	-0.02	0.41	0.51
Same professional role	1.17**	0.22	0.45	0.73	1.58	1.68
Same subgroup	1.96**	0.22	1.37	1.51	2.36	2.47
Different gender	-0.25**	0.07	-0.44	-0.39	-0.13	-0.09
Dyadic reciprocity factors						
Same subgroup	-1.21**	0.42	-2.42	-2.11	-0.39	-0.07
Structural factors						
Density fixed effect (μ)	-5.43	0.22	-6.02	-5.94	-5.05	-4.83
Reciprocity fixed effect (ρ)	3.30	0.16	2.94	3.01	3.62	3.68
Individual-level random effects						
Sender (nominator) variance (σ_A^2)	0.87	0.14	0.58	0.63	1.16	1.25
Receiver (nominee) variance (σ_B^2)	0.75	0.10	0.52	0.57	0.96	1.04
Sender-receiver covariance (σ_{AB})	-0.45	0.09	-0.71	-0.63	-0.29	-0.25

Covariate effects for density and reciprocity are symmetric similarity and difference effects. Burn-in length and sample size for the Markov Chain Monte Carlo estimation algorithm were 8,000 and 40,000 respectively.

* $p < 0.05$, ** $p < 0.01$ based on sample sequence distributions. Significance levels are not indicated for density and reciprocity fixed effects or for send and receiver variance effects because those parameters cannot be omitted from the p_2 model (Van Duijn, Snijders, & Zijlstra, 2004).

The model presented in Table 2.6 predicts the likelihood of advice-seeking ties between two colleagues as a function of sender characteristics, receiver characteristics, and dyadic characteristics determined by sender-receiver similarities. The model includes parameters for investigating the effects of integrated professional experience at level two and level one of the p_2 model. At level two, the individual sender and receiver level, the model includes dummy variables for being a novice newcomer or an experienced newcomer, with incumbents as the reference category. At level one, the dyad level, the model includes a similarity measure that reflects whether the two individuals in a dyad are in the same integrated professional experience category. The model controls for self-assessed collective responsibility as a predictor of an individual's propensity to send advice-seeking ties, and controls for being an RWLA or math teacher and for the frequency with which one reviews district academic standards as predictors of an individual's propensity to receive advice-seeking ties. For density effects at the dyad level, the model controls for the two individuals to be in the same cohesive subgroup, to have the same professional role in the school, and to share the same gender. (Strictly speaking, a gender *dissimilarity* measure is used at the dyad level, coded 0 for same-gender dyads and 1 for different-gender dyads.) Finally, the *same subgroup* measure is included as a covariate for reciprocity effects at the dyad level.

After controlling for these factors, being a novice newcomer in the school is associated with a higher likelihood of seeking instructional advice in comparison with incumbents, mean = 0.71, 2.5 percentile = 0.29, 97.5 percentile = 1.07. This result is statistically significant. The effect is smaller for experienced newcomers. When compared with incumbents, being an experienced newcomer is associated with a higher

likelihood of seeking instructional advice, mean = 0.33, 2.5 percentile = 0.01, 97.5 percentile = 0.70, a result that is also statistically significant. Taken together, these results suggest support for Hypothesis 1. With regard to being sought by advice seekers, being a novice newcomer is associated with a lower likelihood of receiving a tie in comparison with incumbents, mean = -0.85, 2.5 percentile = -1.32, 97.5 percentile = -0.36. Again, based on the distribution of samples from the sample sequence, this effect is statistically significant. Moreover, experienced newcomers are less likely to receive an advice-seeking tie than are incumbents, mean = -0.28, 2.5 percentile = -0.61, 97.5 percentile = -0.02. This difference is also statistically significant. These results suggest support for Hypothesis 2. At the dyad level, the positive density effect of two people being members of the same integrated professional experience category was not statistically significant, mean = 0.21, 2.5 percentile = -0.02, 97.5 percentile = 0.41. Therefore, Hypothesis 3 is not supported.

Because of the way the p_2 model controls for network dependencies, the parameters of the multilevel p_2 model cannot be expressed in terms of odds ratios (Veenstra et al., 2007). However, by entering the parameter estimates from Table 2.6 into the model as expressed in equation (1), it is possible to examine how the model parameters affect the probabilities of the four dyad outcomes. Table 2.7 presents the expected dyad probabilities of instructional advice relationships for pairings of individuals across the three integrated professional experience categories and for different levels of the *same role* and *different gender* density parameters. A separate analysis (not shown) indicated that the probability of null ties was greater than 85% for dyads involving individuals in different subgroups, so Table 2.7 was constructed for

same-subgroup dyads only (*i.e.*, the *same subgroup* parameter was fixed at a value of one). Additional assumptions that apply to Table 2.7 are: (1) level-two random effects are ignored, hence these are expected probabilities for ‘average’ individuals in the categories specified in the table; (2) the sender effect for *self-assessed collective responsibility* and the receiver effect for *reviews district standards* are fixed at the study sample population means, so, again, the table reflects ‘average’ individuals with respect to these parameters; (3) the receiver *RWLA teacher* and *math teacher* effects are fixed at zero, hence the table does not reflect the increased probability of receiving ties for RWLA and math teachers.

Table 2.7: Expected dyad probabilities of instructional advice relationships assuming same-subgroup dyads

Two-by-two cell block entries in the table below show the probabilities associated with these (Y_{ij}, Y_{ji}) dyad outcomes, with rows representing person i and columns representing person j :

(0,0) (0,1)
(1,0) (1,1)

(Probabilities in the cell blocks may not sum to 1 due to rounding.)

Integrated professional experience	Same professional role						Different professional role					
	Novice newcomer		Experienced newcomer		Incumbent		Novice newcomer		Experienced newcomer		Incumbent	
Same gender												
Novice newcomer	0.43	0.13	0.46	0.08	0.45	0.05	0.80	0.07	0.81	0.04	0.79	0.03
	0.13	0.31	0.20	0.27	0.25	0.25	0.07	0.05	0.11	0.04	0.14	0.04
Experienced newcomer	0.46	0.20	0.36	0.13	0.44	0.09	0.81	0.11	0.75	0.08	0.80	0.05
	0.08	0.27	0.13	0.38	0.17	0.30	0.04	0.04	0.08	0.08	0.10	0.05
Incumbent	0.45	0.25	0.44	0.17	0.38	0.13	0.79	0.14	0.80	0.10	0.77	0.08
	0.05	0.25	0.09	0.30	0.13	0.36	0.03	0.04	0.05	0.05	0.08	0.07
Different gender												
Novice newcomer	0.53	0.12	0.55	0.07	0.54	0.05	0.84	0.06	0.85	0.03	0.84	0.02
	0.12	0.23	0.18	0.19	0.24	0.18	0.06	0.04	0.09	0.03	0.11	0.03
Experienced newcomer	0.55	0.18	0.45	0.13	0.53	0.09	0.85	0.09	0.81	0.07	0.84	0.04
	0.07	0.19	0.13	0.29	0.16	0.22	0.03	0.03	0.07	0.05	0.08	0.03
Incumbent	0.54	0.24	0.53	0.16	0.47	0.13	0.84	0.11	0.84	0.08	0.82	0.07
	0.05	0.18	0.09	0.22	0.13	0.27	0.02	0.03	0.04	0.03	0.07	0.05

Predictions shown in this table are based on the multilevel p_2 model results shown in Table 2.6 with the following assumptions: (1) All values are for same-subgroup dyads, hence the *same subgroup* density effect is a factor throughout this table. (2) Level-two random effects are ignored. (3) Values for the sender *self-assessed collective responsibility* effect and the receiver *reviews district standards* effect are fixed at the study sample population means. (4) Values for the receiver *RWLA teacher* and *math teacher* effects are fixed at zero.

Despite the limiting assumptions described above, Table 2.7 is useful for understanding how the p_2 model offers insights into network structures. Each two-by-two cell block in Table 2.7 shows the probabilities of each possible dyad outcome for specific pairings of individuals. For example, given a dyad comprising a novice newcomer and an experienced newcomer who are in the same subgroup and have the same role and gender, the model presented in Table 2.6 predicts a 20% probability of an asymmetric dyad with an advice tie directed from the novice newcomer to the experienced newcomer, but only an 8% probability of an asymmetric dyad with an advice tie directed from the experienced newcomer to the novice newcomer. Moreover, for that pairing, there is a 46% chance of a null dyad (no ties), and a 27% chance of a mutual dyad (each seeks advice from the other). This pattern of dyad probabilities is repeated throughout the table. For asymmetric dyads involving individuals with different experience levels, it is always more likely that a tie will be directed from the less experienced individual to the more experienced individual, and — with the sole exception of dyads involving same-gender, same-role experienced newcomers — reciprocal dyads are always more likely to be null than mutual. Looking across the two-by-two cell blocks, one can see that the likelihood of an incumbent seeking advice from a novice newcomer is even lower than the likelihood of an experienced newcomer seeking advice from a novice newcomer. There is only a 5% chance of observing a same-gender, same-role asymmetric dyad in which an incumbent seeks advice from a novice newcomer, and only a 25% chance of mutual advice-seeking in such a dyad.

Discussion and Conclusion

This study was motivated by the question of how newcomers establish relationships when entering an organization in which incumbents operate in existing social networks. Prior research suggests that newcomers' network relationships play an important role in the processes of learning about and adjusting to organization (Morrison, 2002b), and points to newcomer information seeking activity as a key component of that process (Miller & Jablin, 1991; Morrison, 1993, 2002a). This study adds to that work by investigating the link between features of the information seeking process and the kinds of relationships that newcomers are able to form. Building on the idea that individuals vary in their need for and ability to contribute technical information about teaching, this study examined three hypotheses about how previous experience is associated with patterns of technical information-seeking relationships among novice newcomers, experienced newcomers, and organizational incumbents. To test the three hypotheses, the study applied network analysis techniques to cross-sectional data from six middle schools to examine patterns in the information-seeking networks among members of the schools' teaching and administrative staffs.

Across the six sample schools, the pattern of technical information-seeking relationships differed among novice newcomers, experienced newcomers, and incumbents. Specifically, an analysis of who seeks technical information and who is sought out for technical information suggested that novice newcomers and experienced newcomers are more likely than incumbents to seek technical information, while novice newcomers are less likely than either experienced newcomers or incumbents to be sought out for technical information. An analysis of the frequency with which

relationships were realized between individuals with different experience levels complemented those findings, revealing that novice newcomers are sought out for technical information at a lower rate than would be observed if information-seeking relationships were randomly distributed, and that in general, individuals of all experience levels tend to direct their technical information-seeking ties toward more-experienced colleagues.

While these findings alone are revealing, the multilevel p_2 model provides the strongest evidence by accounting for dyadic dependencies in the network data and controlling for individual and dyadic characteristics. The results of the p_2 model suggest that novice newcomers are more likely than either experienced newcomers or incumbents to seek technical information, while experienced newcomers are more likely than incumbents but less likely than novice newcomers to seek technical information. Moreover, experienced newcomers are less likely than incumbents to be sought by colleagues for technical information, while novice newcomers are less likely than either experienced newcomers or incumbents to be sought by colleagues for technical information.

These findings illustrate the role that previous professional experience plays in structuring a newcomer's position in the organization's technical information-seeking social network. Like novice newcomers, experienced newcomers are more likely than incumbents to seek advice from colleagues, though the difference is not as large for experienced newcomers as for novice newcomers. And, like novice newcomers, experienced newcomers are less likely than incumbents to be sought out for advice, although again, the difference is not as large for experienced newcomers as for novice

newcomers. These results are consistent with the idea that technical information comprises information that relates to the general teaching profession and information that relates to teaching in the context of a specific school organization. Experienced newcomers enter the school organization with general technical information that results in them behaving more like incumbents than novice newcomers with regard to technical information-seeking activity. They may seek technical information less than novice newcomers because they are primarily focused on acquiring school-specific technical information, and they may be sought out for technical information more than novice newcomers because they possess general technical information that is of value to all their colleagues.

These differences between experienced newcomers and novice newcomers may lead to an advantage for experienced newcomers in the process of adjusting to their new schools. As noted previously, organizational newcomers tend to obtain technical information through direct inquiry while referent information and normative information are obtained through observation and inference (Morrison, 1993). The results of this study suggest that experienced newcomers are more similar to incumbents than to novice newcomers with regard to how they seek and supply technical information about teaching. Experienced newcomers interact with incumbents at a higher rate than do novice newcomers, and overall are as likely to receive advice-seeking ties as they are to send advice-seeking ties. Because experienced newcomers have more opportunities than novice newcomers to interact with colleagues — and particularly incumbents — while exchanging technical information about teaching, they are likely to have more and richer opportunities to observe incumbents and gather the

referent and normative information they require while adjusting to the organization. In other words, by having more to contribute to a technical information exchange in their schools' social networks, experienced newcomers may be in a better position to acquire all three kinds of information that facilitate their adjustment to the organization.

This is potentially an important implication, particularly with regard to the design of new teacher induction programs. Specifically, it may be that an effective configuration for a beginning teacher induction program would neither group experienced newcomers in with novice newcomers and treat the two camps as equals, nor isolate novice newcomers from experienced colleagues who are also new to the school and in need of referent and normative information associated with the organization. In particular, isolating novice newcomers from experienced newcomers restricts the ability of novice newcomers to benefit from the enhanced access that experienced newcomers may have to the referent and normative information that both parties require. This issue requires further study, as the present investigation did not have access to data on newcomers' acquisition of referent and normative information. The data used in this analysis were limited to advice-seeking activity leading to exchanges of technical information (*i.e.*, instructional advice) among the school staffs, and it was not possible to examine the extent to which newcomers use interactions in the instructional advice networks to acquire referent or normative information about their organizations, nor was it possible to investigate whether novice newcomers and experienced newcomers benefit differentially from such opportunities. If it could be shown that experienced newcomers acquire referent and normative information faster or more efficiently than novice newcomers, it would then be necessary to investigate

whether experienced newcomers can serve as suppliers of those types of information for novice teachers through interactions that are linked to the organizational entry process. Additional research could extend this analysis further to examine whether any of the advantages suggested here for experienced newcomers are associated with outcomes that are linked to successful organizational socialization, such as performance, organizational commitment, and turnover (Bauer et al., 2007).

The discussion in this chapter emphasizes positive aspects of the network of information-seeking relationships among organizational members. At the individual level, such relationships are an important source of information that newcomers need in order to be successful. At the organizational level, the network of relationships among organizational members supports the socialization of newcomers which may, in turn, yield favorable outcomes, such as increasing newcomers' commitment to staying with the organization. However, it is important to note that social ties and their consequent network structures need not be advantageous to either individuals or organizations in all circumstances. For example, information-exchange ties can transmit faulty or redundant information as well as useful information, creating a challenge for individuals and organizations who need to make judgments about the quality of information transmitted across the network (Adler & Kwon, 1999). Moreover, while individuals may benefit from obtaining useful information from network contacts, they may incur costs in the form of lost productivity due to the time and effort required to provide help to others, to maintain the ties on which they rely, and to convince others to provide needed help (Hansen, Podolny, & Pfeffer, 2001). To the extent such costs are excessive, they might outweigh any benefits that could be extracted from the network.

The overall structure of a social network can also have positive or negative implications, depending on context. While a dense network may reinforce social norms and facilitate trust and cooperation among members of the organization, the same configuration may also be “a source of rigidity that hinders the coordination of complex organizational tasks” (Gargiulo & Benassi, 2000, p. 183).

The study reported here points to several additional opportunities for future research. For example, although these results suggest a link between professional experience and the advantage of entering a new organization with general knowledge about one’s profession, the analysis was based on a small sample of schools and a small number of new organizational entrants. Future research should investigate the phenomenon of novice and experienced newcomer network formation with a larger sample. One benefit of working with a larger sample would be the possibility of defining narrower experience ranges. In the present study, the experience ranges were defined broadly to ensure that each newcomer category would have a sufficient number of members over the six sample schools. With a larger sample, it would be possible to investigate more nuanced questions about the relationship between newcomer experience, organizational tenure, and network formation. For example, how many years of prior experience does one need to gain an advantage over other newcomers during organizational entry? A larger sample could also allow consideration of the fourth category that was omitted from this study: the novice incumbent. What are the characteristics of their network relationships? Do novice incumbents look more like novice newcomers, experienced newcomers, or experienced incumbents? Alternatively, what is the relative importance of professional experience and organizational tenure in

determining the structure of one's information-exchange relationships in an organization? A third issue relates to the fact that the information-exchange network studied here is only one type of network that exists in organizations. Although information exchange networks may function as a principal medium by which newcomers access technical information, referent and normative information may actually be conveyed through other networks, such as friendship networks or influence networks. Future research is needed to determine how newcomers develop each of their networks during their entry into an organization, and the role each network plays in facilitating organizational adjustment. Finally, this study was an analysis of cross-sectional data, but a longitudinal analysis is needed to better understand how one's relationships in an organizational network evolve as one simultaneously gains professional experience and organizational tenure.

Notes

¹ Although the argument here suggests that incumbents will generally have no need for referent and normative information, there are certainly occasions when that is not the case. For example, in the period following the arrival of a new principal who initiates a change in the way teachers are evaluated, newcomers and incumbent teachers are apt to experience a similar deficit of referent and normative information and will look to each other for guidance.

² When multiple name generators are presented, the first presentation of the name generator is novel while subsequent presentations follow the pattern established by the first. Satisficing, in which respondents provide information that they believe satisfies the request but that “is not a complete, optimally considered response” (Pustejovsky & Spillane, 2009, p. 223), occurs when respondents use the precedent set by their responses to the first name generator as a basis for deciding what is a sufficient response to the second name generator. Question-scope redefinition occurs when “a respondent relies on contextual clues from the first name generator to understand the pragmatic meaning of the second generator” (Pustejovsky & Spillane, p. 223).

³ Throughout the analysis, the term *sender* will refer to individuals who, in their survey responses, reported seeking instructional advice from colleagues, while the term *receiver* will refer to the individuals from whom instructional advice was sought. The terms reflects the directional nature of advice-seeking relationships.

⁴ Data for the crystallized sociogram were generated using KliquesFinder (Frank, 1995, 1996). Coordinates for placing nodes in the crystallized sociogram were imported into Pajek where data on experience and professional role were incorporated into the figures. The detailed figure maintains the arrangement of nodes within subgroups as determined by KliquesFinder’s multidimensional scaling procedure, while the inset figure represents the arrangement of the subgroups. The circles in the main diagram were added in Photoshop to highlight the clustering of the subgroups and have no dimensional relation to the rest of the layout.

⁵ Out-degree calculations include measures from all individuals who participated in the network survey and nominated zero or more colleagues, while in-degree calculations include measures for all staff members from each participating school. In other words, non-respondents were excluded from out-degree calculations but were not excluded from in-degree calculations. This reflects the fact that respondents were free to nominate any of their colleagues, including non-respondents.

⁶ To provide a complete picture of the available network data, the table also includes a row and column for individuals whose integrated professional experience was unknown, typically due to partial or complete non-response to the 2007 network survey.

⁷ More specifically, within- and between-group densities were computed for each of the six sample schools, and the means across the six schools are reported in Table 4.

CHAPTER 3

**Never Disconnected: Social Networks and Trust Among
Middle School Staff Members**

When you're a Jet, you're a Jet all the way
From your first cigarette to your last dyin' day.
When you're a Jet if the spit hits the fan,
You've got brothers around, you're a family man!
You're never alone, you're never disconnected!
You're home with your own: when company's expected,
You're well protected!
Then you are set with a capital J,
Which you'll never forget till they cart you away.
When you're a Jet, you stay a Jet!

Stephen Sondheim
West Side Story, "Jet Song"

The message is fairly explicit in the opening number from *West Side Story*: join the Jets and the Jets will take care of you. The message rings out to all those who do not enjoy the bond of the Jets: put your trust in this gang, and you will never be alone. The spirit and unity of the gang's members was captured in the energy of Leonard Bernstein's music and the conviction of Stephen Sondheim's lyrics.

Yet from the very beginning of *West Side Story*, there is tension in the ranks. As the Jets plan to challenge their rivals, the Sharks, the Jets' leader, Riff, must convince the gang's members to trust Tony, who appears to have turned his back on the Jets. The newer Jets are skeptical; they don't know Tony and have little direct experience with him. They are aware of his reputation, but their experience with the Jets provides

conflicting evidence. Tony has not been around enough for them to know where his loyalties lie; he is working a job that keeps him off the streets. Not knowing whether Tony is committed to the cause, they are not prepared to trust him. In contrast, veterans of the gang know Tony well... but they also know that he spends less and less time with the Jets. Riff's argument is simple. Tony is a Jet; therefore Tony is to be trusted by all Jets. Based solely on Riff's conviction and Tony's affiliation with the Jets, all Jets are expected to entrust their safety and, in fact, their lives to Tony. For a young gang member who has only recently joined the group or a veteran who has seen Tony drift away from his former friends, that is a particularly tall order.

People are often required to place their trust in members of a group with whom they have little or no prior experience (McKnight, Cummings, & Chervany, 1998). Further, while a person may, in short order, become familiar with one or more of the group's members, it is clearly possible to be in situations where knowledge about and experience with the group as a whole is limited or nonexistent (Meyerson, Weick, & Kramer, 1996). When one is faced with situations in which trust must be extended to a group and its members, what is the basis for establishing trust and how does trust subsequently evolve? Research suggests that a person may extend trust to new people who are connected to someone the person already knows and trusts (Kramer, 1999; Uzzi, 1997). If this is true, how does the network of ties that connects members of a group inform an individual's perceptions of the trustworthiness of the group and the group's leadership? The issue of how individuals develop trust in their colleagues is important because many critical functions are performed in organizations where individuals have direct trust relationships with some members of the group and

indirect trust relationships — mediated principally by common group membership — with others (Nugent & Abolafia, 2006). For example, the life of a crewmember on an aircraft carrier flight deck is highly vulnerable to the actions of others, and the group's safety and success depends on a high degree of trust among its members (Weick & Roberts, 1993). Closer to home, studies have shown that trust among members of school staffs has been positively linked to teacher retention, the successful implementation of school improvement efforts, and the academic success of students (Allensworth et al., 2009; Bryk & Schneider, 1996, 2002). In these examples, individuals depend not only on their immediate colleagues but also on the group as a whole, and the group's success can depend on the formation and maintenance of trust.

This paper examines trust among staff members in a group of middle schools, focusing on the early phase of trust formation experienced by newcomers during the first few years after organizational entry. Using a framework of relational trust in which the mechanisms of trust reflect the network of interpersonal relationships in which trust evolves, the analysis reported here examines relationships in the schools' professional advice networks and the perceptions of trust reported by members of the schools' staffs. Drawing on data from two consecutive school years, the analysis examines how advice networks are linked to changes in people's — particularly new organizational members' — perceptions of trust among teachers and trust between teachers and the principal. The paper is organized as follows. In the next section, I briefly review research on the importance of trust in schools. I then introduce a framework for examining trust, and hypotheses about how social networks are related to individuals trust in teachers and in

the principal. After then describing the research methods and results of the analysis, I discuss the implications of the findings for policy and future research.

Trust in Schools

Trust is a critical issue in education systems (Tschannen-Moran & Hoy, 2000). Scholars have examined the role of trust in relationships that link each of the key actors in school activities: principals, teachers, parents, and students. Teachers trust that their colleagues will provide support and understanding in the shared public sphere of teaching (Bryk & Schneider, 1996). In addition, teachers trust that the principal will respect their efforts and opinions, provide needed resources, and make decisions based on the students' needs and the good of the school; while principals trust their teachers to put forth their best efforts to advance student learning (Bryk & Schneider, 1996). Teachers and principals trust that parents will support their work and that students will do their best, while parents trust that schools will protect and educate their children (Bryk & Schneider, 1996; Hoy & Tschannen-Moran, 1999). The importance of this complex web of trust relationships has been verified in several key areas. Three important trust relationships — teacher-teacher, teacher-principal, and teacher-parent — were each found to be significantly associated with the success of school improvement efforts (Bryk & Schneider, 1996) and teacher retention (Allensworth et al., 2009). Moreover, trust among the adults in schools has been positively linked with the academic success of students (Bryk & Schneider, 2002). Trust in schools, as in other organizations, is believed to play a key role in leadership efforts, both among formal leaders (Burke, Sims, Lazzara, & Salas, 2007) and in the context of distributed leadership (Louis, Mayrowetz, Smylie, & Murphy, 2009).

Given the importance of interpersonal trust in so many aspects of school operations, a key concern is the establishment and maintenance of trust among new staff members following organizational turnover. Educational researchers have focused much empirical work on the issue of teacher turnover for over two decades (Ingersoll, 2001), yet the problem continues to grab headlines (Ahmed, 2009). A recent report revealed that in the Chicago Public Schools, “about half of CPS schools retained 80% or more of their teachers from 2005-06 to 2006-07,” but “about one-fifth — over 100 schools — lost more than 30% of their teachers in that one year” (Allensworth et al., 2009, pp. 10-12). On one hand, this high turnover rate can be attributed to low levels of trust among teachers, the principal, and parents (Allensworth et al., 2009). On the other hand, the high turnover rate creates a major challenge for these schools: how to maintain and, whenever possible, strengthen trust among those who remain and how to establish trust among teachers who are new to the organization. Trust, as an aspect of social acceptance, is one of several factors in the socialization process that newcomers experience when joining an organization (Bauer, Bodner, Erdogan, Truxillo, & Tucker, 2007). The extent to which trust is established among newcomers affects job performance and satisfaction, organizational commitment, intentions to remain, and turnover (Bauer et al., 2007).

But what exactly is trust? Although the literature suggests a broad consensus that trust is an important factor in many interpersonal and organizational phenomena, there seem to be as many definitions of trust as there are research projects investigating trust. Moreover, recent research has expanded the way trust is conceptualized, expanding on ideas of trust as principally a psychological state to consider trust as a

rational choice behavior or as a property of socially embedded relationships (Kramer, 1999). While many definitions of trust have been suggested, two aspects of trust are consistently cited in research that characterizes trust as a relational property: an “attitude or expectancy about other people and the social systems in which they are embedded,” and a “perceived vulnerability or risk that is derived from individuals’ uncertainty regarding the motives, intentions, and prospective actions of others on whom they depend” (Kramer, 1999, p. 571). Consistent with these characterizations of trust, this study adopts the following definition: Trust is an expectation, assumption, or belief that the future actions of another person or group “will be beneficial, favorable, or at least not detrimental to one's interests” (Robinson, 1996, p. 576), and a willingness to be vulnerable and risk that the person or group will not fulfill that expectation (Mayer, Davis, & Schoorman, 1995). This definition incorporates the two key dimensions of trust mentioned above. First, trust hinges on a belief that another person or group will act in a manner that is not at odds with one’s own interests. This belief may be supported by such factors as past experiences with the other parties, information obtained through communications with third parties, or by the trustor’s general belief in the goodness of others (Kramer, 1999). Second, the trustor accepts risk — of such things as financial loss, personal failure, or public humiliation — by willing to be vulnerable to the actions and choices of the trustees.

Although much trust research has focused on isolated trust relationships — between two actors in a trust game, between teachers as a group and parents as a group, or between an organization collectively and its leader — recent studies have begun to explicitly examine trust relationships as embedded in social networks

(Buskens, 1998; Buskens & Raub, 2002; Ferrin, Dirks, & Shah, 2006). This work extends the research on relational trust by examining how trust depends on social context. For example, if one imagines that a trustor bases a trust decision with a given trustee on knowledge about the trustee's prior interactions with some third parties, then it becomes valuable to examine how the different parties are linked, how the pattern of past interactions are structured, and how information about past interactions is transmitted. Although prior work on trust has recognized the embeddedness of social relationships, few studies have attempted to link social networks with trust decisions. In particular, Ferrin et al. (2006) noted, "most studies have focused on how trust develops as a result of occurrences within the dyad, without giving much consideration to the social context that surrounds the dyad" (p. 870).

In the next section, I introduce a conceptual framework for trust that will be used to investigate how trust develops among members of a school staff during the first few years after organizational entry. The framework draws on ideas from the substantial body of theoretical and empirical research on trust, and incorporates key ideas about the embeddedness of trust relationships in social networks. Following the description of this framework and the hypotheses that follow from it, I describe the research methods and the measure that will be used in the analysis

A Framework for Understanding Trust

Trust is one of the most frequently investigated constructs in organizational research (Bunker, Alban, & Lewicki, 2004; Kramer, 1999), and much work has been done to integrate ideas from the literature into a multidisciplinary conception of trust (Burke et al., 2007; Mayer et al., 1995; Rousseau, Sitkin, Burt, & Camerer, 1998;

Schoorman, Mayer, & Davis, 2007; Tschannen-Moran & Hoy, 2000). In literature reviews of trust research, one can find as many as two dozen distinct definitions and at least as many operationalizations of the construct (Burke et al.; Tschannen-Moran & Hoy). To make sense of the wide range of perspectives, scholars have sought to identify common themes and features. Burke et al. organized the conceptualizations of trust into three “perspectives”: trust as a trait, trust as an emergent property, and trust as a process. *Trust as a trait* emphasizes an individual characteristic, sometimes referred to as a “propensity to trust” (Mayer et al., 1995) that is relatively stable and largely unaffected by context. *Trust as an emergent property* refers to “cognitive, motivational, or emotional states that are dynamic and vary as a function of contextual factors as well as inputs, processes, and outcomes” (Burke et al., p. 609). *Trust as a process* views trust as an intervening process that moderates other behaviors, attitudes, or relationships, such as one’s willingness to communicate with others.

In the present study, trust is viewed as an emergent property that depends on the relationships a person has with others. In other words, trust is characterized as evolving and changing in different contexts depending on the interactions and experiences that unfold in those settings. The framework is presented in terms of three components of trust: referents, phases and mechanisms. *Referents* of trust, also referred to as the trustees, are the individual or collective entities to which a trustor extends trust. *Phases* of trust organize the dynamics of relational trust according to the status of a trustor’s relationships with trustees. *Mechanisms* of trust characterize the processes that drive the dynamics of relational trust within and between the phases. Each of these three properties of the trust framework is elaborated below.

Referents of Trust

Recent research has attempted to delineate trust according to the foci or referents in which an individual places trust (see, for example, Igarashi, Kashima, Kashima, Farsides, Kim, Strack, Werth, & Yuki, 2008; Tan & Lim, 2009). The notion of trust referents used in the present framework has its roots in an analysis of the many ways surveys have been constructed to measure trust (Tschannen-Moran & Hoy, 2000). The results of that analysis reveal that when people are presented with items intended to draw inferences about trust, the items are framed in one of three ways: generalized trust, collective trust, and individualized trust. Although all three referents are described here, the present study focuses only on collective and individualized trust.

Generalized trust reflects an individual's underlying propensity to trust. It is "a general belief in human benevolence" (Igarashi et al., p. 88) or "a generalized expectation about the trustworthiness of others ... a stable within-party factor that will affect the likelihood the party will trust" (Mayer et al., 1995, p. 715). Generalized trust represents a conception of trust as a personality trait. An example of a survey item that queries generalized trust is the respondent's level of agreement with the statement, "Parents can usually be relied on to keep their promises" (Rotter, 1967). In this item, the trust referent, "parents," refers to no particular parent and is not contextualized to any particular environment, organization, or situation (Tan & Lim, 2009).

In the present framework, *collective trust* is contextualized but, like generalized trust, does not refer to any particular individual. Collective trust represents a conception of trust as an emergent property rather than a stable state, and deals with trust between a trustor and a collection of others with which the trustor interacts (or

may interact) in a specified context. An example of a survey item that queries collective trust is the respondent's level of agreement with the statement, "Most of my workmates can be relied upon to do as they say they will do" (Cook & Wall, 1980). In this item, the referent, "my workmates," specifies a subgroup of people within a specific setting while not singling out any particular person or interaction. The characterization of collective trust expressed in this framework treats the organization as a collection of individuals, and the trustor is seen as extending trust to those individuals *en masse*; this is not the same as trust that an individual might extend to an organization taken as a singular entity (as in, for example, Tan & Lim, 2009), which is a scenario not explicitly included in the present study. Note also that while this view of collective trust is consistent with the framework developed by Tschannen-Moran and Hoy (2000), it is not the same as the model of organizational trust proposed by Mayer et al. (1995), which does not explicitly distinguish between individuals and collectives in its characterization of trustees.

Individualized trust reflects a person's trust in a specific individual, which may or may not be tied to a specific context. Individualized trust, like collective trust, is viewed here as an emergent property. An example of a survey item that queries individualized trust is the respondent's level of agreement with the statement, "If _____ promised to do me a favor, he/she would follow through" (Johnson-George & Swap, 1982). In contrast, a survey item such as the respondent's level of agreement with the statement, "The principal of this school keeps his or her word" (Hoy & Tschannen-Moran, 1999) implies a context-specific individualized trust to the extent that the survey focuses on respondent-principal interactions on school-related matters. In both of these items, the

trust referent is a specific, identifiable individual with whom the trustor interacts (or may interact).

Phases of Trust

The perspective of trust as an emergent state implies that trust is dynamic, changing as the interdependence in a relationships increases or decreases or as contextual factors vary (Burke et al., 2007; Tschannen-Moran & Hoy, 2000). To capture these dynamics, scholars have investigated trust in different phases of a trustor's relationship with trustees (Berg, Dickhaut, & McCabe, 1995; McKnight et al., 1998; Spector & Jones, 2004). The present framework identifies three phases of relational trust: an initial phase, a building phase, and a maintenance phase. Though the phases imply a timeline, all three phases will typically be taking place at the same time in an organizational setting. While the present study focuses only on the building and maintenance phases of relational trust, the initial phase is included in the framework to capture the initial conditions of the building phase.

The *initial phase* represents the trust that the individuals extend to others at the outset of a relationship when no prior experience with the trustees is available to inform the trustor's stance. Prior research has shown that newcomers and people who come together in 'spontaneous' work groups have a paradoxical tendency to extend high levels of trust to new colleagues despite the lack of an accumulated history of past experiences on which to base their trust decisions (Berg et al., 1995; McKnight et al., 1998; Meyerson et al., 1996). For example, it is common to see high levels of trust reported by newcomers during their early entry into an organization. This finding is

inconsistent with predictions from calculative-based or knowledge-based models of trust, which suggest that an individual will not extend trust if the potential payoff is low or if experiential knowledge about the trustee's trustworthiness is unavailable (McKnight et al., 1998). Rather, it appears that individuals base their initial trust on other factors, such as their generalized propensity to trust, their knowledge of the institutions within which a situation unfolds, or their first impressions and sense of identification with trustees (McKnight et al., 1998). Thus, the initial phase of trust can be characterized as a state of relying on generalized trust that is uninformed by knowledge and experience with the immediate context or the individuals in that setting.

In the *building phase*, initial trust gives way to the knowledge and experience one gains by interacting with trustees in a particular setting. For example, the initial trust one extends to members of a hospital staff based on a generalized trust in the hospital as an institution is informed by knowledge of the structure and operations of *this* hospital and the outcomes of specific interactions with *this* staff of nurses and physicians. The building phase functions as "a commitment period in which each partner has the opportunity to signal to the other a willingness to accept personal risk and not to exploit the vulnerability of the other for personal gain" (Tschannen-Moran & Hoy, 2000, p. 571). During the building phase, individuals have opportunities to engage in repeated interactions with colleagues and their trust evolves (Jones & George, 1998). Initial trust gives way to collective trust and individualized trust that reflect the person's experiences and interactions.

The *maintenance phase* comprises elements of trust dynamics — such as trust adjustment, trust reinforcement, betrayal, revenge, and reparation — that unfold when

some measure of collective and individualized trust has been established. When individuals have emerged from the building phase, and the initial, generalized trust has given way to trust that is grounded in knowledge and experience with a given setting, trust continues to vary with contextual factors (Burke et al., 2007). For example, “organizational dynamics can complicate trust judgments” (Tschannen-Moran & Hoy, 2000, p. 573). Organizational members come and go, roles change, and resources shift or are reassigned. During such times, individuals monitor their colleagues’ behaviors and adjust their trust judgments. In addition, people manage their own reputations for trustworthiness, as a strong reputation for trustworthiness can prevent a negative event from damaging the trust one receives from colleagues (McKnight et al., 1998). The threat of sanctions or the loss of reputation in the organization can serve as a disincentive to those who might consider violating colleagues’ trust (Frank & Yasumoto, 1998). When betrayal or other violations of trust occur, the organization may suffer from damage to the civic order and trustors may suffer from damage to their identity (Bies & Tripp, 1996). Retaliation can take the form of revenge by the individual whose trust was violated (Bies & Tripp, 1996), or the violation can be corrected if, for example, the violator acknowledges and takes responsibility for the act (Lewicki & Bunker, 1996). Finally, while these points emphasize the actions and reactions of individuals, successful trust maintenance is also important at the organizational level, as a strong sense of collective trustworthiness can be a valuable collective asset when new organizational members are in the building phase and are forming their collective trust.

Mechanisms of Trust

As noted previously, the perspective of trust as an emergent state implies that trust is dynamic. In the previous section, the dynamic nature of emergent trust was characterized in terms of three stages of trust. In this section, two mechanisms that drive trust dynamics are introduced. The present framework adopts the perspective that the experiences and interactions that shape collective and individualized trust are embedded in a social network in which actors engage in repeated interactions. Two mechanisms that have been proposed for explaining how social embeddedness affects trust are *learning* and *control* (Buskens & Raub, 2002). While aspects of these two mechanisms have been mentioned in the preceding sections, their essential features will be more clearly distinguished here.

The *learning mechanism* affects trust by enabling trustors to improve their trust decisions based on experiences from past interactions (Buskens & Raub, 2002). Learning is an accumulation of knowledge from past experience, including knowledge about other actors' "incentives beliefs and other characteristics" (Buskens & Raub, p. 7), that trustors can draw on to reduce uncertainty about present trust decisions. For example, if a person has been trustworthy in past interactions, the trustor may believe that person will be trustworthy in present and future interactions. Learning can come from the trustor's direct interactions with the trustee, through third-parties who provide information about their own interactions with the trustee, or through gossip that is communicated through the social network (Burt & Knez, 1996; Kramer, 1999; Uzzi, 1997).

The *control mechanism* affects trust by providing trustors with ways to influence the long-term incentives of the trustee and thus minimize the threat of trust violations (Buskens & Raub, 2002; Frank & Yasumoto, 1998).¹ In other words, the control mechanism affects a trustor's decision to extend trust by providing the trustor with ways to enforce trust, such as withholding trust in future transactions, taking retaliatory steps to sanction the errant trustee, or informing other actors of the trustee's betrayal thus giving them cause to withhold future trust (Buskens & Raub). The latter case — the potential for sanctions from third-party peers when actors enforce each others' trust — establishes a group norm that raises the threat to trustees and thus supports trustors' decision to trust. The control mechanism is particularly sensitive to embeddedness in the social network. On one hand, many of the threats associated with trust violations depend on the errant trustee being a member of the network with an expectation of future transactions within the network. If the trustee is not concerned about future interactions in the network, the disincentive to violate trust will be low. On the other hand, reliance on third parties depends on their commitment to the network and its norms. A person who views a reportedly errant trustee as trustworthy based on past interactions (an example of the learning mechanism) must weigh that knowledge against information about the trustee's betrayal of another party (another example of the learning mechanism) and the trustworthiness of the person reporting the betrayal when making a decision about enforcing trust through the control mechanism on which all parties rely.

Summary and Hypotheses

The previous section outlined a framework for understanding collective trust, with a focus on factors that contribute to trust formation during organizational entry. The framework defines trust in terms of three referents — generalized trust, collective trust, and individualized trust — that differ according to whether or not the referent is contextualized and whether or not the referent is an identifiable individual. Taking the perspective of trust as an emergent state that depends on a persons' interpersonal relationships, the framework organizes trust dynamics into three stages — initial, building, and maintenance — that differ in the extent to which trust decisions are based on knowledge and experience that trustors have about trustees. Finally, the framework specifies two mechanisms by which trust is affected by embeddedness in social networks — a learning mechanism and a control mechanism.

Prior research suggests that trust among teachers (teacher-teacher trust) and trust between teachers and the school principal (teacher-principal trust) are associated with teacher retention rates (Allensworth et al., 2009) and several factors that contribute to successful school reform, including school commitment, orientation to innovation, and collective responsibility (Bryk & Schneider, 1996). The trust framework outlined above points to five hypotheses about how schools' social networks impact the development and evolution of these forms of trust.

The learning mechanism suggests that trust is affected by knowledge and information gained from past direct and indirect experiences. With regard to direct experiences, Ferrin et al. (2006) found that an individual's trust in a coworker, an example of individualized trust, was positively associated with the frequency of

voluntary and cooperative behaviors performed by that coworker for the individual. In this case, the number of such interactions represents the opportunities a person has to learn from direct experience. Favorable interactions reinforce the trustor's perception of the trustee's trustworthiness. As individuals in a school gain knowledge about colleagues' trustworthiness through positive one-on-one interactions, their collective trust for colleagues may grow. This extension from individualized trust to collective trust may arise through the development of a locally contextualized role-based trust, a depersonalized trust "predicated on knowledge that a person occupies a particular role in the organization rather than specific knowledge about the person's capabilities, dispositions, motives, and intention" (Kramer, 1999, p. 578). In other words, as individuals develop trust for specific teachers in the school with whom they have experienced positive direct interactions, they may consequently develop trust for all teachers in the school. Teacher-teacher trust may be related to the number of favorable interactions people experience in their school's social networks.

Hypothesis 1: A person's collective trust in teachers (teacher-teacher trust) will be positively associated with the number of favorable interactions the person has with colleagues in the school's social network.

The learning mechanism may also affect individual's trust in teachers indirectly. Interactions with colleagues provide an opportunity for an individual to obtain information about the interactions those colleagues have with other people in the organization and about the trust colleagues' feel as a result of their experiences. In other words, in addition to providing an opportunity for exchanging information about

colleagues' experiences with others, the interactions provide a person with access to their colleagues' own feelings of trust — trust that is based on their colleagues' distillation of knowledge and information obtained through their activity in the school's network. Colleagues' trust in teachers represents information to an individual about the trustworthiness of others, and that information may influence the individual's own collective trust in teachers.

Hypothesis 2: A person's collective trust in teachers (teacher-teacher trust) will be positively associated with the teacher-teacher trust expressed by the colleagues with whom the person interacts.

The control mechanism suggests that individuals will be more inclined to trust their colleagues if they believe there are ways to enforce that trust (Buskens & Raub, 2002). Although some forms of enforcement are associated with the trustor's own opportunities for future actions — withholding future trust or retaliating against the betrayer — the trustor may also depend on the network for enforcement against trust violations. When basing trust decisions on expectations of support from third parties, “the actor's behavior is not oriented to a particular other but to the web of social networks” (Portes & Sensenbrenner, as cited in Frank & Yasumoto, 1998, p. 646). The level of trust that may exist among members of a group is associated with the density of ties among colleagues, with higher network densities leading to a higher expectation of norm reinforcement and thus a higher degree of trust (Maroulis & Gomez, 2008; Coleman, 1988). For an individual assessing the trustworthiness of colleagues, a high

density of ties among the individuals' direct interaction partners — one's egocentric density — should lead to a higher degree of collective trust among teachers.

Hypothesis 3: A person's collective trust in teachers (teacher-teacher trust) will be positively associated with the density of relationships among the colleagues with whom the person interacts.

The three hypotheses articulated above relate to the collective trust individuals feel for their teacher colleagues. However, the trust mechanisms described in the framework are expected to operate differently on the individualized trust individuals feel for their principal. The effect of egocentric density on teacher-principal trust will likely be lower or absent as compared with its effect on teacher-teacher trust because teacher-principal trust is an individualized trust involving a specific member of the network — a prominent member, to be sure — who may not be among a given individual's immediate peers and thus may not be perceived as being controllable through that individual's network of direct relationships. Similarly, although favorable interactions between an individual and the principal are certainly likely to raise the individual's trust in the principal, there is little reason to believe that the number of favorable interactions the person has with other people in the school will affect teacher-principal trust. However, interactions a person has with colleagues may affect teacher-principal trust indirectly through the learning mechanism. As noted above, interactions with colleagues provide an opportunity for a person to obtain information about the interactions those colleagues have with other people in the organization — including interactions with the principal — and information about colleagues' own level of

teacher-principal trust. As in the case of teacher-teacher trust, colleagues' trust in the principal provides information to an individual about the principal's trustworthiness. In addition, an individual with limited knowledge or direct experience with the principal may extend the trust they feel for a teacher colleague to the principal if that colleague has a high level of teacher-principal trust (Uzzi, 1997).

Hypothesis 4: A person's individualized trust in the principal (teacher-principal trust) will be positively associated with the teacher-principal trust expressed by their interaction partners.

These four hypotheses suggest associations between the social networks that connect the members of school staffs and individuals' collective trust in teachers and individualized trust in the principal. As stated, they apply equally to everyone, independent of how long a person has been working in the school. However, the framework suggests that network-related effects may be particularly strong among organizational newcomers — individuals who are in the building phase of trust. Newcomers begin with a generalized trust based on their propensity to trust and as-yet unsubstantiated expectations about their colleagues. Their initial trust has no direct connection with the specific environment of their schools. During the building phase, each interaction with colleagues provides meaningful and contextualized information to newcomers about the trustworthiness of the people in their schools, and initial trust gives way to trust that is grounded in that new knowledge. Moreover, lacking experiences from interactions with colleagues, newcomers may rely more on the structural support provided by the density of relationships among the colleagues with

whom they directly interact. In contrast, information from the network represents incremental knowledge for people in the maintenance phase of trust. Their trust in colleagues may be well-established from their past experiences, such that new information has little affect on their trust. These arguments lead to a fifth hypothesis.

Hypothesis 5: Effects associated with the network mechanisms, as expressed in Hypotheses 1–4, will be stronger for newcomers than for incumbents.

These hypotheses will be tested using longitudinal data about the advice networks among staff members in five middle schools. In the next section, I describe the methods by which the data were collected and the specific measures that will be used in the analyses.

Method

Data and Sample

The data for this investigation were collected as part of the Distributed Leadership Study. The data were collected during a longitudinal investigation of an NSF-sponsored, university-based program to improve middle school mathematics instruction, conducted in collaboration with a mid-size Midwestern urban school district. The principal goal of the Distributed Leadership project has been to develop instruments, including the social network surveys used to collect the data reported here, for identifying and documenting instructional leadership practice. Because this work is grounded in a distributed perspective on leadership, the instruments that were developed and the data that were collected focus on all members of a school's staff,

including formally-designated leaders, informal leaders, and teachers. The collection of sociometric network data in schools (as opposed to data collection focusing only on formal leaders or only on math teachers) makes it possible to use these data to investigate how social networks are related to trust in the participating middle school.

Web-based social network surveys were administered to the full teaching and administrative staffs of all ten middle schools in the collaborating school district during February and March of 2007, and again in March and April of 2008. To achieve high response rates, schools were offered an honorarium of \$400 for a response rate of 80% and higher and an honorarium of \$500 for a response rate of 90% or higher. In addition, teachers who completed the survey received a \$25 gift certificate to a national bookstore chain. To encourage participation from all members of the participating schools' staffs, principals were contacted and informed of their schools' response rates periodically during the four weeks that the web-based surveys were available.

The network surveys administered in the spring of 2007 and the spring of 2008 comprised five sets of questions covering demographics, attitudes and opinions, professional roles, informal advice networks, and qualifications / professional activities. Among the ten participating middle schools, each of which offered sixth, seventh, and eighth grade instruction, the response rate to the 2007 network survey ranged from 63% to 91%, with an overall response rate of 82%. In 2008, network survey response rates fell in nine of the ten schools, ranging from 43% to 93%, with an overall response rate of 64%. Low participation in the second wave has been attributed in part to participants' perceptions that little had changed over the course of one year. Overall, the panel data compiled from the 2007 and 2008 surveys contain a total of 775 unique individuals, with

78 observations appearing only in the 2007 wave, 93 observations appearing only in the 2008 wave, and 604 observations appearing in both waves. The sample for this study was drawn from those data and is restricted to the five schools with response rates greater than 65% for the 2008 network survey. Hence, the models reported below were conducted on data from 193 teachers for whom 2008 network and trust measures as well as 2007 trust measures were available for the network models. Information about the five sample schools, including a school-by-school breakdown of measures included in the subsequent analyses, is presented in Table 3.1.

Table 3.1: Descriptive and summary statistics for sample schools

VARIABLE	Quincy	Washington	Van Buren
Number of students	809	694	446
Percent eligible for free/reduced meals	49	21	76
Percent minority	36	10	49
Percent gifted	13	17	9
Percent English language learners	14	0	17
Percent special education	15	15	2
Percent 8th graders exceeding district math stds	82	84	65
Percent 8th graders exceeding district RWLA stds	93	94	78
Network survey response rate, overall	0.69	0.93	0.86
Network survey response rate, teachers	0.71	0.92	0.90
Network density (symmetrized networks; x100)	5.91	9.13	8.29
Total staff size	76	61	65
Teachers in analysis sample	44	42	30
Number of newcomer teachers in analysis sample	11	5	7
Measures			
2008 teacher-teacher trust (<i>TTTR</i>)	2.93 (2.87)	3.80 (2.67)	3.42 (3.23)
2007 teacher-teacher trust	3.77 (2.68)	3.88 (2.74)	3.23 (2.92)
2008 teacher-principal trust (<i>TTTR</i>)	2.49 (3.15)	6.14 (2.10)	3.13 (3.06)
2007 teacher-principal trust	3.39 (3.18)	6.38 (2.24)	3.52 (3.17)
Normalized degree (symmetrized networks; x100)	1.53 (0.87)	1.69 (1.03)	1.56 (1.26)
Weighted, lagged peer <i>TTTR</i>	3.93 (0.14)	3.89 (0.13)	3.18 (0.22)
Weighted, lagged peer <i>TPTR</i>	3.70 (0.19)	6.25 (0.11)	4.12 (0.22)
Egocentric density (symmetrized networks; x100)	33.1 (26.2)	30.3 (26.1)	26.4 (19.2)
Years at current school	10.3 (8.18)	11.0 (8.42)	10.4 (6.56)
Age	42.7 (11.2)	48.0 (9.9)	44.3 (11.5)
Collective responsibility, peers	3.02 (2.34)	3.90 (2.50)	3.44 (2.59)
Percent attending dept meetings once a week or more	45.5	14.3	86.7
Percent male	15.9	35.7	23.3
Percent with graduate degree	50.0	47.6	53.3

Standard deviations in parentheses. All measures from 2008 data unless otherwise noted.

Table 3.1: (continued)

VARIABLE	Adams	Tyler
Number of students	564	878
Percent eligible for free/reduced meals	60	9
Percent minority	26	8
Percent gifted	11	25
Percent English language learners	0	0
Percent special education	21	9
Percent 8th graders exceeding district math stds	68	93
Percent 8th graders exceeding district RWLA stds	78	97
Network survey response rate, overall	0.80	0.71
Network survey response rate, teachers	0.83	0.72
Network density (symmetrized networks; x100)	8.48	5.51
Total staff size	60	76
Teachers in analysis sample	37	41
Number of newcomer teachers in analysis sample	11	12
<i>Measures</i>		
2008 teacher-teacher trust (<i>TTTR</i>)	4.38 (2.24)	3.35 (2.13)
2007 teacher-teacher trust	4.83 (2.44)	3.26 (2.73)
2008 teacher-principal trust (<i>TTTR</i>)	3.79 (3.00)	2.03 (3.67)
2007 teacher-principal trust	4.12 (2.81)	2.70 (3.73)
Normalized degree (symmetrized networks; x100)	1.77 (1.32)	1.55 (1.05)
Weighted, lagged peer <i>TTTR</i>	4.82 (0.12)	3.26 (0.14)
Weighted, lagged peer <i>TPTR</i>	4.31 (0.16)	3.61 (0.24)
Egocentric density (symmetrized networks; x100)	28.9 (25.1)	32.7 (30.3)
Years at current school	8.70 (5.16)	7.51 (6.13)
Age	45.1 (11.2)	45.1 (10.6)
Collective responsibility, peers	3.05 (1.89)	2.87 (2.19)
Percent attending dept meetings once a week or more	62.2	82.9
Percent male	21.6	31.7
Percent with graduate degree	51.4	39.0

Standard deviations in parentheses. All measures from 2008 data unless otherwise noted.

The network portion of the survey investigated three separate advice networks: advice about teaching mathematics, advice about teaching reading, writing, and language arts (RWLA), and advice about teaching in the respondent's primary subject (if not mathematics or RWLA). Social network data were collected using a series of name generator and interpreter questions. For each kind of network, respondents were asked to name up to 15 people to whom they turned for advice about teaching "during this school year," though respondents rarely named that many colleagues. For example, the mean out-degree in 2008 among the 370 respondents who nominated at least one colleague was 4.29 (sd = 3.05). Survey items then probed the nature of the advice sought, the frequency of advice-seeking interactions, and how influential the received advice was perceived to be. For this study, networks were constructed based only on individuals nominated from within the respondents' own schools. This was to ensure that the measures linking trust to respondents' social networks were based on relationships with a common set of colleagues and interactions that took place in a common setting.

Data from the three kinds of advice networks sampled in the network survey (*math*, *RWLA*, and *other primary subject area*) were combined to create an overall matrix of relations among the members of each school staff. If a respondent named a particular colleague in more than one network, then the tie between the two actors in the combined network was assigned the highest frequency and influence values associated with all available nominations. This rule ensured that the combined network accurately reflected the overall frequency and influence associated with interactions between the two actors. For example, if respondent *A* listed person *B* in the math network and

assigned an interaction frequency of *once or twice a month* to the interaction, and also listed person *B* in the RWLA network with an interaction frequency of *once or twice a week*, then the tie from *A* to *B* in the combined network would have an interaction frequency of *once or twice a week* to reflect the fact that *A* and *B* interacted with that frequency about some aspect of instruction.

Measures

Dependent Variables

As noted previously, teacher-teacher trust and teacher-principal trust have been found to be strongly associated with teacher retention rates, school reform efforts, and student academic progress (Allensworth et al., 2009; Bryk & Schneider, 1996, 2002). In the present study, both teacher-teacher trust and teacher-principal trust were measured using a set of items that were analyzed using Rasch scale analysis (Bond & Fox, 2007). The advantage of the Rasch model is that it yields a more linear scale than the raw scores obtained from the survey items, and the Rasch model for the 2007 data can be used to “anchor” the Rasch model for the 2008 data so that the two sets of measurements can be directly compared (Bond & Fox). The items used in each of the two scales are presented below with statistics from the Rasch analyses. The first statistic included with each item is item difficulty, which estimates the likelihood that a respondent will endorse the stated position. The second statistic is the infit, which indicates the degree to which individuals’ responses to the item are consistent with its location in the hierarchically ordered scale. (Values close to 1.0 indicate responses are consistent with the hierarchical order of the items.) The third statistic shown is person

reliability, which estimates the internal consistency of the scale items and is comparable to Cronbach's alpha (Bryk & Schneider, 1996). There is considerable overlap between the scales used in this study and the scales used by Bryk and Schneider (1996) in their investigation of social trust in schools, and several direct comparisons between the two scales will be noted below.

Table 3.2: Rasch scale of teacher-teacher trust (TTTR)

Item	Difficulty	Infit (mean square)
It's okay in this school to discuss feelings, worries, and frustrations with other teachers. ^a	1.20	0.65
Teachers respect other teachers who take the lead in school improvement efforts ^a	0.99	1.10
Teachers in this school trust each other. ^a	0.86	1.08
Teachers at this school respect those colleagues who are experts at their craft ^a	0.22	0.91
Teachers at this school really care about each other. ^a	-0.84	0.84
To what extent do you feel respected by other teachers. ^b	-2.44	1.22
Person Reliability	0.86	

Survey data from 2007 was used to determine the base scale shown here, on which Rasch scales for 2008 data were anchored.

^a Six-point scale: strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree, strongly agree

^b Four-point scale: none, a little, some, a great deal

Teacher-teacher trust (TTTR). The six-items in the teacher-teacher trust scale are listed in Table 3.2. For the teacher-teacher trust scale, five of six items used by Bryk & Schneider (1996) in their investigation of trust in schools are included in the present survey, with four items using identical item wording and response scales. Only the

“teachers respect colleagues who are experts at their craft” item is unique to this scale. The overall respect item has by far the lowest difficulty statistic (-2.44), indicating this is the item most frequently endorsed by respondents. In contrast, the “discussing issues with other teachers” item has the highest difficulty rating (1.20), suggesting that although respondents feel respected and believe teachers trust each other, they may find it difficult to communicate with colleagues about problems they are having. Note, however, that the infit statistic for this item is rather low (0.65), suggesting that responses to this item tend to deviate from its position in the hierarchy. Overall, the scale used in this study appears quite comparable to the scale used by Bryk & Schneider, with the same three items receiving the three highest difficulty ratings and the caring and respect items receiving the lowest difficulty ratings. For the full analytic sample, 2008 TTTR scores ranged from -2.81 to 9.01 with a mean of 3.56 and a standard deviation of 2.65.

Teacher-principal trust (TPTR). The eight-items in the teacher-principal trust scale are listed in Table 3.3. For the teacher-principal trust scale, each of the six items used by Bryk and Schneider (1996) are included in the present survey, with identical wording and response scales. Two additional items are included here: one about the principal’s managerial effectiveness and one about the extent to which the principal places the needs of students ahead of his or her own needs. As in the Bryk & Schneider investigation, the respect item has the lowest difficulty rating. However, the “discussing issues with the principal” item, which received the highest difficulty rating in the Bryk and Schneider study, is among the bottom three items in the difficulty scale here. In fact, a key feature of the teacher-principal trust scale shown below is the relative ease

with which respondents endorse items associate with principals' sensitivity to teachers abilities, feelings, and welfare, and the difficulty with which respondents endorse items linked with principals' professional capacity — managerial effectiveness and concern about professional development. The infit statistics and the person reliability statistic seem to support this observation, as the Rasch model suggests a high level of consistency in the teacher-principal trust data. For the full analytic sample, 2008 TPTR scores ranged from -7.30 to 8.41 with a mean of 3.53 and a standard deviation of 3.35.

Table 3.3: Rasch scale of teacher-principal trust (TPTR)

Item	Difficulty	Infit (mean square)
The principal takes a personal interest in the professional development of teachers. ^a	1.07	0.95
The principal at this school is an effective manager who makes the school run smoothly. ^a	0.97	0.91
I trust the principal at his or her word. ^a	0.51	0.82
The principal looks out for the personal welfare of faculty members. ^a	-0.02	1.06
The principal has confidence in the expertise of the teachers. ^a	-0.26	1.14
It is okay in this school to discuss feelings, worries, and frustrations with the principal. ^a	-0.35	0.76
The principal places the needs of children ahead of his or her personal interests. ^a	-0.51	0.96
To what extent do you feel respected by your principal? ^b	-1.41	1.34
Person Reliability	0.96	

Survey data from 2007 was used to determine the base scale shown here, on which Rasch scales for 2008 data were anchored.

^a Six-point scale: strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree, strongly agree

^b Four-point scale: none, a little, some, a great deal

Independent Variables

Activity in the advice network. Hypothesis 1 states that a person's trust in teachers will be positively associated with the number of interactions the person has with colleagues in the school's social network. For the present analysis, the number of interactions a person has with colleagues — the person's level of activity in the network — is operationalized as the person's network degree. Degree quantifies a person's overall level of activity in a network in terms of the number of ties they have to their colleagues (Wasserman & Faust, 1994). Although the advice relationships captured in the network data are directional, the measure of a person's level of activity in the network should reflect the number of colleagues with whom the person interacts regardless of who initiated the interaction. Hence, to obtain degree measures, the combined networks (described above) for each school were symmetrized using the so-called "weak" rule — a tie exists between *A* and *B* if *A* seeks instructional advice from *B* or if *B* seeks instructional advice from *A* — and degree was computed as the total number of ties to each actor. In addition, because degree depends on the size of the network (for example, the maximum degree in a network with g nodes is $g - 1$), degree values were normalized to ensure that measures were comparable across all schools included in the analysis (Freeman, 1979; Wasserman & Faust), and the normalized degree values were multiplied by 100. The degree measures used in the analysis thus represent the proportion of colleagues in the respondent's school with whom the respondent is connected as either a sender or receiver of instructional advice. For the full analytic sample, normalized degree scores ranged from 0 to 5.22 with a mean of 1.62 and a standard deviation of 1.09.

Weighted lagged peer trust. Measures of lagged peer trust were created to model the extent to which an individual's trust (in teachers and the principal) is associated with the trust expressed by the individual's interaction partners, or peers, as suggested by Hypotheses 2 and 4. Weighted lagged peer trust measures were computed by combining the matrix of relations from the 2008 network survey with the attitudes expressed by respondents in the 2007 survey. Separate peer effects were computed for teacher-teacher trust and teacher-principal trust. Only direct contacts were included in the peer effects calculation; second-order contacts were not considered based on the assumption that their attitudes about trust would be factored into the attitudes of the respondent's direct contacts. As with degree, weighted lagged peer trust was computed based on a symmetrized advice networks to reflect all of a person's interactions, regardless of who reported the advice-seeking relationship in the network survey.

Two measures were combined to weight the contribution of each peer's trust to the overall weighted lagged peer effects: the frequency of advice interactions as specified by the person who reported the advice-seeking relationship,² and the prestige of the peer as measured by that person's in-degree (Wasserman & Faust, 1994). (Whereas a person's degree captures the total number of colleagues with whom the person shares an advice relationship, in-degree counts only those colleagues who report turning to the person for advice.) Frequency is included in the weighting factor based on the idea that a person will be more strongly affected by those with whom they have the most contact. Prestige is included in the weighting factor based on the idea that a person who is named by many people as a source of instructional advice may be particularly influential by virtue of being prestigious and being good at providing

advice (Frank, Zhao, & Borman, 2004). An advantage of constructing lagged peer effect measures — measures that use peers' prior-year attitudes — is that it eliminates the problem of network autocorrelation between the dependent trust variable and the peer effect predictors. Network autocorrelation is the situation in which variables for different actors — such as trust — are not independent across the network because the actors are directly or indirectly linked. This situation would arise if a person's trust as measured in spring 2008 were to be modeled on colleagues' trust as measured in spring 2008. By modeling 2008 trust on a measure of peers' 2007 trust, the model does not involve network autocorrelation and can be estimated with ordinary least squares regression.

For the full analytic sample, the weighted lagged peer effect for teacher-teacher trust ranged from -1.49 to 7.89 with a mean of 3.61 and a standard deviation of 2.09. The weighted lagged peer effect for teacher-principal trust ranged from -3.60 to 8.42 with a mean of 4.06 and a standard deviation of 2.86.

Egocentric network density. Hypothesis 3 states that an individual's collective trust in teacher colleagues will be positively associated with the density of relationships among the colleagues with whom the individual has a direct connection. Egocentric network density is included in the analyses as a measure of network structure, capturing the extent to which a respondent's peers are, themselves, connected in the network. As with degree, density is computed for each respondent based on symmetrized networks. To compute egocentric density, a respondent's egocentric network size is determined by counting all first-order alters with whom the respondent shared a tie in the symmetrized network. The respondent's egocentric network density

is then calculated by dividing the total number of ties between the individuals in the respondent's egocentric network³ by the total number of ties that could exist between those alters (which is a function of the egocentric network size), and multiplying the result by 100. For the full analytic sample, egocentric density ranged from 0 to 100 with a mean of 30.6 and a standard deviation of 25.8.

Newcomer status. One of the items in the network survey asked respondents to specify the number of years they had been employed at their current school. Because one of the goals of this study is to investigate the effect of social networks on the formation of trust in new school staff members, these measures were used to identify organizational newcomers. Specifically, a dummy variable was created such that a value of one was assigned to respondents who had been working in their schools for 4 or fewer years as of the spring of 2008, and a value of zero was assigned to everyone else. Hence, the models provide a means for comparing the organizational newcomers to organizational incumbents. Note that because 2007 measures are used as covariates in the analysis, the final analysis sample excludes newcomers who have only worked in the school for one year and who therefore only appear in the 2008 data. In the full analytic sample, 23.7% of respondents were organizational newcomers.

Controls. The present study examines the associations between the instructional advice networks in schools and individuals' collective trust in their colleagues and individualized trust in the principal. When modeling these relationships, a set of covariates, obtained from responses to the social network surveys, are included to control for other factors which may affect trust. First, individuals' 2007 levels of teacher-teacher and teacher-principal trust are included as baseline controls when modeling

2008 levels of teacher-teacher and teacher-principal trust, respectively. For the full analytic sample, 2007 TTTR scores ranged from -2.81 to 9.05 with a mean of 3.80 and a standard deviation of 2.72. In contrast, 2007 TPTR scores ranged from -5.10 to 8.42 with a mean of 4.05 and a standard deviation of 3.30.

Second, trust may depend on a person's beliefs about colleagues' perceived trustworthiness. Mayer et al. (1995) specified three factors of perceived trustworthiness: ability, which reflects the skills and competencies of the trustee; benevolence, which is the extent to which the "trustee is believed to want to do good *to the trustor*, aside from an egocentric profit motive" (p. 718, italics in original); and integrity, which is "the trustor's perception that the trustee adheres to a set of principles that the trustor finds acceptable" (p. 719). Because these factors were not captured in the network survey, peer collective responsibility for student learning (*CRP*), which measures the extent to which a person believes there is "a shared commitment among the faculty to improve the school so that all students learn" (Bilcer, 1997, p. 29), is used as a proxy for factors associated with perceived trustworthiness. For the full analytic sample, 2008 peer collective responsibility scores ranged from -3.32 to 8.88 with a mean of 3.25 and a standard deviation of 2.32.

Third, although the analyses model trust as a function of interactions that arise from people's advice-seeking activity, advice-seeking is not the only behavior that contributes to a person interacting with colleagues. For example, department meetings provide an organized opportunity for individuals to interact and communicate with colleagues (Bakkenes, De Brabander, & Imants, 1999). Information that could contribute to teacher-teacher and teacher-principal trust could be obtained during meetings

through direct interactions with colleagues in whom trust may be placed or from gossip or other communications that take place during meetings (Kramer, 1999). To control for the potential effects of meeting attendance on trust, the analyses include a measure of whether the respondent attended department meetings once a week or more. In the full analytic sample, 56.2% of respondents reported this level of meeting attendance.

Finally, trust in colleagues, collectively or individually, may depend on the respondent's general propensity to trust (Mayer et al., 1995). Although the present study investigates relational trust that evolves through social network mechanisms, individuals' propensity to trust is reflected in the relational trust framework in terms of the trust that people bestow during the initial phase, when they have no knowledge or experience with their colleagues in the organization (McKnight et al., 1998). Although measures of individual propensity to trust are not available, three demographic variables are included to control for the effect of individual differences: gender, educational level, and age (Mayer & Davis, 1999; Tan & Lim, 2009). In the full analytic sample, 25.8% of respondents were male, 47.9% had a graduate degree, and age ranged from 24 to 68 years with a mean of 45.1 and a standard deviation of 10.9. A fourth measure that has been used as a control in models of interpersonal trust in organizations is organizational tenure. However, tenure is omitted in the present study because the newcomer status measure, described above, is included. A control variable for respondents' ethnicity is omitted from the model because of extreme homogeneity across the sample (only 3.6% of the sample are nonwhite). Means, standard deviations, and correlations for the continuous dependent and predictor variables are shown in

Table 3.4. Additional descriptive statistics are shown in Table 3.5, while differences between newcomers and incumbents are summarized in Table 3.6.

Table 3.4: Descriptive statistics and correlations for continuous variables

VARIABLE	M	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. 2008 TTTR	3.56	2.65	—								
2. 2007 TTTR	3.80	2.72	0.62*	—							
3. 2008 TPTR	3.53	3.35	0.41*	0.33*	—						
4. 2007 TPTR	4.05	3.30	0.34*	0.52*	0.73*	—					
5. Normalized degree	1.62	1.09	0.26*	0.19*	0.17*	0.13	—				
6. Lagged peer TTTR	3.61	2.09	0.25*	0.14	0.13	0.14	0.36*	—			
7. Lagged peer TPTR	4.06	2.86	0.21*	0.12	0.38*	0.40*	0.29*	0.58*	—		
8. Egocentric density	30.56	25.81	0.06	0.08	0.05	0.09	0.17*	0.29*	0.24*	—	
9. Age	45.08	10.88	-0.02	0.04	-0.08	-0.07	-0.05	-0.09	-0.12	-0.15*	—
10. CRP	3.25	2.32	0.51*	0.37*	0.31*	0.22*	0.23*	0.09	0.16*	0.09	0.12

* $p < 0.05$

All measures from 2008 data unless otherwise noted

Table 3.5: Descriptive statistics for the analytic sample of teachers

VARIABLE	
PROFESSIONAL ACTIVITIES, BACKGROUND, and ATTITUDES	
Non-teaching roles	
Percent attending dept meetings once a week or more	56.2
Education, experience, and training	
Percent with graduate degree	47.9
Years teaching	17.48 (9.39)
Years at current school	9.57 (7.14)
DEMOGRAPHICS	
Age	45.08 (10.88)
Percent male	25.7
Percent nonwhite	3.6

Standard deviations in parentheses

All measures from 2008 data unless otherwise noted

Table 3.6: Comparison between organizational newcomers and incumbents

VARIABLES	Newcomers (Yrs@Schl ≤ 4) (n = 46)	Incumbents (Yrs@Schl > 4) (n = 148)
CATEGORY CHARACTERISTIC		
Years at current school	2.83 (1.00)	11.70 (6.92)
TRUST MEASURES		
2008 teacher-teacher trust	3.43 (2.55)	3.60 (2.69)
2007 teacher-teacher trust	3.69 (2.46)	3.84 (2.81)
2008 teacher-principal trust	3.94 (2.78)	3.41 (3.52)
2007 teacher-principal trust	4.80 (2.40)	3.82 (3.51)
NETWORK-RELATED MEASURES		
Normalized degree (symmetrized networks; x100)	1.52 (0.89)	1.65 (1.15)
Weighted lagged peer <i>TTTR</i>	3.84 (0.64)	3.83 (0.57)
Weighted lagged peer <i>TPTR</i>	4.23 (0.79)	4.47 (1.08)
Egocentric network density (symmetrized networks; x100)	34.29 (24.81)	29.40 (26.09)
CONTROL VARIABLES		
Age	38.41 (11.60)	47.17 (9.79)
Collective responsibility for student learning, peers	3.18 (2.20)	3.27 (2.36)
Percent attending dept meetings once a week or more	65.2	53.4
Percent male	17.4	28.4
Percent with graduate degree	37.0	51.4

Standard deviations in parentheses

All measures are from 2008 data unless otherwise noted

Analysis: Network Influence Modeling

Hypotheses 1 and 3 are tested using simple regression models with teacher-teacher trust as the dependent variable and degree and egocentric density as the predictors, respectively. Hypotheses 2 and 4 require additional consideration because

they suggest that an individual's teacher-teacher and teacher-principal trust are a function of other people's trust. This kind of association can be characterized as an example of social influence, a change in one person's beliefs, attitudes, or behaviors in response to information about the beliefs, attitudes, or behaviors of other actors in the person's social setting (Leenders, 2002; Marsden & Friedkin, 1993). In the context of this study, the network influence mechanism suggests that respondent's trust (in teachers and the principal) will change over time to reflect the level of trust reported by those with whom the person shares direct or indirect social relationships. In the limiting case, one possibility is that all individuals connected in a closed social system will eventually converge on a shared sense of trust (Friedkin, 2001), which may be interpreted as an indicator of the overall trustworthiness of the organization (Bryk & Schneider, 1996). Alternatively if the interactions among members of the organization create an informal subgroup structure (Frank, 1995, 1996), then a shared sense of trust may arise within different subgroups while the level of trust varies between subgroups.

Network models of social influence provide a way to investigate the changes in people's trust as a function of their interactions with colleagues. In the present study, social influence models are used to examine how individual's teacher-teacher trust and teacher-principal trust are influenced by the levels of trust reported by their colleagues. In network models of social influence, an individual's attitude is a function of the individual's own characteristics as well as the attitudes of others in the person's social network. The network effects model can be specified as follows (Leenders, 2002):

$$y = \beta_1 W y + \beta_2 X + \varepsilon$$

For a system of n actors, y is an $(n \times 1)$ vector of measures on a response variable and X is an $(n \times k)$ matrix of values on k individual covariates. The coefficients β_1 and β_2 are scalars. The elements of the $(n \times n)$ weight matrix, W , specify the strength of the connection between pairs of actors. In other words, w_{ij} indicates how influential actor j is on actor i or, alternatively, the extent to which actor i is dependent on actor j .

For the analyses in this investigation, the above model is extended in four important ways. First, as described above, the model uses a weighted, lagged measure of peer trust ($PEER_{it}$) as an independent variable when estimating the trust of actor i at time t . Second, the model includes a separate term for estimating the effect of actor i 's own lagged attitude as a control ($Y_{i,t-1}$). Third, the full model includes two additional network-related measures as independent variables: the number of peers with whom actor i is connected in the network ($DEGREE_{it}$) and the density of ties among the peers with whom actor i is connected in the network ($DENSITY_{it}$). Finally, because the data are drawn from a sample of five middle schools, school dummy variables and their interactions with model parameters are included in preliminary analyses to examine whether the network effects differ across schools. The networks effect model for teacher-teacher (or teacher-principal) trust—omitting the school dummy variables—can therefore be specified as:

$$Y_{it} = \beta_0 + \beta_1 PEER_{it} + \beta_2 DEGREE_{it} + \beta_3 DENSITY_{it} + \beta_4 Y_{i,t-1} + \beta_5 X_{it} + \varepsilon_{it}$$

with

$$PEER_{it} = \left[\sum_{j=1, j \neq i}^n w_{ij} Y_{j,t-1} \right]$$

When estimating the network effects model, it is critical to properly operationalize the weight matrix, W , in the lagged measure of peer trust. Decisions about the weight matrix must be driven by prior considerations about how influence is expected to operate in the system under investigation, as different specifications of W can lead to markedly different parameter estimates (Leenders, 2002). For this study, the weight matrix is based on the frequency with which teachers report seeking advice from their colleagues, and on the colleagues' popularity as measured by their in-degree. For all teachers j with whom teacher i does not share a direct connection, the weight matrix element w_{ij} is assigned a value of zero. Importantly, because the peer effect is based on lagged measures of peer trust, the model specified above can be evaluated using ordinary least squares regression.

Results

To test Hypothesis 1, teacher-teacher trust is regressed on degree, newcomer status (reference group is *incumbent*), and the six control variables: prior-year trust, current-year peer collective responsibility, department meeting attendance (an dummy variable with reference group "less often than once per week"), gender (an dummy variable with reference group "female"), graduate degree (an dummy variable with reference group "none"), and age. To test Hypotheses 2 and 4, teacher-teacher trust and teacher-principal trust are regressed on lagged peer teacher-teacher trust (TTTR) and teacher-principal trust (TPTR), respectively, newcomer status, and the six control variables. To test Hypothesis 3, teacher-teacher trust is regressed on egocentric density, newcomer status, and the six control variables. Finally, to test Hypothesis 5, models are re-run with interactions between the dummy variable for newcomer status and the

other model parameters. All models use versions of degree, lagged peer teacher-teacher and teacher principal trust, and egocentric network density that are centered on their respective grand means to reduce collinearity.

As noted in the previous section, the influence models for examining the association between characteristics of individuals' instructional advice networks and their trust in colleagues were written to account for the possibility that the coefficients of the model parameters varied across schools. As a first step, each model presented below was tested to determine whether there were school-specific differences in the full set of parameter estimates. Specifically, a version of each model was estimated that included (a) main effects for each covariate, (b) four dummy variables for the five schools in the sample, and (c) interactions between the school dummy variables and each of the model covariates. A Wald test was then used to test the null hypothesis that the coefficients of the set of school dummy variables and school interactions, taken together, were jointly equal to zero (StataCorp, 2007).⁴ In other words, the test examined whether data from the five schools could be described by a model containing just the main effects of the predictors and no school dummy variables. For each model involving teacher-teacher trust, the results of the tests confirmed the null hypotheses that the coefficients of the set of school dummy variables and school interactions, taken together, were jointly equal to zero. Thus, school dummy variables are omitted and teacher-teacher trust models with only main effects are reported. For the model involving teacher-principal trust, Wald tests suggested that coefficients for the subset of interactions between the school dummy variables and the control variables were jointly equal to zero, but that coefficients of the school dummy variables and their interactions

with lagged peer TPTR were not. Hence, a model of teacher-principal trust that includes interactions between school dummy variables and lagged peer TPTR is described below.

Table 3.7: Regression analyses of 2008 teacher-teacher trust (TTTR)

VARIABLES	(7-1)	(7-2)	(7-3)	(7-4)
LEARNING MECHANISM				
Degree (normalized, x100, centered)	0.202 (0.136)			0.094 (0.142)
Lagged peer TTTR (centered)		0.190*** (0.068)		0.202*** (0.074)
CONTROL MECHANISM				
Egocentric density (x100, centered)			-0.003 (0.006)	-0.008 (0.006)
ORGANIZATIONAL TENURE				
Newcomer	-0.250 (0.353)	-0.268 (0.347)	-0.297 (0.354)	-0.225 (0.348)
CONTROLS				
2007 TTTR	0.478*** (0.055)	0.470*** (0.054)	0.490*** (0.055)	0.469*** (0.055)
2008 CRP	0.359*** (0.067)	0.370*** (0.065)	0.378*** (0.066)	0.369*** (0.066)
Attends dept mtgs weekly or more	0.266 (0.288)	0.325 (0.281)	0.347 (0.289)	0.351 (0.286)
Male	-0.061 (0.336)	-0.025 (0.332)	-0.118 (0.335)	0.092 (0.335)
Graduate degree	-0.034 (0.302)	0.060 (0.299)	-0.054 (0.301)	-0.001 (0.301)
Age	-0.018 (0.015)	-0.017 (0.014)	-0.021 (0.015)	-0.017 (0.014)
Intercept	1.348	1.192	1.345	1.206
Adjusted R-squared	0.473	0.489	0.467	0.490
N	193	193	193	193

*** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses.

Modeling Teacher-Teacher Trust

Models testing the first three hypotheses for teacher-teacher trust are shown in Table 3.7. For all models in Table 3.7, the coefficients for prior-year teacher-teacher trust and same-year peer collective responsibility are positive and statistically significant. The latter result is consistent with the idea that peer collective responsibility can be used as a proxy for individuals' perceptions of colleagues' trustworthiness. The coefficient for attending department meetings weekly or more is positive and of similar magnitude to the coefficient for peer collective responsibility, though it does not reach statistical significance in any of the four models in Table 3.7. Coefficients for the three demographic variables, included in the model to control for individual differences, are small and not statistically significant, suggesting that individual differences do not explain variations that are observed in teacher-teacher trust.

The first three models in Table 3.7 regress teacher-teacher trust on each of the three network measures — degree, lagged peer TTTR, and egocentric density — separately, while the fourth model regresses teacher-teacher trust on the three network measures together. When modeled separately, both degree ($\beta = 0.08$, $p = 0.14$) and lagged peer TTTR ($\beta = 0.15$, $p = 0.005$) are positively associated with teacher-teacher trust, though only the latter is statistically significant. The beta coefficient for lagged peer TTTR suggests that a one standard deviation increase in the peer effect is associated with an increase in teacher-teacher trust of 0.15 standard deviations; other beta coefficients are interpreted similarly. In other words, people who interact with individuals who report higher levels of teacher-teacher trust are more likely to themselves express higher feelings of teacher-teacher trust. In contrast, the coefficient

for egocentric density is indistinguishable from zero. Taken separately, these results lend credence to the effect of the learning mechanism on teacher-teacher trust, but not the effect of the control mechanism. When the three measures are combined into a single model, as in Model 7-4, the coefficient for degree decreases in magnitude ($\beta = 0.04, p = 0.51$) while the coefficient for lagged peer TTTR increases slightly ($\beta = 0.16, p = 0.007$) and the coefficient for egocentric density remains essentially unchanged. Of the three network measures, lagged peer TTTR has the strongest association with teacher-teacher trust. These results support Hypothesis 2 — a positive association between a person's level of teacher-teacher trust and the level of teacher-teacher trust reported by the person's interaction partners — but do not support Hypotheses 1 or 3, which posited that teacher-teacher trust would be positively associated with a person's level of network activity and with the density of relationships among the person's interaction partners. As noted, this suggests support for the learning mechanism but not the control mechanism of relational trust.

Hypothesis 5 predicts that network effects associated with the learning and control mechanisms will be stronger for organizational newcomers than for incumbents because newcomers are expected to be in the building phase of trust while incumbents are in the maintenance phase of trust. When examining Hypothesis 5 for teacher-teacher trust, a Wald test (as described above) indicated that the coefficients for interactions between newcomer status and the three network measures were jointly equal to zero, $F(3, 179) = 0.45, p = 0.72$. A similar result was obtained for a model that included interactions between the newcomer status dummy and all model covariates, $F(3, 174) = 0.71, p = 0.70$. Because interactions with newcomer status were not

significant, the results of these analysis are not presented. The findings suggest that Hypothesis 5 is not supported for teacher-teacher trust. In other words, there is no evidence that the associations between the network measures and teacher-teacher trust were different for newcomers as compared to incumbents.

Modeling Teacher-Principal Trust

Models testing Hypothesis 4 are shown in Table 3.8. The first model in the table omits school dummy variables altogether. The second model in the table adds school dummy variables, and the third model adds their interactions with lagged peer TPTR. Note that for Model 9-2, a Wald test indicated that the four school dummy variables were jointly equal to zero, $F(4, 180) = 1.24, p = 0.30$. However, a Wald test of the school dummy variables and their interactions with lagged peer TPTR in Model 9-3 rejected the null hypothesis that the eight school-related effects were jointly zero, $F(8, 176) = 2.07, p = 0.04$.⁵ Therefore, the analysis of the teacher-principal trust model addresses the implications of between-school differences.

Table 3.8: Regression analyses of 2008 teacher-principal trust (TPTR), with school dummy variables and interactions

VARIABLES	(8-1)	(8-2)	(8-3)
LEARNING MECHANISM			
Lagged peer TPTR (centered)	0.128** (0.059)	0.112* (0.062)	0.112* (0.063)
SCHOOL MAIN EFFECTS			
School 1 (Quincy Middle School)		-0.572* (0.305)	-0.621* (0.312)
School 2 (Washington Middle School)		0.233 (0.382)	0.759* (0.413)
School 3 (Van Buren Middle School)		0.230 (0.352)	0.018 (0.355)
School 4 (Adams Middle School)		0.335 (0.311)	0.223 (0.311)
LAGGED PEER TPTR x SCHOOL INTERACTIONS			
Lagged peer TPTR x School 1 (Quincy)			0.185 (0.126)
Lagged peer TPTR x School 2 (Washington)			-0.343*** (0.115)
Lagged peer TPTR x School 3 (Van Buren)			-0.082 (0.131)
Lagged peer TPTR x School 4(Adams)			0.127 (0.127)
ORGANIZATIONAL TENURE			
Newcomer	-0.216 (0.388)	-0.189 (0.392)	-0.215 (0.390)
CONTROLS			
2007 TPTR	0.646*** (0.053)	0.625*** (0.055)	0.589*** (0.055)
2008 CRP	0.248*** (0.069)	0.244*** (0.070)	0.254*** (0.069)
Attends dept mtgs weekly or more	-1.227*** (0.317)	-1.245*** (0.369)	-1.278*** (0.365)
Male	0.492 (0.370)	0.412 (0.377)	0.352 (0.377)
Age	-0.028* (0.016)	-0.032* (0.016)	-0.029* (0.016)
Graduate degree	0.399 (0.331)	0.352 (0.334)	0.231 (0.329)
Intercept	1.833	2.171	2.426
Adjusted R-squared	0.606	0.608	0.623
N	193	193	193

*** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses.

School dummy variables are coded using effects coding, hence terms involving school dummy variables represent deviations from an overall mean.

For all models in Table 3.8, the coefficients for prior-year teacher-principal trust and same-year peer collective responsibility are positive and statistically significant. As noted previously, the results for the peer collective responsibility measures are consistent with the idea of using the measure as a proxy for individuals' perceptions of their colleagues' trustworthiness. It is worth noting that the standardized effect of peer collective responsibility on teacher-principal trust ($\beta = 0.17, p < 0.001$) in Model 8-1 is roughly half the size of the standardized effect of peer collective responsibility on teacher-teacher trust ($\beta = 0.32, p < 0.001$) in Model 7-2. This difference may reflect the fact that teacher-principal trust is an individualized trust that is only weakly captured by the peer collective responsibility measure, which represents individuals' impressions about the staff of teachers in the school.

In contrast with the models for teacher-teacher trust, the coefficient for attending department meetings weekly or more is negative and statistically significant in all versions of the teacher-principal trust model shown in Table 3.8. For example, in Model 8-3, attending department meetings at least once per week is associated with a 1.28 point reduction in teacher-principal trust ($\beta = -0.19, p = 0.001$). The learning mechanism suggests one possible explanation for this finding. It may be that information conveyed during department meetings reflects poorly on the principal with regard to one or more of the items used to measure teacher-principal trust, such as "the principal takes a personal interest in the professional development of teachers," or "the principal at this school is an effective manager who makes the school run smoothly." To the extent this is true, individuals who attend department meetings on a regular basis and are consistently exposed to that kind of information may, as the data suggest, express a

lower teacher-principal trust. Comparing this effect with the network-related effects that are the primary focus of this study, the learning that happens at department meetings may offset and reverse any positive impressions that accrue through favorable interactions in the instructional advice network.

The pattern of associations between the three demographic variables and teacher-principal trust are different than the pattern observed in the models of teacher-teacher trust. Recall that for teacher-teacher trust, each of the three demographic variables was small and indistinguishable from zero. In contrast, the coefficient for age, though small, is negative and statistically significant in the teacher-principal trust models. Moreover, the coefficients for the gender dummy variable and the graduate degree dummy variable are positive, though not statistically significant. As it happens, four of the principals in the five sample schools are male, and three of them report having a graduate degree. Although the demographic variables were included to control for individual differences because no measure of individual propensity to trust was available, the results are consistent with the idea that respondents will express higher individualized trust in their principal when the respondent and the principal have something in common, although similarity in gender and status were not previously found to predict an employee's trust in a coworker (Ferrin et al., 2006). However, there is insufficient evidence to draw definite conclusions about this issue. In fact, the average age of the five principals from the sample schools is 51.2 years (SD = 2.9), so the notion that individuals report higher teacher-principal trust when they share a characteristic with the principal is somewhat inconsistent with a negative association between respondents' age and their teacher-principal trust.

When modeled alone, without school dummy variables, lagged peer TPTR is positively associated with teacher-principal trust and statistically significant ($\beta = 0.11$, $p = 0.03$). By itself, this result provides some evidence in support of a learning mechanism operating on teacher-principal trust. However, unlike the case of teacher-teacher trust, significant between-school differences were found in the effect of lagged peer TPTR on teacher-principal trust. One possible explanation for why school-specific differences were detected for teacher-principal trust but not for any of the models of teacher-teacher trust is that teacher-principal trust is an individualized trust linked to respondents' perceptions about a specific and prominent person in the school. Whereas perceptions of teacher-teacher trust reflect interactions with many colleagues such that negative trust experiences may be countered by positive trust experiences, respondents' teacher-principal trust scores depend on perceptions about their own or their colleagues' interactions with only the principal. To the extent that principals vary in their trustworthiness, at least as perceived by teachers, school-specific differences in models of teacher-principal trust can be expected.

The third model in Table 3.8 presents the between-school differences in the effect of lagged peer TPTR on teacher-principal trust. Because effect coding was used for the school dummy variables, the intercept of the model represents the unweighted mean of the expected values of teacher-principal trust across all five schools, assuming the values of all covariates are zero.⁶ The coefficient for the main effect of lagged peer TPTR is positive and statistically significant at the .10 level ($\beta = 0.10$, $p = 0.08$). It represents the average effect of lagged peer TPTR on teacher-principal trust across all five schools. This results suggests support for Hypothesis 4; an individual's teacher-principal trust is

positively associated with the level of teacher-principal trust reported by colleagues with whom the individual interacts in the school's instructional advice network.

However, the model also reveals a significant difference in the effect of weighted lagged TPTR on teacher-principal trust in Washington Middle School as compared with the average across all schools. Specifically, the coefficient of the interaction between the Washington school dummy and lagged peer TPTR is negative and highly significant ($\beta = -0.21, p = 0.003$). The sum of the standardized main effect of lagged peer TPTR and the school-specific effect for Washington is -0.11 , suggesting an overall negative association between lagged peer TPTR and respondents' teacher-principal trust in Washington Middle School. This result implies a paradoxical situation in which a person's teacher-principal trust is *lower* when that person has interacted frequently with prestigious colleagues who previously reported a high level of teacher-principal trust. One possible explanation for this result is a ceiling effect in the scale used to measure teacher-principal trust. As can be seen in Table 3.1, respondents in Washington Middle School reported a significantly higher level of teacher-principal trust than respondents in the four other sample schools in both 2007, $t(192) = 5.56, p < 0.001$, and 2008, $t(192) = 6.23, p < 0.001$. Moreover, in both 2007 and 2008, more than one-third of all respondents in Washington Middle School reported the highest level of teacher-principal trust that could be captured by the scale used in the network survey. The paradox described here may therefore reflect a limitation in the teacher-principal trust data, though that possibility cannot be absolutely confirmed.

With regard to teacher-principal trust, Hypothesis 5 predicts that the effect of lagged peer TPTR will be stronger for organizational newcomers than for incumbents

because newcomers are expected to be in the building phase of trust while incumbents are in the maintenance phase of trust. When examining Hypothesis 5 for teacher-principal trust, a Wald test indicated that the coefficients for interactions between newcomer status and lagged peer TPTR were jointly equal to zero, $F(2, 183) = 1.20$, $p = 0.30$. A similar results was obtained for a model that included interactions between the newcomer status dummy and all model covariates, $F(7, 178) = 0.48$, $p = 0.85$. Because interactions with newcomer status were not significant, the results of these analysis are, again, not presented. The findings suggest that Hypothesis 5 is not supported for teacher-principal trust. As in the case of teacher-teacher trust, above, there is no evidence that the association between lagged peer TPTR and teacher- principal trust is different for newcomers as compared to incumbents.

Discussion

For many years, scholars from multiple disciplines have investigated trust and its role in interpersonal relationships and in organizations (Burke et al., 2007; Kramer, 1999; Mayer et al., 1995). Trust in schools — among principals, teachers, students, and parents — has been linked to the success of school operations and is an important area of research (Bryk & Schneider, 2002; Tschannen-Moran & Hoy, 2000). Using a framework of relational trust, the present study hypothesized that trust is linked to a person's embeddedness in social networks through two mechanisms called *learning* and *control*. Longitudinal data from the professional staffs in a group of middle schools were used to test four hypotheses that together suggested that the mechanisms might affect collective teacher-teacher trust differently than individualistic teacher-principal trust,

and a fifth hypothesis that suggested that the effects would be stronger for organizational newcomers than for incumbents.

The findings indicate that a person's teacher-teacher trust is positively associated with the levels of teacher-teacher trust previously reported by colleagues with whom the individual interacts directly in the advice network. In addition, although a positive association was found between teacher-teacher trust and a person's level of activity in the network, the effect was not statistically significant. These results were consistent with the first two hypotheses. However, contrary to the third hypothesis, the density of relationships among the colleagues with whom a person interacts was not found to be associated with that person's level of teacher-teacher trust. The analysis offered support for the fourth hypothesis, which suggested that a person's teacher-principal would be positively associated with levels of teacher-principal trust previously reported by colleagues with whom the person interacts directly. Finally, support was not found for the hypothesis that effects implied by the two mechanisms would be stronger for newcomers than for incumbents. However, while the findings suggest that the effects of the learning and control mechanisms do not differ as a function of one's stage of organizational tenure, the negative findings might be a result of limitations in the data, a possibility that will be discussed below.

The results of the study did not support the hypothesized association between a person's collective trust in teacher colleagues and the density of relationships among the colleagues with whom the person interacts directly. There are two possible explanations for the negative findings. First, although people tended to interact with colleagues who themselves interacted with each other, as reflected in an average

egocentric density for the teachers in the five sample schools of 31%, the actual number of colleagues with whom people shared a direct advice relationship was rather small. In fact, the median number of colleagues with whom a teacher in the sample was directly linked was 5, compared to an average staff size of 68 across the five sample schools. Thus, even if a person's socially proximate peers interacted with one another at a very high rate, that person may perceive that the small number of directly connected colleagues is insufficient to enforce trust. An alternative formulation of enforceable trust, such as shared membership in a cohesive subgroup (Frank & Yasumoto, 1998), might reveal evidence for the control mechanism. A second explanation is that advice networks may not form the primary basis for trust decisions in the school. Advice relationships involve trust insofar as an advice-seeker reveals a lack of knowledge or an inability to resolve a problem and thereby is vulnerable to the advisor's goodwill. However, the advice network examined in this study is not the only kind of network in which teachers are embedded in their schools. The egocentric structure of other networks, such as friendship networks (Morrison, 2002) or close colleague networks (Frank, Zhao, & Berman, 2004), may be more strongly linked to teachers' collective trust in other teachers.

In addition, the present study failed to find a difference in the effects of the learning mechanism on trust for newcomers as compared with organizational incumbents. The basis for the hypothesized effects was that newcomers enter their schools with no knowledge or experience on which to base their teacher-teacher or teacher-principal trust. Past research suggests that newcomers suspend their belief that others will do them harm and extend initial trust based on a generalized propensity to

trust (Jones & George, 1998; McKnight et al., 1998). From that moment forward, newcomers enter a building phase during which they acquire information, through experience and interactions with others, that becomes the basis for collective and personalized trust. It was hypothesized that during the building phase, the effects of the learning mechanisms on trust would be stronger than during the maintenance phase. The inability to detect such a difference in this study is likely due to the characteristics of the longitudinal data used for the analysis. Specifically, because data were collected in the spring of 2007 and again in the spring of 2008, baseline data were not available for people who joined the school in the fall of 2007. The duration of the building phase is not known, and if teachers advance to the maintenance phase before the end of their first year working in a school, then none of the people in the sample — newcomers in this study comprised teachers at the ends of their second, third, and fourth years in the school — were in the building phase of trust. Any difference that might exist between the effects of the learning mechanism on newcomers in the building phase and on incumbents in the maintenance phase would not be seen in the available data.

The discussion in this chapter emphasizes positive aspects of the network of information-seeking relationships among organizational members. At the individual level, such relationships are an important source of information that newcomers need in order to be successful. At the organizational level, the network of relationships among organizational members supports the socialization of newcomers which may, in turn, yield favorable outcomes, such as increasing newcomers' commitment to staying with the organization. However, it is important to note that social ties and their consequent network structures need not be advantageous to either individuals or organizations in

all circumstances. For example, information-exchange ties can transmit faulty or redundant information as well as useful information, creating a challenge for individuals and organizations who need to make judgments about the quality of information transmitted across the network (Adler & Kwon, 1999). Moreover, while individuals may benefit from obtaining useful information from network contacts, they may incur costs in the form of lost productivity due to the time and effort required to provide help to others, to maintain the ties on which they rely, and to convince others to provide needed help (Hansen et al., 2001). To the extent such costs are excessive, they might outweigh any benefits that could be extracted from the network. The overall structure of a social network can also have positive or negative implications, depending on context. While a dense network may reinforce social norms and facilitate trust and cooperation among members of the organization, the same configuration may also be “a source of rigidity that hinders the coordination of complex organizational tasks” (Gargiulo & Benassi, 2000, p. 183).

Limitations

Two limitations of the research and the implications of these limitations were described above. First, because the analysis was restricted to instructional advice networks, the impact on trust of other kinds of relationships that teachers have with their colleagues could not be assessed. Positive findings in this study linking the learning mechanism to trust suggest that trust does depend on the embeddedness of people and their relationships. Additional research is necessary to understand whether the learning and control mechanisms operate through different kinds of relationships,

such as friendship, and whether those relationships affect trust to different degrees. Second, the evolution of newcomers' trust during their first year in their schools could not be examined with the data from these five middle schools because of the timing of data collection. This limitation may have had a significant impact on an important dimension of the study — how collective and individualized trust develops in newcomers during the building phase. While this limitation does not detract from the general finding of a link between network embeddedness and trust, future research into the development of trust among organizational newcomers should be designed based on the idea that the building phase may last less than one school year.

A third limitation of the present study stems from the homogeneous ethnic profile of the research setting. As noted in the methods section, the teacher sample from the five participating middle schools was roughly 96% white. Relational trust may be in part influenced by category-based trust, in which a trustor's feelings are influenced by the trustee's membership in a social category and by whether the trustee is a member of the same category as the trustor (Kramer, 1999). For racial categories, the data used in the present study offer no way to consider how category-based trust may moderate the learning and control mechanisms. On one hand, this feature may have simplified the investigation, as racial and ethnic tensions have been shown to be associated with trust in school (Bryk & Schneider, 1996), and the extreme ethnic homogeneity of the sample may have mitigated any confounding effect of ethnicity on the analysis of network-related effects. On the other hand, this limitation leaves important questions unanswered about how networks and ethnicity interact to affect trust. For example, do ethnic tensions bias the learning mechanism of trust such that negative experiences

have a disproportionate effect on trust compared to positive experiences? Alternatively, does shared ethnicity strengthen the control mechanism of trust, a simplified example of the link between subgroup membership (which may depend on factors other than just ethnicity) and enforceable trust that was demonstrated by Frank and Yasumoto (1998). Answers to such questions may be found by repeating the investigation in settings that are more ethnically diverse.

A fourth limitation of the present study is methodological. Social influence models of the type used in this study, particularly when modeling people's trust on lagged measures of their peers' trust, have been criticized for assuming that network measures influence individual attitudes or behaviors while failing to consider the possibility that the networks arise because actors choose to form ties with people who are similar in terms of those attitudes or behaviors (Marsden & Friedkin, 1993). In other words, the method fails to address selection bias that arises from the fact that the attitudes and actions of individual members of a social system and the network structure of social ties in which those individuals are embedded are interdependent (Steglich, Snijders, & West, 2006). To the extent that similarities in teacher-teacher trust and teacher-principal trust do not affect teachers decisions about who to turn to for advice, selection bias may not be cause for concern in the present analysis. That being said, it is not possible to definitively rule out selection bias in these data. In fact, the analyses presented here assumes stable network structures by basing all of the network measures on a cross-sectional snapshot of the advice relationships that existed in the spring of 2008. An alternative approach, such as a longitudinal analysis of network

relationships and trust, would be required in order to investigate how attitudes evolve in tandem with networks (Snijders, van de Bunt, & Steglich, 2009; Steglich et al., 2006).

Implications and Conclusion

Although several of the hypothesized relationships between network properties and trust were not supported by the analysis, the present study has implications for research on trust in organizations. First, the finding of positive associations between trust and both network activity and the characteristics of people with whom one shares a network tie warrant additional research into the link between trust and embeddedness in social networks. Although it may sometimes be appropriate to examine an interaction between a trustor and a trustee as a case of dyadic interpersonal trust, such instances are rarely isolated and, as the results reported here suggest, can affect the trust that the two parties have for others in their social context and affect the trust expressed by others not directly involved in the original interaction. Future investigations of trust must consider the level of an individuals' activity in their social networks and the characteristics of the people with whom interactions are shared.

The investigation presented here also has implications for people working in schools. On one hand, people studying trust in schools need to be more explicit about specifying the role played by schools' social networks in the formation and maintenance of trust. Bryk & Schneider (1996) found that trust in schools depended on such things as principal leadership, school size, and racial or ethnic tensions. Social networks may moderate the effects these factors have on trust, and researchers will need to investigate how the factors are related. On the other hand, people who design policies to improve

trust in schools and achieve the favorable outcomes described above need to pay attention to the network of relationships among those whose attitudes one is trying to change. Stability and consistency in efforts to raise trust are critical, because the interconnectedness of staff members may tend to drive trust back to a stable level of trustworthiness that is more reflective of the past than of the hoped-for future. A single positive exchange that demonstrates high trustworthiness will be factored in with all the other experiences and exchange outcomes that occur and have occurred in the school, and may therefore fail to have an appreciable impact on people's trust. The same can be said of an isolated instance of betrayed trust. However, if past experience has driven people to be risk averse, loss of trust may persist despite concerted efforts to change the way people think and feel. Positive information may be discounted and behaviors that depend on trust may not change.

Despite the limitations outlined above, this study provides valuable insight into the role that social networks play in the dynamics of teacher-teacher and teacher-principal trust among staff members in the five participating middle schools. The results suggest that future investigations of trust in schools and policies intended to affect trust in school must be mindful of the embeddedness of trust relations in the schools' social networks.

Notes

¹ Frank & Yasumoto (1998) discuss enforceable trust in the context of the pursuit of social capital. In the language of the present analysis, social capital is viewed as an asset acquired by trustees when trustors extend trust — “resources that [the trustee] may access through social ties” (Frank & Yasumoto, p. 645). Because this paper deals primarily with trust decisions made by trustors rather than the accumulation of trust by trustees, the framework characterizes learning and control as mechanisms associated with trust dynamics and not as mechanisms associated with the pursuit of social capital. To a large extent, however, the mechanisms can be seen as two sides of the same coin. For example, a reciprocity transaction in the social capital framework is an opportunity for one seeking social capital to perform acts that will hopefully be reciprocated (Frank & Yasumoto), while, for the person receiving the benefits of that act, the fact of the event is input to the learning mechanism and thus a basis for future trust decisions (Buskens & Raub, 2002). Similarly, while the enforceable trust mechanism in the social capital framework “suggests a constraint imposed on the actor” seeking social capital (Frank & Yasumoto, p. 646), the control mechanism in the trust framework views that constraint as a form of control vested in trustors and their allies in the social network (Buskens & Raub).

² Respondents designated a frequency of interactions for each advice-seeking tie according to the scale (1) *a few times a year*, (2) *once or twice a month*, (3) *once or twice a week*, and (4) *daily or almost daily*. Frequency was rescaled prior to computing the weighted average of peer attitudes to make the intervals of the frequency scale approximately linear with *a few times a year* assigned a scaled value of 0.05, *once or twice a month* assigned a scaled value of 0.5, *once or twice a week* assigned a value of 1.0, and *daily or almost daily* assigned a scaled value of 4.0.

³ When computing egocentric network size and density, the focal individual is excluded from the network. If a person has no alters or only one alter, egocentric network density is, strictly speaking, undefined. However, an egocentric density value of zero was assigned to respondents with zero alters or one alter to reflect the basic idea that the individual had no colleagues that sought information from each other (Ueno, 2005).

⁴ Additional Wald tests were run to test whether subsets of the coefficients for the school interaction terms were equal to zero. For example, in the model that predicts teacher-teacher trust in 2008 based on degree and the six control variables, a Wald test was run to test if the subset of interactions between the school dummy variables and degree were simultaneously equal to zero. Another Wald test was run to test if the subset of interactions between the school dummy variables and the controls were simultaneously equal to zero. In all cases, with one exception described in the text, the tests confirmed the null hypotheses that the coefficients for school interactions were together equal to zero.

⁵ A Wald test for a version of the teacher-principal trust model that included interactions between the school dummy variables and all other covariates found that the subset of coefficients for interactions between the school dummy variables and newcomer status and between the school dummy variables and the six control variables control variables were jointly equal to zero, $F(28, 148) = 0.89, p = 0.63$.

⁶ Effect coding differs from simple dummy coding for a categorical variable in its treatment of the omitted category. If simple dummy coding were used for the school variable with Tyler Middle School as the omitted category, then the dummy variable for Quincy Middle School would have a coded value of 1 for all individuals who worked at Quincy in 2008 and a coded value of 0 for everyone else. Similar coding would apply to the dummy variables for Washington, Van Buren, and Adams Middle Schools. If this set of dummies was used in an analysis, the intercept of the model would represent the level of teacher-principal trust in the omitted school, Tyler, assuming all other covariates were zero. The coefficients of the four school dummy variables would indicate the difference in teacher-principal trust for their respective schools relative to Tyler.

When effect coding is used, with Tyler as the omitted category, the dummy variable for Quincy would have a coded value of 1 for all individuals who worked at Quincy in 2008, a coded value of -1 for all individuals who worked at Tyler in 2008, and a coded value of 0 for everyone else. Again, similar coding would apply to the dummy variables for Washington, Van Buren, and Adams. When effect-coded dummies are used in an analysis, the intercept of the model represents the unweighted mean of the expected values of teacher-principal trust across all schools, assuming all other covariates are zero. The coefficients of the four school dummy variables indicate the difference in teacher-principal trust for their respective schools relative to the full set of schools. The difference between the omitted category, in this case, Tyler, and the unweighted mean of the expected values of teacher-principal trust across all schools is obtained by summing the coefficients for the four included dummy variables and multiplying the result by -1.

CHAPTER 4

Unfreeze the Moment: A Longitudinal Analysis of a Middle School Instructional Advice Network

In recent years, social network studies conducted in schools have added to an academic understanding of important phenomena involving teachers and other members of the school staff, including the relationship between teachers' social capital and their turnover intentions (Thomas, 2005), and the effectiveness of school leadership (Friedkin & Slater, 1994). However, a widely recognized limitation of many social network studies is that they very often focus on static networks (Moody, 2002; Sutor, J. J., Wellman, B., & Morgan, D. L., 1997). While social network studies that rely on cross sectional data clearly extend our existing knowledge of social processes that unfold in schools, the focus on static networks may fail to capture time-related features of social processes, such as the dependence of diffusion processes on the order in which relationships form and interactions occur (Moody, 2002).

In schools, the social networks that link members of a school staff are expected to change as a result of teacher turnover. Such changes may impact school processes that depend on the social networks that connect teachers. However, the amount of change that occurs in the network from year to year and the impact that this change might have on different phenomena cannot be determined without analyzing longitudinal network data from schools. The present study examines two waves of data on the instructional advice network in Washington Middle School, which is located in a mid-sized

Midwestern city. A cursory glance at this particular school might suggest that the advice network would be relatively stable across the two years in which data were collected — turnover was only 13%, and the overall staff size and role distribution were unchanged. However, this study reveals that appearances can be deceiving, and that the advice network at WMS changed quite a bit over a short time.

In the next section I elaborate on these ideas. I begin with a discussion of teacher turnover in schools and follow with a description of how research on school social networks may be extended by taking into account changes in networks due to turnover and due to shifting relationships among the people who remain in the school. I then recount how the data for this study were collected and describe a set of measures that will be used in a dynamic model of network change. After presenting the measures, I describe the *Simulation Investigation for Empirical Network Analysis* (SIENA) modeling software (Burk, Steglich, & Snijders, 2007; Snijders, Steglich, & Schweinberger, 2005; Steglich, Snijders, & Pearson, 2007), a network analysis tool that is used to model the evolution of the WMS instructional advice network. The results section begins with an examination of the differences in the school's 2007 and 2008 advice networks, and continues with a summary of the SIENA model results. The paper concludes with a discussion of the findings and the implications of the study.

Teacher Turnover and Changes in Schools' Social Networks

Although scholars have been investigating teacher turnover for well over 40 years (see, for example, Charters, 1970; Heyns, 1988; Mark & Anderson, 1978), interest in the issue has not diminished. In the past four years, at least three literature reviews dealing with teacher recruitment, retention, and attrition have been published,

including two “comprehensive” reviews in the *Review of Educational Research* journal (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006; Johnson, Berg, & Donaldson, 2005). This attention is well-warranted. Data from the 2004–05 follow-up to the 2003–04 Schools and Staffing Survey (SASS) indicate that 8% of public school teachers had moved to a new school and another 8% had left the profession altogether, levels that were virtually unchanged from the follow-up to the 1999–2000 SASS (Luekens, Lyter, & Fox, 2004; Marvel, Lyter, Peltola, Strizek, & Morton, 2006). However, these levels are somewhat higher than the levels reported in the follow-up to the 1990–91 SASS, in which it was found that 7.3% of teachers moved to a new school while just 5.1% of teachers left the profession (Bobbitt, Leich, Whitener, & Lynch, 1994).

Despite an express goal of improving teacher retention (Johnson et al., 2005), these national data suggest that little progress has been made. While a recent study indicates that the rate of teachers leaving the teaching profession is no greater than the attrition rates in similar professions, such as nursing and social work (Harris & Adams, 2007), the combined impact of “leavers” and “movers” on school organizations can have profound effects over time. For example, in Chicago Public Schools, roughly one-third of teachers have left their schools after two years, and less than half remain in the same school beyond four years (Allensworth, Ponisciak, & Mazzeo, 2009). Although research on the consequences of teacher turnover is limited (Smith & Ingersoll, 2004; Johnson et al.), most scholars agree that teacher turnover bears a cost due to declines in organizational stability, coherence, and morale. Such declines inhibit the development and maintenance of effective learning communities in schools and lead to disruptions in

professional development, a loss of teacher leadership, and the risk of an overall drop in teacher quality (Allensworth et al.; Johnson et al.; Smith & Ingersoll).

One proximal consequence of teacher turnover is a disruption in the intra-organizational social networks that exist among members of the school staff. When departing teachers leave, the ties they shared with those who remain are severed and the people left behind must adapt to the loss of former colleagues, perhaps by developing new relationships. Shah (2000) examined the impact of downsizing on the structure of the advice network in an electronics firm. She found that those who survived the layoff moved quickly to reconfigure their advice networks and forge new ties with other survivors, arguing that people restored their advice relationships with a sense of urgency because such ties are essential to avoid work disruptions. Although Shah's research was conducted outside education and under extreme circumstances — 42% of the workforce had been laid off — the logic of her findings suggests that teachers, who lose 15–20% of their coworkers in any given year (Allensworth et al., 2009), may also move quickly to reconfigure their advice networks following the departure of colleagues to whom they used to turn.

Aside from the differences in the sector and scale exemplified by Shah's (2000) research, an important difference in the case of schools is that staff changes which are not a result of downsizing are typically followed by the arrival of new colleagues. Their arrival can be expected to generate additional changes in the structure of schools' advice networks. New teachers may have no relationships with organizational incumbents upon entering their new school, but they may quickly begin to form ties during a process of information seeking, in which newcomers attempt to acquire the

technical, referent, and normative information they need to adapt to their new environment (Miller & Jablin, 1991; Morrison, 2002a). At the same time, newcomers may be recognized as legitimate sources of advice by organizational incumbents, some of whom are seeking to replace lost ties, particularly if the newcomers have prior teaching experience (Chapter 2 of this dissertation). Taken together, the departure of some teachers and the arrival of new ones may result in changes in both the composition — including changes in the identities, attitudes, and combined expertise of newcomers as compared to those who departed — as well as the structure of a school's social networks from one year to the next.

Although turnover clearly has the potential to transform an organization's social networks, it is not the only factor that could lead to network change. Research across a variety of social settings suggests that personal networks are generally not static (Bignami-Van Assche, 2005; Feld, 1997; Feld, Suitor, & Hoegh, 2007; Morgan, Neal, & Carder, 1991; Snijders, van de Bunt, & Steglich, 2009; Suitor & Keeton, 1997; Wellman, Wong, Tindall, & Nazer, 1997). Morgan et al. described personal networks as having a core-periphery structure, in which a person's relationships with members of the core group tend to remain stable over time (*i.e.*, to be mentioned repeatedly when people are asked on separate occasions to list members of their networks) while people in the periphery tend to come and go. The time frames over which instability has been observed vary widely, ranging across repeated observations separated by as little as two months (Morgan et al.) and as much as a decade (Suitor & Keeton; Wellman et al.). The research suggests that these changes represent true shifts in the pattern of a

peoples' relationships and not simply an inconsistency in memory about the range of others with whom they interacted.

Even core relationships change over time due to changes in people's roles, status, personal needs, and, of course, the aforementioned turnover (Suitor & Keeton; Wellman et al.). Some of these change dynamics can be envisioned unfolding in a school setting. For example, if a teacher switches from teaching sixth-grade in a self-contained classroom to teaching seventh grade math in single-subject classes in the same school, that teacher may begin to seek advice from a different set of colleagues, independent of any turnover at the organizational level. Such a change would alter not only the person's own immediate advice network, but also the networks of those colleagues with whom advice-seeking relationships are either initiated or withdrawn. Furthermore, the change in that person's professional role may mimic a turnover event for other sixth-grade teachers who previously turned to the person for advice and now find that they need to cultivate new advice relationships. A second example is less obvious but perhaps more common. Specifically, as teachers gain experience in the profession and tenure in the school, their expertise in teaching and their familiarity with the organization will grow. As a result, the kinds of advice they seek and the people to whom they consequently turn may change.

Research that examines teacher social networks has contributed new knowledge to the understanding of organizational phenomena in schools. For example, research on determinants of school social networks has demonstrated that networks are affected by factors outside the school, such as district policy (Coburn & Russell, 2008), as well as factors associated with teachers themselves, such as how their professional and

organizational experience levels compare to those of the colleagues with whom they interact (Chapter 2 of this dissertation). Additional research has demonstrated the effect that teacher social networks have on teachers' behaviors and attitudes, including collective trust for other teachers and individualized trust for the principal (Chapter 3 of this dissertation), as well as teacher turnover intentions (Thomas, 2005). The analyses in these studies share the common feature of using cross-sectional social network data that treat the network as static. In other words, the analyses were conducted on a snapshot of how people's networks were configured at a particular moment in time, rather than allowing for the possibility that the networks were constantly changing, as suggested above.

Although Suitor, Wellman, and Morgan (1997) acknowledge that scholars recognize the limitations of relying on cross sectional network data, as well as the financial and organizational issues that make the acquisition of longitudinal data challenging, it is difficult to know how much insight might be lost without actually examining how much and why networks change over time. Studies that do look at the dynamics of social networks suggest that important insights can be gained when an analysis takes network dynamics into account. For example, Moody (2002) demonstrated that diffusion across a network — of diseases through sexual contact or of information through conversation — is limited by the pattern of relationships that exist at a particular moment in time. In other words, if information is transmitted through a network via conversation, then it does not only matter *that* person *A* speaks or has spoken with persons *B* and *C* during the past year, it matters *when*, and particularly in what order, the conversations occurred. The importance of timing, as

demonstrated by Moody, may also impact how a teacher's network develops after joining a new school. The outcomes of network processes may depend on the order in which people encounter one another and the success or failure of early interactions. For a teachers at the end of their first year in a new school, the pattern of relationships they maintain and the trust they have in their colleagues and in the school principal may depend on who they met at the beginning of the year, how those early interactions unfolded, and who they may have subsequently encountered.

The present study extends the two other studies presented in this dissertation by examining the changes in a middle school advice network between spring of 2007 and spring of 2008. The investigation, which draws on longitudinal network data collected in successive years, comprises two components. First, recognizing that change from one year to the next is virtually inevitable, the study compares the characteristics of the 2007 advice network with the characteristics of the 2008 network and attempts to understand how much change actually took place. In contrast to the case of extreme organizational disruption reported by Shah (2000) and described above, this study looks at a school for which surface similarities in network characteristics — including the number of people in the network, the roles they perform at the school, and the overall density of ties among colleagues — might suggest a high degree of stability. By examining the impact of turnover and the stability of the core and peripheral networks among people who worked in the network both years, the analysis reveals that appearances can, indeed, be deceiving. Second, this study draws on results from cross sectional analyses of this school and others in the same district to test a longitudinal model of the evolution of the school's advice network. Using an evolutionary model of the advice network, the study

examines the extent to which the network dynamics are explained by parameters that were effective at characterizing a snapshot of the network and by factors that capture how ongoing changes in the network depend on its moment-to-moment structural characteristics.

Methods

Data and Sample

The data for this investigation were collected as part of the Distributed Leadership Study during a longitudinal investigation of an NSF-sponsored, university-based program to improve middle school mathematics instruction. Web-based social network surveys were administered to the full teaching and administrative staffs of all ten middle schools in a mid-size Midwestern urban school district during February and March of 2007, and again in March and April of 2008. The surveys comprised five sets of questions covering instructional advice networks, demographics, attitudes and opinions, professional roles, and qualifications and professional activities. To obtain high response rates, schools were offered an honorarium of \$400 for a response rate of 80% or higher, and an honorarium of \$500 for a response rate of 90% or higher. In addition, teachers who completed the survey received a \$25 gift certificate to a national book store chain. To encourage participation from all members of the participating schools' staffs, principals were contacted and informed of their schools' response rates periodically during the four weeks that the web-based surveys were available. Among the ten participating middle schools, response rates to the 2007 survey ranged from 63% to 91%, with an overall response rate of 82%. In 2008, response rates fell in nine of the

ten schools, ranging from 43% to 93%, with an overall response rate of 64%. Low participation in the second wave has been attributed in part to participants' own beliefs that little had changed over the course of one year.

The present analysis focuses on Washington Middle School (WMS), one of the ten schools that participated in the full study. WMS was chosen for this longitudinal analysis because it delivered high response rates in both waves of data collection (89% in 2007, and 93% in 2008). WMS is an urban middle school located in a Midwestern city with a population of over 200,000, and enrolls roughly 700 students in grades 6–8. According to statistics published by the district for the 2007-08 school year, 11% of the student population at WMS were minorities, below the district average of roughly 24%, and 21% of students were eligible for free or reduced-price meals, below the district average of 42%. WMS matched district averages with 19% of students in gifted programs and 15% of students receiving special education. More than 80% of 8th grade students met or exceeded district standards for mathematics in 2007 and more than 90% met or exceeded district standards for RWLA, performance measures that were again comparable to district averages.

At the time of the first wave of data collection, the staff at WMS numbered 61 teachers, administrators, and counselors. The teaching staff comprised 4 mathematics teachers, 7 reading-writing-language arts (RWLA) teachers, 4 social sciences teachers, 3 natural sciences teachers, 9 sixth-grade teachers, 5 health/PE teachers, 7 special education teachers, and 11 teachers dedicated to other subjects, such as foreign languages and music. Between the 2006-07 and 2007-08 school years, turnover at WMS was 13%, slightly below the national average of 16% (Allensworth et al., 2009). Eight

teachers left the staff after the 2007 data were collected, and 8 new teachers were added prior to data collection in 2008. With regard to the turnover observed between 2007 and 2008, the principal of WMS commented that losing eight people in one year was “an anomaly.” He asserted that “people really don’t leave here,” and noted that WMS had one of the lowest — if not the lowest — turnover rates in the district. As for the eight staff members who left WMS in 2007, the principal reported that four teachers retired from teaching in 2007, two other staff members left the school to take leadership positions in the district, and one individual relocated to another city. (The data suggest that the eighth person to leave was a temporary replacement for someone who was gone for one year.) Overall, the allocation of roles at WMS did not change as a result of the turnover. However, there was one reassignment between 2007 and 2008. One of the school’s sixth-grade teachers changed roles to be a math teacher, filling one of the spaces left by two departing math teachers at the end of 2007. The sixth-grade teaching vacancy was filled by a new hire. Based on survey responses and school roster data, all other personnel who were on staff in 2006-07 and 2007-08 filled the same professional role in both academic years.

Two induction programs, one at the district level and one at the school level, were available to new teachers at WMS in 2008 depending on their level of professional experience. First, the district operated a structured mentoring program for individuals who are in their first year of teaching. As part of this program, new teachers are assigned mentors in their school. Mentors for new teachers are selected by the district in consultation with the school principals, and mentors receive training from the district as well as a stipend for taking on the mentoring role. The district mentoring program lasts

two-years, with fewer structured interactions between the mentor and mentee in the second year. Second, WMS operated an induction program for teachers who were new to the school. The WMS program comprised summer orientation and a mentoring program. The summer orientation was an opportunity to introduce the school and its practices to new teachers before the school year began. Then, teachers who were new to the building were assigned a “go-to person” — different from the mentors who participate in the district program — who would be available to provide additional support for the new teachers with regard to the school’s local practices. Finally, all new teachers were encouraged to consider the administrative team — the principal, the assistant principal, and the special education coordinator — as “go-to” people.

At the time of the main study, WMS was in the early stages of a multimillion dollar renovation and expansion project, adding 16 new classrooms and a new athletic facility to complement existing computer-equipped classrooms and multi-media facilities. The renovation project — characterized by the principal of WMS as “a huge undertaking” — began in 2007 and was completed in 2009. During the renovation, a number of teachers moved out of their old classrooms, into temporary space (such as trailer-based classrooms outside the building), and then into their new classrooms. It is not known which teachers were dislocated during the renovation or how long any given teacher was teaching in the temporary space.

The school principal reported that there were no major changes to textbooks or curriculum during the 2006–2007 and 2007–2008 school years, and that any other changes that might have occurred during the time frame were “minimal at most.” For example, WMS is often selected by the district to pilot new materials and provide

teacher assessments of those new materials to the district. Such pilot programs are typically implemented in one-half of the 8th grade classes. Although the principal of WMS could not recall specific programs that may have been piloted between 2006 and 2008, it was suggested that the teachers “usually have something,” and that piloting new materials was something to which teachers at WMS were accustomed.

Measures

Dependent Variable

Advice relationships. The analyses in this study focus on directed, weighted networks of advice relationships. The directionality of the networks is determined by who turns to whom for advice about instruction, and the weights assigned to network ties reflect the frequency of advice-seeking interactions. In the network portion of the surveys, respondents were asked to list up to 15 people to whom they turned for advice about teaching “during this school year” in three different areas: RWLA, mathematics, and the respondent’s primary subject if it was not RWLA or mathematics. (Note that in this design, non-RWLA/mathematics teachers were asked to articulate three distinct advice networks.) For each person nominated, the respondent was asked to weight the relationship according to the frequency of interactions (4 = daily or almost daily, 3 = once or twice per week, 2 = once or twice per month, 1 = a few times per year). Data on the three different kinds of advice-seeking relationships were integrated to yield a single, comprehensive network of advice-seeking activity in the school. For a given pair of actors i and j , the $i \rightarrow j$ relationship was assigned a value equal to the highest frequency of advice-seeking interactions reported by i across the three areas specified in

the network survey. If i did not turn to j for advice, the relationship was assigned a value of zero. Note that if i seeks advice from j about mathematics twice per week, and also seeks advice from j about science twice per week, then it is possible for the frequency of $i \rightarrow j$ advice-seeking to be “daily or almost daily” if each advice-seeking interaction is a separate event. Because it is not known how respondents performed their actual advice-seeking activity, the above rule for combining the three advice networks provides a conservative estimate of the interaction frequency weights.

Independent Variables

Professional experience. A cross-sectional study of six middle school advice networks found that the structure of advice relationships was associated with the professional experience of the advice-seeker and of the person from whom advice was sought (Chapter 2 of this dissertation). Specifically, it was found that novice newcomers — individuals who are new to the school and who have little or no prior professional experience — are both more likely to solicit advice and less likely to be sought after for advice than their more-experienced colleagues. Although it would be ideal to test these findings in the dynamic model, the small sample size associated with examining this single school precludes the separation of newcomers into two groups according to their experience levels. The staff at WMS includes only 7 novice teachers in both 2007 and 2008, where novice is liberally defined as having fewer than 6 years of teaching experience. Hence, the model examines the effect of being an organizational newcomer, where newcomer status is defined as having worked in the school for fewer than 4 years. With respect to the 2007 distribution of the number of years people had been

working at WMS, a newcomer cutoff value of 4 years yields a group of 20 individuals representing the bottom quartile of school tenure values.

Behaviors and attitudes. Educators who exchange instructional advice with colleagues may do so as part of a general desire to improve instructional practices. To control for this general tendency, behavior and attitude measures are included in the analyses as sender and receiver covariates.¹ Two behavioral measures control for individuals' general tendency to seek information about teaching. They are the frequency with which respondents reported reviewing district academic standards and the frequency with which respondents reported consulting curricular materials. Each of these was measured with a single survey item on a five-point scale (1 = never, 2 = a few times per year, 3 = once or twice per month, 4 = once or twice per week, 5 = daily or almost daily). One attitude measure — self-assessed collective responsibility for student learning — controls for the extent to which individuals internalize responsibility for student learning, believe that they have the power to teach all students, are willing to adapt their teaching methods to students' success or failure, and feel efficacious in teaching (Lee & Smith, 1996). As a measure of professional community, the average collective responsibility among teachers has been shown to be positively associated with high levels of staff cooperation (Lee & Smith). In this study, collective responsibility is used as an individual measure to capture people's attitudes about their ability to improve their instructional practices and thereby affect student outcomes. The self-assessed collective responsibility measure was constructed as a Rasch-equated composite from a seven-item scale (Cronbach's alpha = 0.73 for the full 2007 sample).

Professional role. A utility perspective (Frank & Maroulis, 2009) suggests that individuals will attempt to maximize the gain from an advice-seeking interaction by turning to others who are most likely to provide useful advice. One implication of this perspective is that individuals will seek advice from others who perform the same professional role or teach in the same subject area. To control for this tendency while testing the effect of experience levels on information-seeking activity, a dyadic similarity variable for professional role is included in the analysis to reflect whether two individuals in a dyad have the same role. For the present analysis, the sample was divided into eleven professional roles: English and ESL teachers, math teachers, foreign language teachers, social sciences teachers, natural science teachers, health and PE teachers, arts teachers (including art, music, and drama), enrichment teachers (including specialty courses such as business, computers, and high-ability education), special education teachers, self-contained classroom teachers (which is identical to specifying 6th-grade teachers in the six participating middle schools), and administrators (which include principals, assistant principals, and other non-teaching members of the schools staff). Because the survey instrument explicitly asked all respondents who they consulted for advice about teaching RWLA and mathematics, dummy variables for being an RWLA or math teacher are included as receiver covariates to control for an expected overall tendency for those individuals to receive relatively more advice-seeking ties than individuals in other professional roles.

Cohesive subgroups. This study examines the patterns of advice relationships that emerge between pairs of individuals in a social network. However, an essential feature of social networks is that ties between a given pair of individuals are not independent of

the ties they have with other members of the network. The pattern and strength of network ties will be analyzed to identify the informal subgroups in which network ties are concentrated (Frank, 1995, 1996). Informal subgroups can be characterized as meso-level network entities that structure social interactions (Frank & Zhao, 2005). The characteristics of the subgroups structures are examined in the first portion of the analysis, and a dyadic similarity variable that indicates whether two individuals were members of the same informal subgroup at the beginning of the evolutionary model is used to control for the initial meso-level structure when modeling how individuals form or drop relationships over time.

Demographic characteristics. Individuals may choose to seek advice from colleagues who share similar physical traits or demographic characteristics. Factors that would contribute to this tendency among educators include race and gender. Because the staff at WMS is almost perfectly homogeneous with regard to race, a similarity measure for race is not included in the analysis. A measure for gender is included at the individual level, and a similarity measure for gender is included at the dyadic level to reflect whether two individuals in a dyad are the same gender.

Analysis

One objective of this research is to investigate the extent to which factors that were identified in a cross-sectional p_2 model of network structure (Van Duijn, Snijders, & Zijlstra, 2004) are related to the evolution of the instructional advice network at WMS between 2007 and 2008. As described in Chapter 2 and summarized above, important p_2 model predictors of the structure of advice relationships were derived from individuals' levels of professional experience, professional roles, gender, and cohesive subgroup

membership. These measures are tested in an evolutionary model along with structural parameters, described below, that may also be related to people's decisions about their network relationships. A key difference between the a cross-sectional p_2 model and a longitudinal SIENA model, aside from the fact that the latter uses network data collected from the same group of people at multiple time points, is that whereas the p_2 model attempts to explain patterns in the network structure as it exists at a moment in time, the SIENA model attempts to explain how actors in a network make decisions about whether, with whom, and how often to form new network relationships or to sever existing network relationships.

The SIENA software program, part of the StOCNET software package, is used to run SIENA models, which were developed to address the complexities of modeling social network data (Boer, Huisman, Snijders, Steglich, Wichers, and Zeggelink, 2006; Snijders, Steglich, & Schweinberger, 2005; Steglich, Snijders, & Pearson, in press). The SIENA software uses longitudinal data about actors and their networks to estimate models that can be used to test hypotheses about how networks evolve. SIENA models are actor-based models for network dynamics (Snijders et al., 2009). They are *actor-based* because actors are assumed to control their outbound ties, and models are estimated by simulating the decision processes of actors who have the opportunity at any given time-step of initiating a new relationship, withdrawing an existing relationship, or modifying a behavior or belief. According to Snijders et al. (2009),

The probabilities for a choice depend on the so-called *objective function*.

This is a function of the network, as perceived by the focal actor.

Informally, the objective function expresses how likely it is for the

actor to change her/his network in a particular way. On average, each actor 'tries to' move into a direction of higher values of her/his objective function, subject to the constraints of the current network structure and the changes made by the other actors in the network; and subject to random influences. The objective function will depend in practice on the personal network of the actor, as defined by the network between the focal actor plus those to whom there is a direct tie (or, depending on the specification, the focal actor plus those to whom there is a direct or indirect – i.e., distance-two – tie), including the covariates for all actors in this personal network. Thus, the probabilities of changes are assumed to depend on the personal networks that would result from the changes that possibly could be made, and their composition in terms of covariates, via the objective function values of those networks.

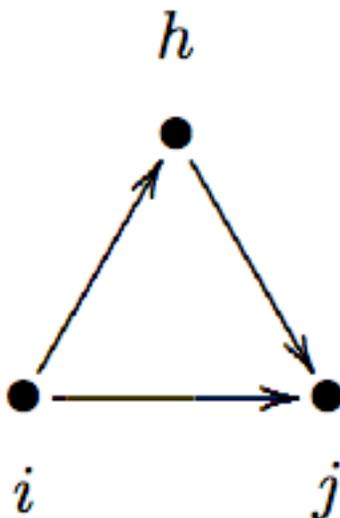
Network data from 2007 and 2008 are used as the dependent variables in the present study. Actor attributes, chosen to reflect the findings from the cross sectional p_2 model, are included as covariates in the network model. Attributes can be designated as *ego* measures, *alter* measures, and *similarity* measures. Measures ascribed to ego are associated with an actor's tendency to send a tie or, in this study, to seek instructional advice. Measures ascribed to alter are associated with an actor's tendency to receive a tie or to be sought out for advice. Similarity measures are associated with pairs of actors and reflect the extent to which ties are more or less likely depending on how similar the two actors are in regard to the selected measure. (A *same* parameter would reflect the

extent to which ties are more or less likely if the two actors share an identical attribute, such as teaching the same subject or being the same gender.)

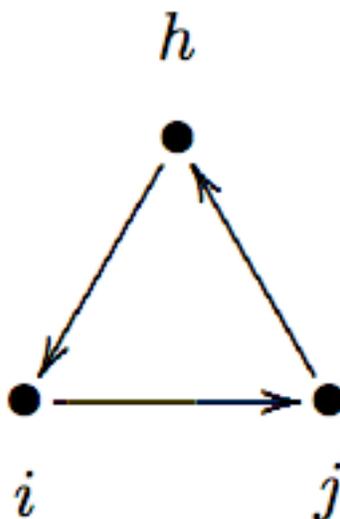
In addition to the parameters derived from the p_2 model, network structure effects are included in the evolutionary network model. Structural effects capture the extent to which a person's decisions about whether to send a new tie or withdraw an existing tie depend on the pattern of ties in which the person is already embedded. For example, person *A* may choose to extend a new tie to person *B* not because person *B* has more professional experience, but rather because person *B* shares ties with three colleagues with whom person *A* already has existing ties. In other words, the structure of a person's network may drive the person's moment to moment decisions such as which ties to initiate, which to maintain, and which to sever. An out-degree effect, which is included in every SIENA model to control for the overall density of the network, reflects the overall tendency for actors in the network to seek instructional advice.² A reciprocity effect is also included in the model to capture the extent to which actors seek advice from those who solicit advice.

Figure 4.1: Network closure effects: Three-cycles and transitive ties

Images obtained from the SIENA user manual.



Transitive ties triadic closure effect



Three-cycles triadic closure effect

Two structural effects are included in the evolutionary model along with the actor and dyadic covariates described above. A *transitive ties* effect (top frame of Figure 4.1) captures the tendency for actor i to form an $i \rightarrow j$ tie when there exists any person h in the network such that the arrangement of ties $i \rightarrow h$ and $h \rightarrow j$ already exists. In contrast, a *three-cycles* effect (bottom frame of Figure 4.1) captures the tendency for actor i to receive a $j \rightarrow i$ tie when the $i \rightarrow h$ and $h \rightarrow j$ ties already exist. The three-cycles effect can be characterized as a generalized reciprocity and may be related to the hierarchical nature of the relationships in the network. In other words, in a strongly hierarchical network, in which h has higher status (or more expertise) than j , and j has higher status (or more expertise) than i , one would expect to see a higher parameter estimate for the transitive ties effect than for the three-cycles effect. Because these effects involve the formation of a third tie among three actors where two ties already exist, they are referred to as triadic closure effects.

Three network effects based on actors' level of activity in the network are also included in the model. An *in-degree prestige* effect reflects the tendency of actors with high in-degrees to attract additional ties beyond the ones they already receive. In the advice network, a positive in-degree prestige effect might indicate the tendency for experts in the school to receive more and more advice-seeking relationships from their colleagues. An *out-degree prestige* effect reflects the tendency for actors with high out-degrees to attract inbound advice-seeking ties. In the advice network, a negative out-degree prestige effect might indicate the tendency for people in the school to not seek advice from colleagues who themselves are very active advice-seekers. An *out-degree activity* effect captures the tendency for actors with high out-degrees to send still more

outbound ties. In the advice network, a negative out-degree activity effect may indicate learning through the network such that a high level of advice-seeking in one time period is linked to a lower level of advice seeking in the subsequent time period.

Two types of data are used to configure the network evolution model in SIENA: network data and individual attribute data. First, network data, in the form of binary adjacency matrices that include all people who were on staff at WMS in either 2007 or 2008, were prepared from survey responses. Turnover was captured in a unique SIENA data file that specifies when each actor entered and departed the system. Individuals present for both waves of data collection are specified as entering before time-one and leaving after time-two. For the present study, all turnover was defined to take place at 25% of the distance between time-one and time-two, reflecting the fact that the first wave of network data were collected 3–4 months before the end of the school year. Second, individual attribute data were prepared. Attribute variables in SIENA are either held constant between time points and updated at each time point or allowed to change continuously between time points. Because this analysis only draws on data from two time points, changes that might apply to variables at time-two are not incorporated into the model. Hence, time-invariant measures, including professional role and gender, are fixed throughout the analysis at 2007 levels. If values for a time-invariant measure were missing in the 2007 data but available in the 2008 data, then the 2008 values were used in place of the missing values from the 2007 survey.

In addition to the results of SIENA models, which are complex and computationally intensive, an alternative analysis of the longitudinal network data is described with respect to the transitive ties effect described above. The purpose of the

alternative analysis is to consider whether findings from the SIENA models might be obtained using a simpler method. Specifically, the alternative analysis uses inspection to identify instances of open triads in 2007 — triads in which the arrangement of ties $i \rightarrow h$ and $h \rightarrow j$ exist in the first year of the study — and examines the extent to which such open triads tend to be closed in 2008 by the addition of an $i \rightarrow h$ tie. The results of the alternative analysis are then compared with the results implied by the SIENA models.

Results

Indications of Network Dynamics

Before presenting the results of the SIENA models, I will examine evidence of change in the WMS advice networks between 2007 and 2008. Superficially, the situation in the school looks fairly stable across the two years. As noted previously, WMS experienced 13% turnover between the 2006-07 and 2007-08 school years, below the national average (Allensworth et al., 2009). Over the same period, the staff size remained constant at 61 people and the allocation of staff to professional roles was unchanged. Roles that were vacated in the spring of 2007 were filled as of the spring of 2008, either through hiring or through internal reassignment.

Table 4.1: Means and standard deviations from 2007 WMS network surveys

Variable	2007 Survey Data		
	All	Stayers	Leavers
Count	61	53	8
Number of survey responses	54	48	6
Response rate	88.5	90.6	75.0
DEMOGRAPHICS AND EXPERIENCE ¹			
Percent male	34.5	32.7	50.0
Years working at WMS	11.4 (9.6)	10.0 (7.9)	23.5 (14.7)
Years of teaching experience	20.6 (10.4)	19.8 (9.9)	27.5 (12.9)
Percent with subject-area endorsement	57.4	60.3	37.5
Percent with graduate degree	55.7	43.4	50.0
COLLECTIVE RESPONSIBILITY			
Collective responsibility, self ²	2.04 (1.53)	2.24 (1.40)	0.42 (1.72)
Collective responsibility, peer ³	3.47 (2.50)	3.52 (2.61)	3.06 (1.45)
TRUST			
Teacher-teacher trust ⁴	3.63 (2.62)	3.79 (2.64)	2.30 (2.29)
Teacher-principal trust ⁵	5.91 (2.68)	6.24 (2.52)	3.25 (2.61)
NETWORK MEASURES			
Out-degree	3.21 (3.55)	3.51 (3.62)	1.25 (2.38)
In-degree	3.21 (3.10)	3.32 (3.17)	2.50 (2.76)
Betweenness	47.3 (102.1)	51.6 (108.2)	18.8 (35.7)
Egocentric network size	5.44 (4.12)	5.70 (4.22)	3.75 (3.01)
Egocentric density	18.8 (18.3)	20.7 (18.8)	5.6 (5.9)

Standard deviations in parentheses.

¹ Ethnicity is not shown due to high homogeneity; in 2007, 1.7% of the WMS staff was nonwhite.

² Rasch model of *collective responsibility, self*; scores range from -1.16 to 5.05.

³ Rasch model of *collective responsibility, peer*; scores range from -1.03 to 8.91.

⁴ Rasch model of *teacher-teacher trust*; scores range from -1.49 to 9.05.

⁵ Rasch model of *teacher-principal*; scores range from -2.09 to 8.42.

Table 4.1 summarizes data from the 2007 survey, breaking out results for the 53 individuals who stayed in the school across the two years and the 8 who left after the 2007 survey was completed. Table 4.2 summarizes those data for the 2008 survey, and breaks down the differences between those who stayed and the 2008 organizational

newcomers. These summaries reveal striking differences between the individuals who remain in the school between 2007 and 2008 and the individuals who leave. Leavers report markedly lower trust levels than stayers on both teacher-teacher and teacher-principal trust, and lower levels than stayers on both self and peer collective responsibility. Despite the small number of leavers, the differences between the two groups are significant for self-assessed collective responsibility, $t(59) = 3.32$, $p < 0.01$, and for teacher-principal trust, $t(59) = 3.03$, $p < 0.01$. Although newcomers reported lower levels of self-assessed collective responsibility than stayers in 2008, whose scores were unchanged between the two years, the school-average levels of self-assessed collective responsibility increased slightly from 2007 to 2008. Similar patterns are observed for teacher-teacher trust and teach-principal trust, although the year-to-year changes in the school-wide measures were not significant. Overall peer collective responsibility rose between 2007 and 2008 despite newcomers reporting lower levels of peer collective responsibility than did the previous year's leavers. This is due to an apparent increase in peer collective responsibility scores among stayers, though the difference is not significant. Taken together, these comparisons suggests that the individuals who left WMS between 2007 and 2008 had lower levels of teacher-teacher and teacher-principal trust and lower levels of self-assessed and peer collective responsibility than their colleagues who stayed, and that in 2008, the level of peer collective responsibility among stayers rose compared to 2007.

Table 4.2: Means and standard deviations from 2008 WMS network surveys

Variable	2008 Survey Data		
	All	Stayers	Newcomers
Count	61	53	8
Number of survey responses	57	49	8
Response rate	93.4	92.5	100.0
DEMOGRAPHICS AND EXPERIENCE			
Percent male	38.3	32.7	75.0
Years working at WMS	9.6 (8.0)	10.8 (7.9)	1.4 (1.1)
Years of teaching experience	19.5 (10.8)	20.9 (9.8)	11.2 (13.7)
Percent with subject-area endorsement	63.9	62.3	0.75
Percent with graduate degree	57.4	50.9	50.0
COLLECTIVE RESPONSIBILITY			
Collective responsibility, self ²	2.16 (1.38)	2.24 (1.38)	1.68 (1.35)
Collective responsibility, peer ³	3.67 (2.43)	3.80 (2.47)	2.73 (2.05)
TRUST			
Teacher-teacher trust ⁴	3.89 (2.47)	3.87 (2.55)	4.00 (2.10)
Teacher-principal trust ⁵	6.08 (2.09)	6.13 (2.17)	5.78 (1.65)
NETWORK MEASURES			
Out-degree	3.03 (2.93)	2.91 (2.85)	3.88 (3.52)
In-degree	3.03 (2.93)	3.08 (3.00)	2.75 (2.60)
Betweenness	52.0 (102.6)	57.6 (108.5)	14.8 (29.7)
Egocentric network size	5.48 (3.53)	5.36 (3.63)	6.25 (2.76)
Egocentric density	16.9 (17.4)	17.2 (18.4)	14.9 (8.8)

Standard deviations in parentheses.

¹ Ethnicity is not shown due to high homogeneity; in 2008, 3.3% of the WMS staff was nonwhite.

² Rasch model of *collective responsibility, self*, anchored on 2007 values; scores range from 0.35 to 6.51.

³ Rasch model of *collective responsibility, peer*, anchored on 2007 values; scores range from -1.84 to 8.88.

⁴ Rasch model of *teacher-teacher trust*, anchored on 2007 values; scores range from -0.03 to 9.01.

⁵ Rasch model of *teacher-principal*, anchored on 2007 values; scores range from 0.85 to 8.41.

Table 4.3: Turnover at WMS between 2007 and 2008

2006-07 LEAVERS						
Respondent ID	Gender	Role	Years teaching	Years at WMS	Out-degree	In-degree
3941	Male	Industrial technology teacher	36	36	1	0
7758	—	Mathematics teacher	—	—	0	7
16513	Female	Media specialist	26	10	0	1
16888	Male	Social sciences teacher	33	29	1	2
17897	Male	Mathematics teacher	28	28	0	6
37158	Female	ELA teacher	39	37	1	3
41693	—	School psychologist	—	—	0	0
43856	Female	Secondary counselor	3	1	7	1

2007-08 NEWCOMERS						
Respondent ID	Gender	Role	Years teaching	Years at WMS	Out-degree	In-degree
9973	Male	Mathematics teacher	5	1	2	6
14631	Male	Social sciences teacher	3	1	7	1
21859	Male	6 th grade teacher	10	1	3	4
25798	Male	Industrial technology teacher	0	—	6	0
26837	Female	Media specialist	21	1	0	7
32003	Male	ELA teacher	2	1	3	2
34740	Female	School psychologist	8	1	0	1
36874	Male	Secondary counselor	41	4	10	1

In contrast with the modest changes in trust at WMS, the data suggest substantial changes in the structure of the WMS advice network between 2007 and 2008. Change in the advice network becomes apparent with a preliminary examination of the data from these years. Overall, the density of ties in the combined advice network dropped slightly, from 5.4% (196 directed ties among 61 actors) to 5.1% (185 directed ties among 61 actors), despite a higher response rate for the 2008 network survey. Given an average out-degree of 3.21 and survey data on three additional actors in 2008, one might expect the density to have increased slightly. A change in the pattern of reported advice-

seeking behavior, suggested by the observed decline in network density, can be better understood by examining the effects of turnover and tie stability.

Table 4.3 presents a list of the people who left in 2007 and the people who were new in 2008. The four departing teachers for whom data are available had an average of 34.0 years of teaching experience and had been working at WMS for an average of 32.5 years. Their replacements were uniformly less experienced, with an average of just 4.2 years of teaching experience and, of course, just one year of experience at WMS. (Note that the 4 years working at WMS for the secondary counselor who arrived in 2008 with 41 years of professional experience may indicate a return to WMS following an absence in 2007.) The change in the experience levels between the 2007 leavers and the 2008 newcomers is echoed in their network activity. The four teachers who completed the 2007 network survey account for just 3 outbound ties in the advice network while collectively receiving 18 advice ties. Together with the others who left in 2007, and accounting for ties between the leavers, the departure of 8 people accounts for the termination of 26 advice ties in the 2007 network.

In contrast, the 8 newcomers contribute 50 advice ties to the 2008 network, a net gain of 24 ties. The five teachers who were new in 2008 sent 21 advice-seeking ties and received 13 advice-seeking ties from their colleagues. Most of these interactions were between newcomers and incumbents. Just 1 of the 21 outbound ties was directed from a newcomer teacher (25798, a novice industrial technology teacher) to a newcomer teacher (9973, a mathematics teacher with 5 years of teaching experience in the spring of 2008). Moreover, just 1 of the 13 inbound advice ties was received by a newcomer teacher (21859, a sixth-grade teacher and the most experienced newcomer) from another

newcomer (36874, a counselor). In summary, turnover appears to contribute substantially to changes in the balance of advice-seeking in WMS, although the effect does not explain the observed drop in overall network density.

In fact, when combined with the overall drop in network density, the net gain in the number of network ties due to turnover suggests a sharp decline in the advice-seeking activity reported by people who remained in the network across the two years. The behavior of a subset of repeat respondents — 45 people who worked in WMS both years and completed both network surveys — provides insight into the stability of reported advice-seeking behavior. The 45 repeat-respondents in this subset account for a total of 174 outbound ties in the combined 2007 advice-seeking network, of which 162 were directed to the 53 individuals who were in the network both years. Only 66 of the 162 advice-seeking ties directed from repeat-respondents to the full group of people who remained in the organization were repeated in 2008, suggesting a stability of 40.7%. Alternatively, stability can be reported in terms of overlap, where overlap is defined to be the number of ties named at both times as a percentage of the total number of ties named at either time (Morgan et al. 1997). Repeat-respondents replaced the 96 ties dropped from the 2007 surveys with 62 new ties in 2008, resulting in an overlap of just 29.5%. One way to think about the 70% of ties that were named in 2007 but not in 2008 is that they represent a set of advice relationships that are accessible but not essential. In other words, while a person may depend on advice from a small number of colleagues — roughly 30% according to the data — and return to them consistently over time, the remaining relationships might be ad hoc, established out of

convenience or to satisfy a particular need at a moment in time, remembered for a short while, and then forgotten.

Prior research suggests that tie stability is linked to the strength of the relationship (Feld, 1997; Suitor et al. 1997; Wellman et al., 1997). In other words, ties to people who are perceived as very supportive or to people with whom an individual interacts very often are more likely to persist. Table 4.4 presents the mean frequency weight assigned to stable, dropped, and new advice ties in WMS in the 2007 and 2008 network surveys. Tie stability in the network is strongly associated with the frequency of advice seeking interactions indicated by the respondents. In the 2007 network survey, respondents assigned a higher frequency weight to stable advice ties than to ties that were dropped in 2008, $t(160) = 2.62$, $p < 0.01$. Similarly, in the 2008 network survey, respondents assigned a higher frequency weight to repeated advice ties than to new ties, $t(126) = 2.10$, $p < 0.05$. On average, respondents assigned a higher frequency weight to new 2008 ties than to dropped 2007 ties, though the difference was not statistically significant, $t(156) = -0.85$, $p = 0.40$. Combined with the lower overall number of new ties reported in 2008, the higher mean frequency of new 2008 ties suggests that individuals taking the survey for a second time may have opted not to document low-frequency interactions, although this proposition cannot be verified with the available data.

Table 4.4: Frequency weights of advice-seeking ties linking people on staff in both years

	2007	2008
Stable ties (n = 66)	2.89 (0.98)	3.00 (0.99)
Dropped ties (n = 96)	2.46 (1.06)	—
New ties (n = 62)	—	2.61 (1.11)

Standard deviations in parentheses.

Sample includes all directed advice ties for which *ego* is a person who was on staff in 2007 and 2008 and who responded to the network survey in both years (n = 45), and *alter* is a person who was on staff in 2007 and 2008 (n = 53).

The above analyses reveal substantial changes in the instructional advice network at WMS between 2007 and 2008. The low stability of ties reported by repeat-respondents, combined with the effects of turnover, suggests that many of the advice-seeking relationships reported in 2008 were new. Figures 4.2 and 4.3 provide a visual depiction of how the structure of the advice networks changed from year to year; the key in each figure identifies the roles performed by the actors shown in the sociograms. The sociograms depict non-overlapping cohesive subgroups into which people are informally organized by their advice-seeking relationships. Data for these sociograms were generated using *KliqueFinder* (Frank, 1995, 1996).³ Tables 4.5 and 4.6 summarize the characteristics of individuals in each subgroup for 2007 and 2008, respectively. While the diagrams are presented here to illustrate the extent of the changes in reported advice-seeking interactions, it is worth noting the instances where subgroup assignment is strongly linked to role: for sixth-grade teachers (many of whom appear to have joined WMS together four years prior to the survey) and for health/PE teachers. In the 2008 sociogram, music teachers are also isolated in their own subgroup, and the survey responses suggest health/PE teachers are completely isolated. The concentration of

some roles and the relatively strong mixing of others is likely linked to the design of the network survey, in which all staff members, including those whose primary subject was not RWLA or mathematics, were asked to indicate who they turn to for advice about RWLA and mathematics. Absent that common domain, the advice networks might be considerably more sparse and groups comprising common roles more isolated, as each respondent would have only provided names associated with advice seeking in their primary subject.

Figure 4.2: Washington Middle School 2007 cohesive subgroups

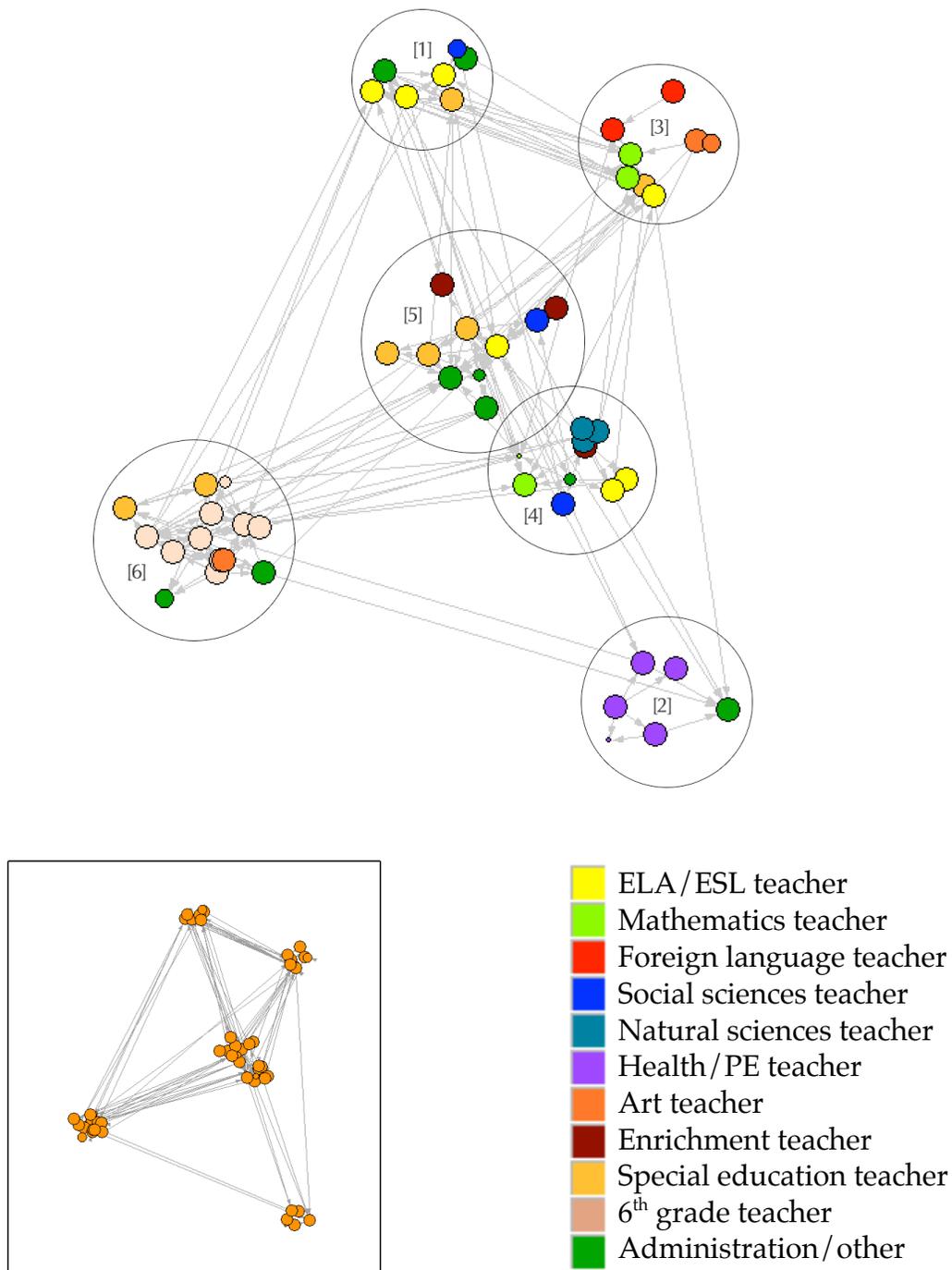


Figure 4.3: Washington Middle School 2008 cohesive subgroups

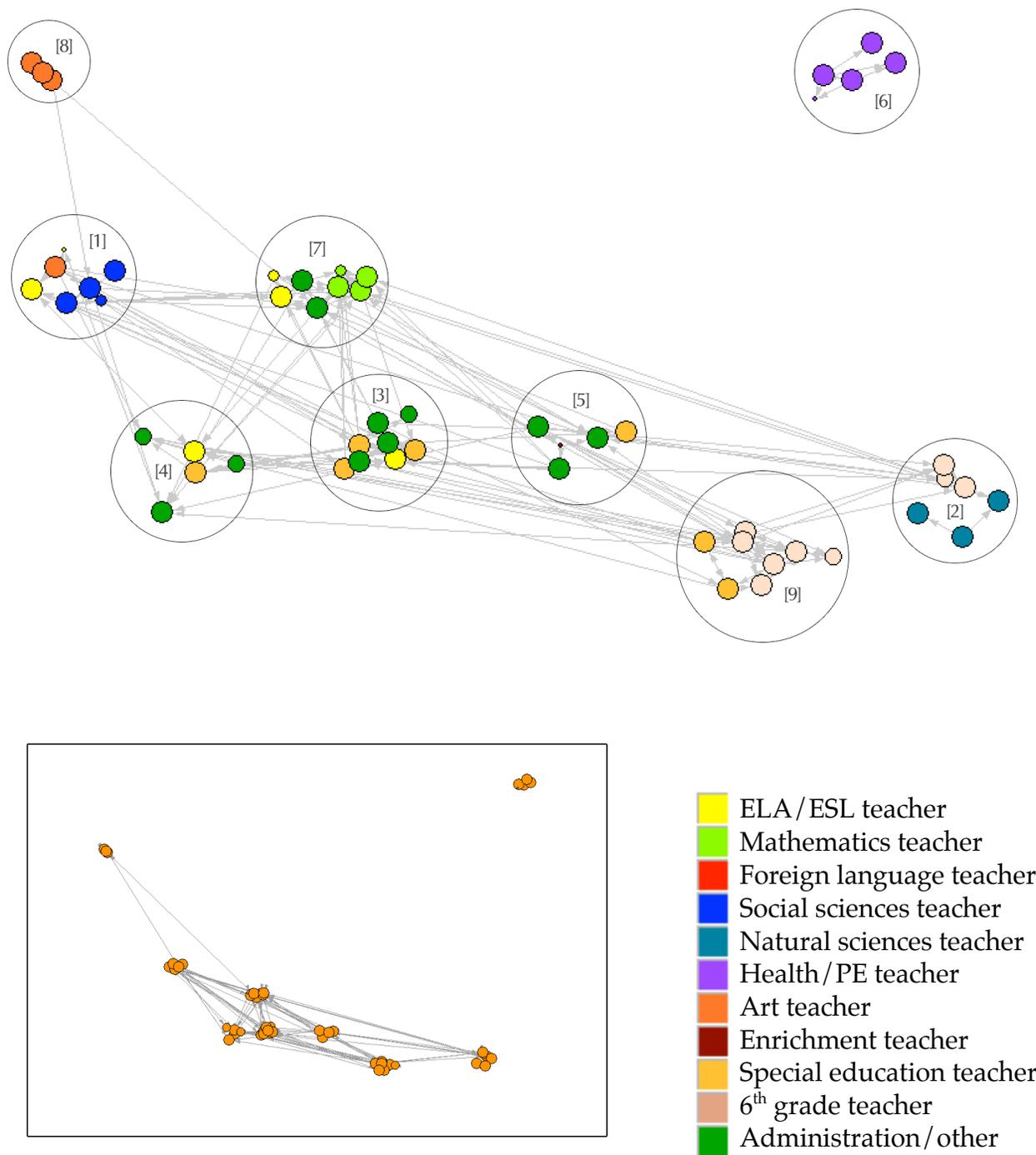


Table 4.5: Advice network cohesive subgroups in WMS, 2007 network survey data

Respondent ID	Gender	Role	Years teaching	Years at school	Leaves at end of 2007
<i>Subgroup 1</i>					
17633	Female	ELA teacher	32	28	
19821	Female	ELA teacher	11	4	
25450	Female	ELA teacher	31	10	
29919	Male	Social sciences teacher	20	20	
41638	Female	Special education teacher	7	4	
16513	Female	Media specialist	26	10	YES
41650	Female	Secondary counselor	25	12	
<i>Subgroup 2</i>					
17726	Male	Health, PE teacher	29	24	
18248	Male	Health, PE teacher	28	13	
18700	Male	Health, PE teacher	7	4	
23711	—	Health, PE teacher	—	—	
31923	Male	Health, PE teacher	33	28	
22899	Male	Principal	7	10	
<i>Subgroup 3</i>					
11117	Female	ELA teacher	31	9	
2092	Female	Mathematics teacher	37	26	
31698	Male	Mathematics teacher	6	6	
6617	Female	Foreign language teacher	18	12	
43316	Female	Foreign language teacher	25	6	
11069	Male	Music teacher	29	9	
24644	Female	Music teacher	19	3	
10091	Female	Special education teacher	25	12	
<i>Subgroup 4</i>					
30364	Female	ELA teacher	6	6	
37158	Female	ELA teacher	39	37	YES
7758	—	Mathematics teacher	—	—	YES
17897	Male	Mathematics teacher	28	28	YES
16888	Male	Social sciences teacher	33	29	YES
16187	Female	Natural sciences teacher	34	10	
24797	Female	Natural sciences teacher	13	8	
26606	Male	Natural sciences teacher	4	4	
4702	Female	Business teacher	10	4	
43856	Female	Secondary counselor	3	1	YES

Table 4.5 (continued)

Respondent ID	Gender	Role	Years teaching	Years at school	Leaves at end of 2007
<i>Subgroup 5</i>					
24559	Female	ELA teacher	27	16	
43758	Female	Social sciences teacher	25	9	
3941	Male	Industrial technology teacher	36	36	YES
29350	Female	Family consumer science teacher	34	21	
15560	Female	Special education teacher	12	9	
25223	Female	Special education teacher	25	21	
27888	Male	Special education teacher	12	12	
28576	Female	Speech pathologist	32	9	
34009	Female	Speech pathologist	4	3	
44112	Female	Program coordinator	32	5	
<i>Subgroup 6</i>					
3967	Female	6 th grade teacher	15	4	
7229	Female	6 th grade teacher	20	18	
9349	Female	6 th grade teacher	10	4	
11240	Male	6 th grade teacher	24	4	
12400	Male	6 th grade teacher	16	4	
12894	Female	6 th grade teacher	24	4	
21063	Female	6 th grade teacher	4	2	
31135	Male	6 th grade teacher	19	4	
31421	Female	6 th grade teacher	18	4	
43040	Female	Music teacher	22	10	
24163	Female	Special education teacher	20	4	
39556	Male	Special education teacher	9	8	
12601	Female	Secondary counselor	11	7	
44470	Male	Assistant principal	15	3	
<i>Unaffiliated</i>					
8372	Female	Social sciences teacher	32	12	
6457	Male	Art teacher	29	29	
11329	Male	Music teacher	3	3	
19440	Female	Computer teacher	32	31	
37417	Female	School nurse	16	6	
41693	—	School psychologist	—	—	YES

Table 4.6: Advice network cohesive subgroups in WMS, 2008 network survey data

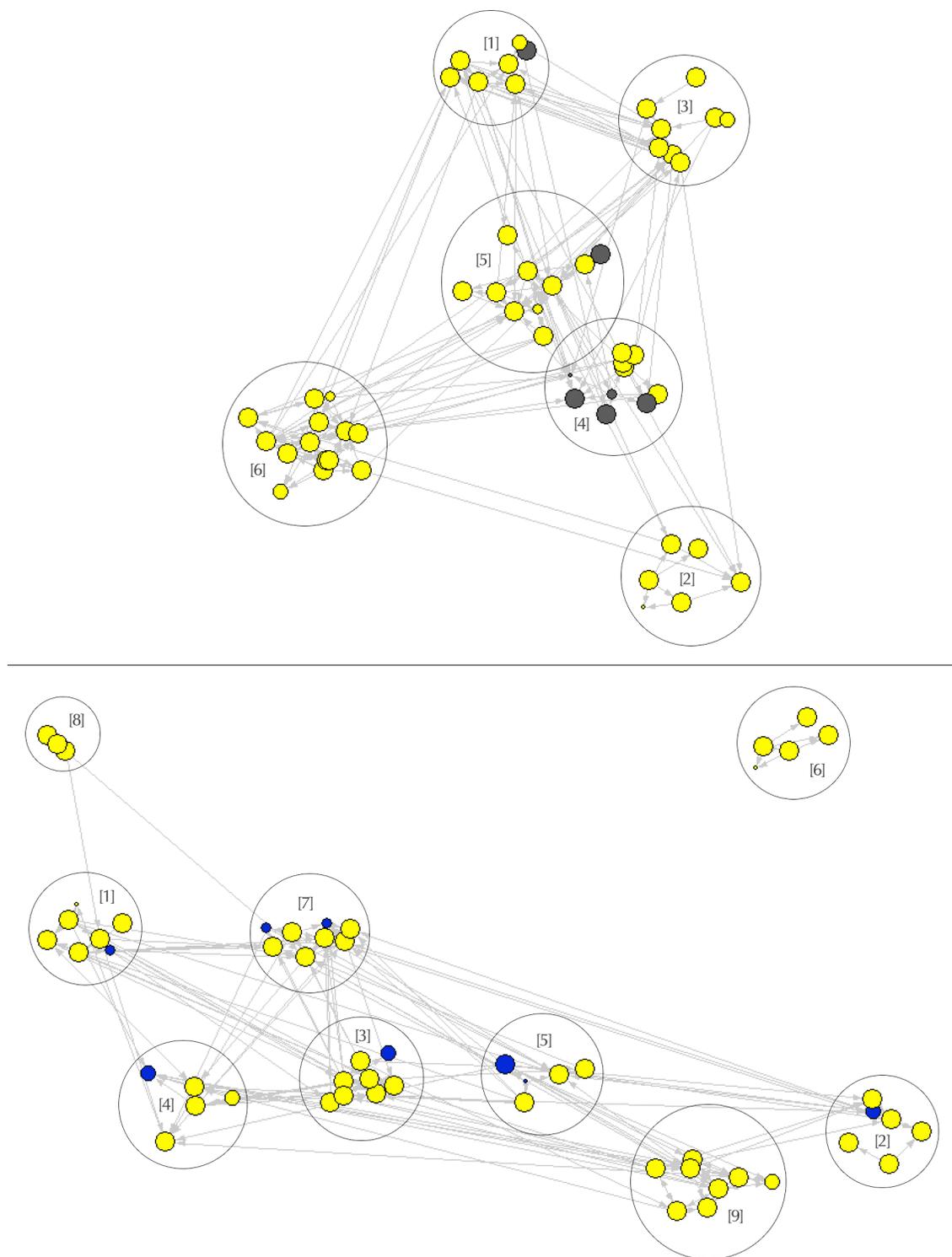
Respondent ID	Gender	Role	Years teaching	Years at school	New in 2007–2008
<i>Subgroup 1</i>					
19821	Female	ELA teacher	12	5	
25450	Female	ELA teacher	30	11	
8372	Female	Social sciences teacher	33	13	
14631	Male	Social sciences teacher	3	1	YES
29919	Male	Social sciences teacher	21	8	
43758	Female	Social sciences teacher	26	10	
43040	Female	Music teacher	23	10	
<i>Subgroup 2</i>					
16187	Female	Natural sciences teacher	35	26	
24797	Female	Natural sciences teacher	14	9	
26606	Male	Natural sciences teacher	5	5	
12400	Male	6 th grade teacher	17	5	
21859	Male	6 th grade teacher	10	1	YES
31135	Male	6 th grade teacher	19	5	
<i>Subgroup 3</i>					
24559	Female	ELA teacher	27	17	
15560	Female	Special education teacher	13	10	
25223	Female	Special education teacher	26	21	
41638	Female	Special education teacher	8	5	
34009	Female	Speech pathologist	5	4	
34740	Female	School psychologist	8	1	YES
37417	Female	School nurse	22	7	
44112	Female	Program coordinator	33	6	
<i>Subgroup 4</i>					
11117	Female	ELA teacher	32	10	
17633	Female	ELA teacher	33	28	
10091	Female	Special education teacher	25	17	
26837	Female	Media specialist	21	1	YES
28576	Female	Speech pathologist	30	2	
<i>Subgroup 5</i>					
25798	Male	Industrial technology teacher	0	—	YES
27888	Male	Special education teacher	13	13	
12601	Female	Secondary counselor	14	8	
36874	Male	Secondary counselor	41	4	YES
44470	Male	Assistant principal	16	4	

Table 4.6 (continued)

Respondent ID	Gender	Role	Years teaching	Years at school	New in 2007–2008
<i>Subgroup 6</i>					
17726	Male	Health, PE teacher	31	26	
18248	Male	Health, PE teacher	29	13	
18700	Male	Health, PE teacher	8	5	
23711	—	Health, PE teacher	—	—	
31923	Male	Health, PE teacher	35	29	
<i>Subgroup 7</i>					
30364	Female	ELA teacher	7	7	
32003	Male	ELA teacher	2	1	YES
2092	Female	Mathematics teacher	38	27	
9973	Male	Mathematics teacher	5	1	YES
11240	Male	Mathematics teacher	25	5	
31698	Male	Mathematics teacher	7	7	
22899	Male	Principal	8	11	
41650	Female	Secondary counselor	30	12	
<i>Subgroup 8</i>					
11069	Male	Music teacher	31	10	
11329	Male	Music teacher	4	4	
24644	Female	Music teacher	21	4	
<i>Subgroup 9</i>					
3967	Female	6 th grade teacher	16	5	
7229	Female	6 th grade teacher	20	5	
9349	Female	6 th grade teacher	11	5	
12894	Female	6 th grade teacher	25	5	
21063	Female	6 th grade teacher	12	2	
31421	Female	6 th grade teacher	19	6	
24163	Female	Special education teacher	21	5	
39556	Male	Special education teacher	10	9	
<i>Unaffiliated</i>					
6617	Female	Foreign language teacher	20	14	
43316	Female	Foreign language teacher	26	7	
4702	Female	Business teacher	10	5	
6457	Male	Art teacher	30	30	
19440	Female	Computer teacher	33	32	
29350	Female	Family consumer science teacher	35	24	

Figure 4.4 presents another view of the 2007 and 2008 sociograms, indicating by color code the individuals who left in 2007 and those who arrived in 2008. Five of 8 leavers, including 4 of the 5 departing teachers, were assigned to subgroup [4] in the KliquesFinder analysis. In contrast, the 8 newcomers in 2008 are distributed across six different subgroups, and tend to be grouped together with colleagues who perform the same or similar role in the school. (For example, the new school psychologist is in a group with one of the school's speech pathologists and the school nurse.) The diagrams suggest that changes in the subgroup structure, like changes in the overall number of advice ties in the school, may be associated with turnover. The departure of teachers with high levels of experience and organizational tenure, who were positioned together near the center of the network, may have contributed to a breakdown of sorts in the overall structure of advice relationships. Because those teachers attracted many advice-seeking ties — particularly the two math teachers who, between them, were nominated by 13 colleagues — their presence created a hub near the center of the network to which many colleagues were connected. When those teachers departed and severed their advice ties, colleagues who had been linked to one of the departing teachers were, in a sense, no longer bound to the central hub formed by these veterans. Moreover, the arrival of new teachers with, on average, less experience and a higher level of advice-seeking activity may have, in essence, pulled the network apart into subgroups that are more strongly linked to roles.

Figure 4.4: Washington Middle School 2007 leavers and 2008 newcomers



It is important to note that the building renovation that was taking place during the time of this study may have played a role in the changes that have been observed in the structure of the advice network at WMS. Teachers who leave their old classrooms, move into temporary space, and then settle into new classrooms may find that people to whom they turned for advice because of proximity were no longer readily available as information resources. In other words, teachers who often turn to their neighbors for advice would report a different network if their neighborhood changed as a result of the renovation. Unfortunately, no information is available regarding who moved and the timing of the moves over the course of the renovation project, so the precise impact of the renovation on the structure of teachers' networks cannot be determined.

Taken together, the above analyses point to an extremely dynamic advice network at WMS. Turnover resulted in the termination of advice ties involving those who left the organization and the addition of new ties linked to organizational newcomers. Low tie stability among those who remained at the school further affected the network, with more than half of the advice relationships reported by stayers in 2007 being dropped in 2008. Together, the lower number of ties reported by stayers and the addition of ties involving newcomers resulted in a shift of the overall pattern of interactions, as illustrated in the sociograms. The next section presents the results of a SIENA model that attempts to explain some of the dynamics behind these changes.

Network Evolution

The findings outlined in the previous section reveal that there were significant changes in the WMS advice network between 2007 and 2008. Changes in the school staff

due to turnover and changes in people's peripheral networks as reported in the network survey resulted in changes in the structure of the network. In this section, a series of network evolution models are presented to characterize the dynamics of those structural changes and to investigate the extent to which parameters that explained the cross-sectional structure of the 2007 advice networks in a p_2 model (Chapter 2 of this dissertation) are predictive in a longitudinal SIENA model.

Table 4.7: SIENA model, matched parameters from p_2 selection model (Ch. 2), estimates and standard errors for advice network evolution

	Model 7-1			Model 7-2		
	Estim.	S.E.	p	Estim.	S.E.	p
Network rate parameter	10.04	1.41		13.61	1.82	
Effect of newcomer status on rate	0.45	0.23	0.05	0.52	0.31	0.09
INDIVIDUAL ATTRIBUTES						
Newcomer, <i>ego</i>	0.15	0.13	0.23	-0.02	0.13	0.85
Newcomer, <i>alter</i>	0.08	0.13	0.55	0.17	0.16	0.30
Newcomer, <i>same</i>	-0.12	0.12	0.30	-0.18	0.14	0.21
RWLA teacher, <i>alter</i>	-0.14	0.13	0.29	0.16	0.19	0.41
Math teacher, <i>alter</i>	0.21	0.14	0.13	0.13	0.16	0.41
Role, <i>same</i>	0.56	0.16	< 0.001	0.55	0.16	< 0.001
Reviews district stds, <i>alter</i>	0.07	0.07	0.30	0.03	0.08	0.71
Collective responsibility, <i>ego</i>	0.01	0.03	0.65	-0.01	0.03	0.82
Male, <i>same</i>	0.24	0.12	0.051	0.25	0.13	0.061
Subgroup, <i>same</i>	0.31	0.19	0.10	0.32	0.21	0.13
Subgroup, <i>same</i> x Reciprocity	-0.34	0.48	0.49	-0.35	0.55	0.53
NETWORK EFFECTS						
Out-degree (density)	-1.85	0.12	0.12	-2.08	0.50	< 0.001
Reciprocity	0.56	0.33	0.33	1.31	0.47	0.005
3-cycles				-0.19	0.29	0.52
Transitive ties				1.10	0.24	< 0.001
In-degree prestige (sqrt)				0.23	0.12	0.056
Out-degree prestige (sqrt)				-0.96	0.27	< 0.001
Out-degree activity (sqrt)				0.19	0.08	0.016

The parameter estimates and standard errors are presented for every effect included in the model. The p-values are an indication of the statistical significance of the parameter estimates and were obtained by referring the t-ratio (estimate divided by standard error) to a standard normal distribution, which is possible because the parameter estimates generated by SIENA have been found to be approximately normally distributed (Snijders et al., 2009).

Table 4.7 presents two SIENA models that have been constructed to reflect the theoretical framework for information seeking described in Chapter 2 and to align closely with the p_2 model shown in Table 2.6. Hence, the models in Table 4.7 include ego (sender) effects for newcomer status and collective responsibility; alter (receiver) effects for newcomer status, being either an RWLA or mathematics teacher, and reviewing district standards; similarity effects for newcomer status, professional role, 2007 subgroup, and gender, and an interaction term between same subgroup and reciprocity. Whereas Model 7-1 includes an out-degree (density) effect and a reciprocity effect, which are consistent with the p_2 model in Table 2.6, Model 7-2 includes additional structural features that can be investigated using a SIENA model but not a p_2 model. Finally, the SIENA models include rate parameters — one for the overall rate of network change and one for the effect of being a newcomer on the rate of network change. The overall rate parameter represents the expected frequency with which actors have an opportunity to change a network tie. (Note that because a rate of zero would suggest no changes in the network, a nonsensical outcome in a properly specified evolutionary model, a p-value is not shown for the overall rate parameter.) The effect of newcomer status on rate is a measure of the extent to which newcomers differ from incumbents with regard to how often they change their ties, which might be expected given that 8 new staff members entered the school with no ties and collectively accounted for 24 ties by the spring.

Model 7-1 is the closest comparator to the p_2 model in Chapter 2 from among the SIENA models presented here. The results reveal distinct differences between the models, and several parameters that were effective in explaining the static structure of

the advice networks are not predictive in the evolutionary model. In fact, only two of the parameters suggested by the p_2 model are significant in Model 7-1: the effect of having the same professional role and the effect of being the same gender are both positively associated with the likelihood that a person will choose to establish a relationship with a particular colleague.

Although Model 7-1 provides a relatively direct comparison between the predictions of the p_2 model and the predictions of a SIENA model, it is, in two important ways, incomplete. First, the model omits network structure effects that may offer additional insight into the factors that contribute to actors' decisions about their networks. Such structural effects are possible in a SIENA model because the simulation procedure takes account of the overall network configuration at every iteration, whereas the p_2 models is based strictly on the arrangement of ties between two members of a dyad. Second, Model 7-1 omits effects that make it possible to determine a given parameter's overall contribution to the objective function. Model 7-2 begins to address the former issue, while the models presented in Tables 4.8 and 4.9 address the latter issue.

Model 7-2 extends Model 7-1 with the addition of five network structure effects that were introduced in the Analysis section of this chapter. Specifically, Model 7-2 includes effects for three-cycles, transitive ties, in-degree and out-degree prestige, and out-degree activity. The parameter estimates for the structure effects in Model 7-2 suggest that network structure plays a significant role in the evolution of the WMS advice network. The three-cycles effect is the only structural effect that is not statistically significant in Model 7-2, though the negative value of the three-cycles effect

— combined with the large, positive, and statistically significant transitive ties effect — is consistent with the idea that the advice network follows a hierarchy, with individuals generally seeking advice from those who have more knowledge, expertise, or status.

Table 4.8 presents two models that extend the models in Table 4.7 by completing the specifications for the included parameters. For example, Model 7-1 and Model 7-2 only include an ego effect for collective responsibility. In other words, collective responsibility was only modeled in terms of its contribution to an actor's decision to send (or withdraw) a network tie. Model 8-1 and Model 8-2 add alter and similarity effects for collective responsibility. By including all three effects, it is possible to determine the overall contribution of collective responsibility to the objective function that guides actors' advice network choices in the simulation (Snijders et al., 2009). Specific examples of this computation will be described below. Table 4.8 replicates Table 4.7 with the addition of alter, ego, and similarity effects that complete the specification for the reviews district standards parameter, the collective responsibility parameter, and the gender parameter. The RWLA and math teacher parameters are extended by adding ego effects; their similarity effects are captured within the more general effect for same role. Separate ego and alter effects were not added for the 11-category role parameter and the 6-category subgroup parameter because adding parameters for each category would result in more parameters than the current version of the SIENA software can handle. The addition of the new effects in Model 8-1 and Model 8-2 reveal that several parameters may contribute to network evolution in ways that were not evident in the cross sectional analysis, including an ego effect for gender and an ego effect for being an RWLA teacher.

Table 4.8: SIENA model, fully specified parameters from p_2 selection model (Ch. 2), estimates and standard errors for advice network evolution

	Model 8-1			Model 8-2		
	Estim.	S.E.	p	Estim.	S.E.	p
Network rate parameter	9.56	0.98		12.25	1.71	
Effect of newcomer status on rate	0.36	0.22	0.10	0.33	0.26	0.21
INDIVIDUAL ATTRIBUTES						
Newcomer, <i>ego</i>	0.17	0.14	0.21	0.06	0.14	0.66
Newcomer, <i>alter</i>	0.07	0.14	0.60	0.15	0.16	0.33
Newcomer, <i>same</i>	-0.13	0.12	0.29	-0.18	0.16	0.29
RWLA teacher, <i>ego</i>	-0.22	0.19	0.24	-0.36	0.18	0.050
RWLA teacher, <i>alter</i>	-0.11	0.16	0.46	-0.03	0.18	0.85
Math teacher, <i>ego</i>	0.13	0.20	0.52	0.10	0.18	0.57
Math teacher, <i>alter</i>	0.25	0.16	0.13	0.20	0.24	0.40
Role, <i>same</i>	0.56	0.16	< 0.001	0.57	0.16	< 0.001
Reviews district stds, <i>ego</i>	-0.05	0.08	0.51	-0.03	0.07	0.67
Reviews district stds, <i>alter</i>	0.06	0.07	0.42	0.01	0.08	0.88
Reviews district stds, <i>similarity</i>	0.58	0.27	0.035	0.54	0.35	0.12
Collective responsibility, <i>ego</i>	0.03	0.03	0.36	0.01	0.03	0.80
Collective responsibility, <i>alter</i>	0.03	0.03	0.40	0.02	0.04	0.65
Collective responsibility, <i>similarity</i>	-0.14	0.36	0.70	-0.09	0.46	0.84
Male, <i>ego</i>	0.24	0.15	0.12	0.27	0.15	0.067
Male, <i>alter</i>	0.06	0.14	0.67	0.07	0.16	0.65
Male, <i>same</i>	0.31	0.13	0.012	0.28	0.16	0.073
Subgroup, <i>same</i> (density)	0.33	0.20	0.11	0.29	0.24	0.24
Subgroup, <i>same</i> (reciprocity)	-0.36	0.45	0.42	-0.24	0.57	0.68
NETWORK EFFECTS						
Out-degree (density)	-1.90	0.13	< 0.001	-2.47	0.58	< 0.001
Reciprocity	0.56	0.34	0.10	1.22	0.48	0.012
3-cycles				-0.26	0.30	0.38
Transitive ties				1.16	0.29	< 0.001
In-degree prestige (sqrt)				0.25	0.14	0.069
Out-degree prestige (sqrt)				-0.82	0.32	0.012
Out-degree activity (sqrt)				0.22	0.08	0.007

The parameter estimates and standard errors are presented for every effect included in the model. The p-values are an indication of the statistical significance of the parameter estimates and were obtained by referring the t-ratio (estimate divided by standard error) to a standard normal distribution, which is possible because the parameter estimates generated by SIENA have been found to be approximately normally distributed (Snijders et al., 2009).

The models in Table 4.8 also include several predictors for which parameter estimates have been close to zero and not statistically significant in all variations of the evolutionary model presented so far. Following a forward and backward stepwise model specification procedure described by Snijders et al. (2009), the model was refined to achieve the final version presented in Table 4.9. The final model was not obtained by simply deleting any effects that failed to achieve statistical significance. Non-significant effects may remain in the model because they complete the specification for a model parameter, such as gender (as described above); because they are theoretically justified and non-significant findings are meaningful; or because their absence leads to instability in model estimation (Snijders et al., 2009). The model in Table 4.9 is an evolutionary model of the WMS advice network that was developed based on the results of a cross-sectional p_2 model. It is conceivable that a different model would have been obtained if the model specification process started with different assumptions.

An examination of the parameter estimates suggests some interesting features for the evolutionary process of the WMS advice network. As anticipated, the positive effect of newcomer status on the rate of change suggests that newcomers at WMS change their advice ties more frequently than incumbents, a difference that is significant at the 0.10 level. This rate effect can be attributed to the fact that newcomers are forming ties and building a set of stable relationships whereas incumbents already have a set of stable relationships (recall that 40% of incumbents' ties were repeated in the second year) and are changing on their periphery.

Table 4.9: SIENA model estimates and standard errors for advice network evolution

	Estim.	S.E.	p
Network rate parameter	11.30	1.40	
Effect of newcomer status on rate	0.41	0.23	0.078
INDIVIDUAL ATTRIBUTES			
RWLA teacher, <i>ego</i>	-0.23	0.14	0.11
RWLA teacher, <i>alter</i>	0.08	0.19	0.66
Role, <i>same</i>	0.63	0.18	< 0.001
Reviews district standards, <i>ego</i>	-0.02	0.07	0.80
Reviews district standards, <i>alter</i>	0.05	0.07	0.50
Reviews district standards, <i>similarity</i>	0.51	0.31	0.10
Male, <i>ego</i>	0.31	0.14	0.022
Male, <i>alter</i>	0.13	0.16	0.43
Male, <i>same</i>	0.26	0.14	0.060
NETWORK EFFECTS			
Out-degree (density)	-1.78	0.54	< 0.001
Reciprocity	1.07	0.35	0.002
3-cycles	-0.32	0.27	0.23
Transitive ties	1.35	0.26	< 0.001
In-degree prestige (square root)	0.16	0.13	0.20
Out-degree prestige (square root)	-0.93	0.37	0.012
Out-degree activity (square root)	0.11	0.08	0.20

The parameter estimates and standard errors are presented for every effect included in the model. The p-values are an indication of the statistical significance of the parameter estimates and were obtained by referring the t-ratio (estimate divided by standard error) to a standard normal distribution, which is possible because the parameter estimates generated by SIENA have been found to be approximately normally distributed (Snijders et al., 2009).

The network effects and individual attributes offer some insight into factors that may guide actors' decisions about forming and withdrawing ties in the advice network. As noted previously, the out-degree and reciprocity effects are included by convention

in every SIENA model to control for overall characteristics of the observed networks. The out-degree effect controls for the overall tendency for people to form advice ties in the observed WMS network and, in essence, constrains the total number of ties that the simulation generates among the actors. Similarly, the reciprocity effect controls for the overall tendency for people to reciprocate advice ties in the observed WMS network. The negative value for the density effect reflects the fact that the observed network is fairly sparse with an overall density below 50%. The positive reciprocity effect indicates that there is a tendency for actors to seek advice from colleagues to whom they already provide advice. Together with the non-significant negative estimate for three-cycles, the reciprocity parameter suggests that people in the network tend to collaborate with colleagues by reciprocating an advice relationship within a dyad and tend not to close triadic relationships by forming a three-cycle. The positive parameter estimate for transitive ties is statistically significant, and indicates that an actor is more likely to form a tie with a target individual if at least one person exists as an intermediary. This finding makes sense in the context of an advice network. If a person is considering whether to seek advice from a coworker, the likelihood of choosing to form that tie is greater if there is anybody in the first person's existing network who already seeks advice from that coworker.

The three effects associated with network activity levels were included in the model. The estimate for in-degree prestige, which captures the tendency for actors who are sought out for advice by many people in the network to receive still more ties from colleagues, is not significant. Thus, by itself, being a target of advice-seeking from many colleagues (*i.e.*, having a high in-degree) does not increase the likelihood that one will

be sought out by others. In contrast, the estimate for out-degree prestige is large, statistically significant, and negative. In the WMS advice network, people who tend to seek advice from many others (*i.e.*, have a high out-degree), are unlikely to be sought out for advice themselves. One interpretation of this result is that people who are known to seek a lot of advice are perceived as not having much advice to offer. From a utility perspective (Frank & Maroulis, 2009), this finding reflects the idea that people will not choose to seek advice from a person who is not likely to provide advice that is useful. Alternatively, the out-degree prestige effect may be operating as a structural alternative to an individual attribute effect (Snijders et al., 2009), such as being an organizational newcomer. In other words, the out-degree prestige effect may be capturing the tendency for organizational newcomers to seek advice from many people while simultaneously being sought out for advice less often than their colleagues. In a sense, the out-degree prestige measure could be thought of as embodying a combined newcomer ego/alter effect, which might be indicated by changes in the separate newcomer ego and newcomer alter affects between Model 8-1, which omitted structural effects, and Model 8-2, in which the structural effects were added.

The out-degree activity effect is positive though not statistically significant. This parameter would suggest that people who already seek advice from many colleagues are somewhat more likely to add another outbound advice-seeking tie when the opportunity arises. In the context of the WMS advice network, this result could reflect the behavior of several of the 2008 newcomers, whose out-degrees exceeded the overall school average out-degree by a factor of two or more. With regard to the individual attributes included in the model, the findings suggest that males tend to be more active

in the advice-seeking network than females, and that actors are more likely to seek advice from colleagues who are the same gender and who perform the same professional role. From a utility perspective, the result for the same role effect can be interpreted as suggesting that people seek advice from others who are most likely to be able to provide useful advice, as would be the case for a same-role colleague as compared to a colleague who occupies a different role.

As noted previously, it is possible to compute a parameter's overall contribution to the objective function by including ego, alter, and similarity effects in a given model (Snijders et al., 2009). To illustrate this procedure, the overall contribution of the gender was computed using the estimates from the model in Table 4.9 and the procedure described by Snijder et al. The results of this calculation are shown in Table 4.10. The values in the table represent the contribution a single tie would make to an actor's objective function, considering only gender-related effects. The values show that both males and females prefer to seek advice from same-gender colleagues, that the relative preference for a same-gender advice relationship is much stronger for males than for females, and that for females, an advice relationship with a male actually subtracts slightly from the overall value of the objective function.

Table 4.10: Contribution of gender to the value of the objective function

Ego	Alter	
	Female	Male
Female	0.087	-0.043
Male	0.137	0.527

Values based on parameter estimate from the SIENA model in Table 4.9

The results of the SIENA models described above provide insight into factors that contribute to the evolution of the advice network in WMS between 2007 and 2008. In each of the models shown, the transitive ties triadic closure effect was found to be a strong predictor of network evolution in this school. The transitive ties effect, as shown in Figure 4.1, describes a simple transformation in which the existence of the $i \rightarrow h \rightarrow j$ tie pattern in 2007 would lead to the formation of an $i \rightarrow j$ tie in 2008. It might be asked whether the significance of this effect could be determined using a simpler method than SIENA modeling. To examine this possibility, simple inspection was used to enumerate the triads in the 2007 network that, in any arrangement of the three actors, included the $i \rightarrow h \rightarrow j$ tie pattern. The analysis revealed 628 such triads. Of those 628 triads, 236 already included the $i \rightarrow j$ tie that is indicative of transitive closure, leaving 392 cases for which a tendency toward transitive closure might be revealed by inspecting the 2008 data. Evidence of the transitive ties effect would be provided if triads with the $i \rightarrow h \rightarrow j$ tie pattern in 2007 were found to have added the $i \rightarrow j$ tie in 2008 at a significant rate.

An examination of the 2008 network data reveals that clear-cut evidence of a transitive ties effect is elusive when simply inspecting the 2007 and 2008 networks. Of the 392 cases in which triads included the $i \rightarrow h \rightarrow j$ tie pattern in 2007, 344 no longer fit the prerequisite pattern in 2008. (In other words, either the $i \rightarrow h$ tie or the $h \rightarrow j$ tie did not appear in the 2008 network.) In 31 of those 344 cases, the $i \rightarrow j$ tie appeared in 2008, but the triad could no longer be characterized as closed and simple inspection could not reveal whether the $i \rightarrow j$ tie appeared before or after one of the other two ties was severed. Of the 48 triads that included the $i \rightarrow h \rightarrow j$ tie pattern in both 2007 and 2008, only 4 triads added the $i \rightarrow j$ tie in 2008. Overall, simple inspection of the 2007 and 2008

network data does not provide clear evidence of a transitive ties closure effect in the evolution of the WMS advice network.

Although simple inspection of the network structure at two moments in time has the advantage of being easier to execute and easier to interpret vis-à-vis SIENA modeling, the above analysis suggests that the simpler method may fail to provide insight into how the network evolves. In this regard, one advantage of the SIENA model is that it considers not just the end states of the analysis but also a hypothetical sequence of intermediate states that bridge the two moments in time. A second advantage of the SIENA model is that it allows for the departure and arrival of actors in between the points at which the network is explicitly measured. In essence, a direct comparison of the two end states assumes that the evolution of the network can be meaningfully represented by a single transformation in which changes among the actors and their ties occur simultaneously. By simulating intermediate microsteps between the end states, the SIENA model provides an opportunity to understand how a series of small changes may give rise to the observed differences between snapshots of the network. Finally, a third advantage of the SIENA model is that it adds to the strength of an inference regarding a given factor, such as the transitive ties closure effect, by controlling for other factors that may also influence tie formation. Even if simple inspection had revealed a tendency toward transitive closure, it would not have been able to distinguish that effect from other factors that may have contributed to the formation of an $i \rightarrow j$ tie in 2008.

Discussion and Conclusion

A key goal of this study was to understand how much the WMS advice network changed from year to year and to what extent changes were associated with organizational turnover and the instability of network ties reported by people who remained in the school. Through a series of analyses, it became clear that despite surface similarities between the 2007 and 2008 advice networks—same number of actors, same roles, and comparable network density—there were substantial changes in the composition and structure of the WMS advice network. The low turnover at WMS resulted in considerable “brain drain,” as five veteran teachers who were, on the whole, advisors to the network (the sum of their in-degrees exceeded the sum of their out-degrees by a factor of 6) were replaced by five relative novices who sent 50% more advice-seeking ties than they received. This, combined with the overall tendency for repeat-respondents to name fewer alters in 2008 than in 2007, shifted the balance of network ties such that advice-based subgroups in 2008 were smaller and more strongly characterized by professional role, a tendency that was captured by a significant same-role effect in the SIENA network evolution model. The crystallized sociograms further reveal that the subgroups in 2007 were positioned around a central core. When that core was disrupted and the departing teachers were replaced by organizational newcomers, the subgroup structure in WMS shifted away from the core. Thus, in addition to the loss of veteran teachers’ expertise due to turnover, the transformation of the subgroup structure in the WMS suggests that information exchange across the staff may have suffered.

Yet, it is not entirely obvious that the consequences of turnover at WMS are as altogether dire as the above description suggests. Although the school clearly suffered a loss in terms of the aggregate experience of the veteran teachers who departed, the leavers also carried away a set of attitudes that likely were not contributing to the success of the school. In the 2007 survey, the individuals destined to leave the school reported much lower levels of collective trust in other teachers, trust in the principal, and both peer and self-assessed collective responsibility than did the individuals who remained in the school. While the exact circumstance behind the departure of eight WMS staff members between 2007 and 2008 cannot be known from the data that are available, one could argue that the school benefited from their departure. Trust among the adults in a school has been positively linked to teacher retention, the successful implementation of school improvement efforts, and the academic success of students (Allensworth et al., 2009; Bryk & Schneider, 1996, 2002). Collective responsibility, when aggregated across individuals and used as an organizational property of schools, has been positively linked to student learning (Lee & Loeb, 2000; Lee & Smith, 1996). Thus, although the loss of veteran teachers and the possibility of the aforementioned “brain drain” is an aspect of teacher turnover with which schools must be concerned, in the case of WMS, the departure of this particular group of educators between 2007 and 2008 may ultimately prove to be a good thing. If the school was able to replace the leavers with newcomers whose attitudes were more positive, as the 2008 survey results suggest they were, and if the newcomers stay with the school and develop their expertise by gaining experience and collaborating with colleagues, then there is a chance that this

particular instance of turnover will be one of those cases where the consequences are more positive than negative.

A second objective of this research was to compare a cross-sectional model of the advice network structure and a longitudinal model of network evolution. A SIENA model was developed based on a set of parameters that were found to be significant in the p_2 model presented in Chapter 2. The results of the SIENA model of the WMA advice network suggest that parameters that explain the evolution of the network are different than the parameters that explain the cross-sectional structure of the network. In both models, the relationships between pairs of individuals is strongly associated with whether or not the individuals are the same gender or have the same role in the school. However, whereas professional experience is a significant predictor in a p_2 model of the middle school advice network structure, which is based on the pattern of ties in dyads, the evolution of the network was better explained by structural effects that capture the characteristics of the network outside the focal dyad, such as whether the two people in the dyad already have relationships with a third colleague.

There are several reasons why the differences in the p_2 and SIENA model results are not in conflict. First, whereas the previously reported p_2 model was run on a multilevel sample of six middle schools, the SIENA models presented in this study used data from only one school. Because of the sample size limitations associated with examining the network in a single school, the experience measure in this study, as noted above, only captured the number of years a person had been working in the school. There were simply too few cases of novice teachers at WMS during the time of this study to distinguish between novice newcomers and experienced newcomers, which

was the critical distinction in the other analysis. In addition, although the data from WMS was included in the multilevel p_2 models, differences between the parameters that were significant in the multilevel p_2 model and the parameters that were significant in the single-school SIENA model may be due to school-specific features that distinguish WMS from the other middle schools with which it was grouped, as was found when examining the relationship between advice networks and teacher-principal trust in Chapter 3.

A second reason to have confidence in both sets of findings is related to the difference between the SIENA models used here and the p_2 models of the previous investigation. As noted above, the p_2 model describes patterns of dyadic ties — the ties that exist between any two actors chosen from the network — in terms of individual and dyadic attributes using data about the structure of a network at a single moment in time (Van Duijn et al., 2004). SIENA models differ from p_2 models in two important ways. First, SIENA models attempt to capture the characteristics of the entire network and not just the ties between two people that are, for the purpose of the analysis, assumed to be independent of the rest of the network. Second, SIENA models use longitudinal network data. Given data from two time points, a SIENA model takes the time-one network as given and estimates a model that explains the process by which actors make decisions in such a way that the network changes into the network observed at time-two. In other words, the p_2 model explains the structure of a network at a moment in time while the SIENA model explains the process by which a network evolves from a given configuration at time-one to a new configuration at time-two.

Given this perspective on the two approaches, the apparent differences in the findings between this study and the analysis reported in Chapter 2 may not be contradictory. The evolutionary process described by the SIENA model results may tend to generate network configurations that, when viewed cross-sectionally, are consistent with the results of the p_2 dyadic analysis. What is most important, however, is the implication for future research. Taken together, the studies suggest that p_2 models and SIENA models can be used to gain complementary insights into network data. Specifically, a p_2 model can be used to explain the structure of relationships in a network at time-one—the network that the SIENA model takes as given—and a SIENA model can be used to investigate the process by which the network evolves from that point forward. To date, this approach appears to have been used in just one other study (Lazega et al., 2006). Researchers should be mindful of opportunities to combine these analytic approaches when studying longitudinal network data.

The above discussion illustrates one way that this study complements the prior investigation of selection and structure in the middle school advice networks (Chapter 2). Taken together, the two studies clarify what each contributes to an overall understanding of the structure and dynamics of these networks. Although the focus here was on a single school, the findings of this study are an important addition to the other studies that investigate phenomena related to middle school advice networks. It is clear that to fully understand how the advice networks connect members of the school staff, it is necessary to examine the networks both cross-sectionally and longitudinally.

Notes

¹ Throughout the analysis, the terms *sender* and *ego* are synonymous and refer to individuals who, in their survey responses, reported seeking instructional advice from colleagues, while the terms *receiver* and *alter* refers to the individuals from whom instructional advice was sought. The terms reflects the directional nature of advice-seeking relationships.

²² Without a density control, actors in the model could, if their preference functions dictated, add ties until they were connected to everyone else in the system (or drop ties until they were complete isolated). The inclusion of a density control parameter limits this possibility and ensures that the overall density of ties in the simulated network remains consistent with the overall density of ties in the empirical data. A reciprocity effect serves the same purpose with regard to actor's general tendency to maintain reciprocal relationships.

³ Data for the crystallized sociogram were generated using KliqueFinder (Frank, 1995, 1996). Coordinates for placing nodes in the crystallized sociogram were imported into Pajek where data on experience and professional role were incorporated into the figures. The detailed figure maintains the arrangement of nodes within subgroups as determined by KliqueFinder's multidimensional scaling procedure, while the inset figure represents the arrangement of the subgroups. The circles in the main diagram were added in Photoshop to highlight the clustering of the subgroups and have no dimensional relation to the rest of the layout. Isolated actors — those not linked to any subgroup — are not included.

CHAPTER 5

Conclusion

The motivation for the work in this dissertation is a cycle of processes that begins and ends with teacher turnover. Teacher turnover begets organizational newcomers who, as they search for the information they need while adjusting to their new jobs, form ties within their schools' information-seeking networks. In turn, these networks of information-seeking interactions between teachers and their co-workers affect teachers' attitudes and behaviors, such as teachers' trust in their colleagues. That trust, among other things, is linked to the long-term success of new teachers' socialization into their schools (Allensworth et al., 2009; Bryk & Schneider, 1996, 2002). Moreover, trust and socialization are both linked to teacher retention. Teachers who feel strong trust for colleagues and who are successfully socialized report a higher intention to remain in their schools (Bauer et al., 2007; Saks & Ashforth, 1997). In contrast, low trust and poor socialization are linked to the failure to retain teachers, which then leads to turnover, and the cycle begins anew. Teacher turnover within school organizations — and the more general issue of teacher mobility in the education system — have been important issues for well over 40 years (see, for example, Charters, 1970; Heyns, 1988; Mark & Anderson, 1978). The problem of how to retain teachers continues to capture the attention of educational researchers because turnover among teachers imposes a cost on school organizations (Allensworth et al, 2009). Turnover negatively impacts the organizational stability, coherence, and morale in schools, leading to disruptions in

professional development, a loss of teacher leadership, and the risk of an overall drop in teacher quality (Allensworth et al., 2009; Johnson et al., 2005; Smith & Ingersoll, 2004).

This dissertation comprised three studies that examined how information-seeking activity leads to the formation of informal social networks in which teachers are embedded, and how interactions in those networks influence the trust that develops among colleagues in schools. Using longitudinal network data collected in 2007 and 2008 for the Distributed Leadership Study, techniques of social network analysis were used to examine the informal instructional advice networks of a set of middle schools from a Midwestern, mid-sized, urban school district. The social network analytic methods used in this research yielded insights into two important and interdependent dimensions of social processes: the structure of social ties in which people are embedded, and the attitudes and behaviors people develop through their interactions in social networks. In addition, longitudinal network analysis were used to begin to understand how the network of information-seeking relationships in one representative school evolved over time.

The first of three separate studies used network data collected in the spring of 2007 to investigate the patterns of relationships between pairs of individuals working together in middle schools, including teachers, principals, and other staff members. A framework for newcomer information seeking was presented that separated technical information — information about how to teach — into a school-specific component associated with teaching in a particular school, and a general component associated with the broader occupation of teaching (Brown & Duguid, 2001). Based on this distinction, newcomers were divided into two subcategories: experienced newcomers,

who enter an organization needing school-specific technical information while being able to contribute general technical information, and novice newcomers, who enter the school needing both and offering neither.

Using a multi-level p_2 model (Van Duijn et al., 2004; Zijlstra et al., 2006), the investigation found that the structure of instructional advice relationships differed among novice newcomers, experienced newcomers, and incumbents. Specifically, the findings suggested that individuals entering a school organization with more than 6 years of prior teaching experience attract more information-seeking relationships from incumbents than individuals who were new to the school and new to the profession. Structurally, experienced newcomers appear to gain an advantage over novice newcomers by virtue of their possession of general technical information about teaching. The study posited that experienced newcomers' advantage in technical information exchange may afford an additional advantage over novice newcomers with regard to access to other kinds information that are needed in the socialization process (Morrison, 1993).

The second study used network data collected in the spring of 2008 to investigate the association between advice networks and respondents' trust toward teachers in their school and trust toward their principals. In this study, trust was defined as an expectation, assumption, or belief that the future actions of another person or group "will be beneficial, favorable, or at least not detrimental to one's interests" (Robinson, 1996, p. 576), and a willingness to be vulnerable and risk that the person or group will not fulfill that expectation (Mayer et al., 1995). Building on this definition, the study presented a framework for relational trust that distinguished between the collective

trust teachers feel for other teachers as a whole and the individualistic trust teachers feel for the principal. The framework also specified two mechanisms by which trust may be affected by social networks: a learning mechanism and a control mechanism (Buskens & Raub, 2002; Frank & Yasumoto, 1998). Measures of trust were regressed on measures derived from the social network data, including degree, egocentric density, and a measure of social influence based on peers' prestige and reported levels of trust. The investigation revealed that a person's trust in teachers and the principal are both related to the levels of trust reported by the colleagues with whom the person interacts in the advice network. This finding was consistent with the learning mechanism of trust. Support was not found for the control mechanism of trust, in which individuals base trust decisions on their perception that it is possible to sanction a colleague's violation of trust through mutual embeddedness in a dense social network. The null finding for the control mechanism may be related to the fact that individuals in the advice networks are connected to few colleagues whose interconnectedness is thought to mediate the control mechanism.

While the first two studies provided valuable insights into middle school advice networks, identifying factors related to the structure of teachers' network ties and the link between those ties and teachers' trust in their colleagues, they both assumed that the structure of instructional advice networks were fixed. Specifically, the first study used only network data collected in 2007, while the second study used only network data collected in 2008. Because teacher turnover virtually ensures that schools' social networks change from year to year, a full understanding of network-related phenomena

in schools requires an understanding of how much change occurs, whether networks change independently of turnover, and what factors explain how networks evolve.

The third study extended the analysis of network structure by closely examining the changes in one school between 2007 and 2008. Two analyses were presented. In the first analysis, the 2007 advice network was compared with the 2008 advice network according to attributes of the staff members in the school, the number of advice-seeking relationships they maintain, and the structure of subgroups into which people can be sorted according to the interactions they report. Upon closer inspection, it became clear that due to the effects of turnover and the instability of personal advice-seeking networks among people who were on staff both years, both the composition and structure of the instructional advice network at WMS changed between the spring of 2007 and the spring of 2008. The second analysis presented an evolutionary SIENA model (Snijders et al., 2009) of the changes in the WMS advice network between 2007 and 2008. The analysis investigated the extent to which parameters that explain the cross-sectional structure of the 2007 advice networks, as presented in the first study, were able to explain the evolutionary dynamics of the network between 2007 and 2008. The key finding of this analysis was that whereas newcomer status is a significant predictor of the static structure of the advice network, the evolution of the network is better explained by its structural characteristics, particularly the tendency for people to initiate advice-seeking relationships with their advisors' advisors. The results of the analyses in the third essay confirmed the early intuition that there is much to be learned by examining the social networks in schools longitudinally, and that findings from such analyses can complement cross-sectional investigations of static networks.

Taken together, the three studies of this dissertation offer a preliminary glimpse into the turnover cycle described at the beginning of this chapter. The first two studies investigate how information-seeking behaviors are related to new teachers' entry into the structure of one type of informal social network that exists in schools, and how the network of information-seeking relationships affects the formation of trust among colleagues. A key limitation of these two studies is that they are cross sectional, investigating aspects of the turnover cycle by examining teachers and their networks at a single point in time. Thus while the studies yield interesting findings, they cannot fully illuminate the turnover cycle, which unfolds over time. The third study overcomes this limitation by applying longitudinal network analysis. Future research could build on the longitudinal analysis presented here and look more closely at how new teachers' information-seeking networks and their trust in colleagues change over time.

Future work can also explore how advice networks impact teachers' decisions to stay or leave their schools, a critical step in the turnover cycle. Although the combination of the three studies in this dissertation provide new insights into the first stage of the cycle by examining new teachers and their entry into the network, they do not directly investigate the effects of trust and socialization on either intentions to stay or the actual decision to stay or leave, important associations that are suggested by prior research (*e.g.*, Allensworth et al., 2009; Bauer et al., 2007; Bryk & Schneider, 1996, 2002; Saks & Ashforth, 1997). Still, the work of this dissertation demonstrates that it should be possible in future research to use longitudinal network data to examine the co-evolution of teachers' information-seeking networks, their trust in colleagues, their intentions to remain with the school, and their actual decisions regarding staying or leaving the

organization. Future research could also examine the impact of informal social networks based on other relationships, such as friendship. Although such longitudinal network studies require a significant investment of time and resources, much stands to be learned about the turnover cycle and the role of informal networks on organizational socialization processes.

Although the three studies presented in this dissertation do not examine every step in the turnover cycle, the research makes a contribution by suggesting strategies to guide school administrators who are faced with the challenge of teacher turnover. Rather than providing specific prescriptions for solving the teacher mobility by, for example, altering the formal organization or designing specific incentives for teachers, these strategies offer ways of thinking about teacher turnover and its related issues. A central theme of the strategies is the importance of understanding and taking into account the informal information-exchange network of the school — how different people establish relationships and with whom, how the pattern of relationships changes over time, and how the network of information-exchange interactions affects the attitudes of the people in the school. The strategies are presented in terms of three administrative decision areas: staffing, hiring, and socialization. The staffing strategy addresses considerations about the overall composition of a school's professional staff. The hiring strategy addresses considerations about choosing who to hire when replacing those who leave. The socialization strategy addresses considerations about how to assist new hires who are adjusting to their new positions.

Staffing. Taken together, the three studies in this dissertation suggest that school administrators must pay close attention to staff composition. On the surface, this does

not appear to be a particularly insightful observation. It is always important to pursue highly qualified teachers who are dedicated to putting forth their best efforts in service of students' education, and to ensure that a potential teacher has the expertise required by a given position. However, the findings of this research indicate that administrators should consider not simply whether individual teachers are qualified or even whether there is a sense that a particular group of people is likely to work well together. A more thorough consideration of staffing should take into account how individuals are able to contribute to their school's informal information-exchange network. People working in a school look to colleagues for information about how to perform their jobs. Newcomers and novices are particularly dependent on the information they can acquire from their network of colleagues. Thus, to increase the likelihood that individuals will have access to the information they need when they turn to colleagues in the informal networks, administrators should be mindful of the information that people possess and can provide to their colleagues, as well as the distribution of that information across the school. One simple implication of this staffing strategy is that it may be inadvisable to staff a school with all new people or all novice teachers. In other words, administrators should be sure that there are teachers on staff with prior teaching experience who can serve as resources for the technical information about teaching that their colleagues may seek, and that those teachers are effectively distributed across the organization so that their knowledge is not too strongly concentrated in one area.

Hiring. While the previous discussion focused on staffing in the broad sense of considering all the people on the teaching staff taken as a unit, the hiring strategy addresses decisions that are made when a subset of the staff leaves and replacements

must be hired. In other words, the hiring strategy deals with how administrators react to turnover. The research in this dissertation suggests that administrators should consider how turnover events may impact their schools' informal social networks. The central idea for the hiring strategy is that knowledge about who is leaving may have implications for who is hired and where the new hires are placed. As before, the important implication of this dissertation is that it is essential to look beyond the simple interpretation of this point — that a departing math teacher should be replaced with another math teacher — and to consider how newly hired replacement teachers may fit into a school's information-exchange network. For example, imagine that a departing math teacher is an experienced teacher who served as a primary source of technical information about teaching for many other teachers in the school. If there is no one else in the organization who can step in to fill the information void left by the departing teacher, then the information-exchange network of the school may break down and be unable to satisfy the needs of teachers who remain. In this instance, the hiring strategy suggests there is a need to hire a veteran math teacher who could fill the void, and to do what is necessary to ensure that the new hire is able to quickly build relationships in the network (rather than leaving the formation of those relationships to chance). On the other hand, if there is someone else in the organization who can step up to fill the void left by the departing teacher, then administrators may choose to invest in supporting the incumbent and take advantage of the opportunity to hire a novice who can grow into the position and, hopefully, work at the school for many years.

Socialization. The two strategies described above highlight the importance of recognizing that informal information-exchange networks exist among the teachers and

other staff members in schools, and that administrators may sometimes have an opportunity to affect the composition, and perhaps even the structure, of those networks. The socialization strategy suggests that administrators and policymakers should also seek opportunities to influence how teachers engage the informal networks of the school. The period of organizational entry is a prime opportunity for school administrators to apply this strategy by taking into account their schools' informal social networks — including the informal information-exchange network — when designing induction programs to help newcomers become socialized to their schools. Although the three studies in this dissertation do not deal directly with formal induction programs, they highlight the an important social process — the exchange of information among colleagues — that operates in schools. The informal social network associated with this process exists regardless of whether there are formal efforts by administrators to manage information exchange activities, and newly hired teachers will build relationships in their schools' informal networks whether or not there are formal induction programs for new hires. Even incumbents, who presumably are not recipients of formal induction, are active information-seekers in the informal social network. The socialization strategy suggests that it might be valuable to design induction such that new teachers are afforded ample opportunities to engage with the informal networks that already exist among the teachers in the school. For example, rather than only supporting one-on-one relationships between new teachers and individual mentor teachers, programs can be developed that help new teachers establish one-to-many relationships within the school's informal information-exchange network.

Each study in this dissertation suggests an additional consideration to administrators who would consider implementing formal induction that attempts to help new teachers establish relationships in their schools' informal networks. These considerations follow from the three dimensions of social network analysis investigated in this research: selection, influence, and evolution. Recall that selection refers to factors that explain which relationships exist and which do not, influence refers to how individuals' relationships in the network affect their attitudes and behaviors, and evolution refers to how the network and its effects on people change over time. With regard to selection, administrators should take into account that new teachers with different levels of prior experience will differ with regard to how they naturally engage with the informal information exchange network. Induction programs should take advantage of the fact that experienced newcomers may already be contributors as well as recipients of information, while providing additional support for the novice newcomers whose informational needs are greater. With regard to influence, administrators should understand that networks of information-exchange relationships are going to contribute more to newcomer socialization than just information. In particular, the present research found that teachers' relationships in the information-exchange network were associated with their trust for colleagues. Although it is possible that interactions in an informal network may yield unfavorable outcomes for a newcomer — a bad experience may irreparably damage one's trust — in general, a program that helps newcomers connect with their schools' informal networks is likely to provide positive reinforcement to newcomers' socialization. Finally, with regard to evolution, administrators should understand that any program that attempts to exploit

the information-exchange network must be designed flexibly, as the network itself is dynamic, and its structure may be very different from year to year due to turnover, changing roles, and individual growth and professional advancement.

REFERENCES

- Adkins, C. L. (1995). Previous work experience and organizational socialization: A longitudinal examination. *The Academy of Management Journal*, 38(3), 839–862.
- Adler, P. S., & Kwon, S. W. (2000). Social capital: The good, the bad, and the ugly. In E. L. Lesser (Ed.), *Knowledge and Social Capital: Foundations and Applications* (pp. 89–115). Woburn, MA: Butterworth-Heinemann.
- Ahmed, A. (2009, June 29). Teacher turnover plagues Chicago public schools. Chicago Tribune. Retrieved from <http://www.chicagotribune.com/news/local/chicago-public-schools-studyjun29,0,1744651.story>
- Allensworth, E., Ponisciak, S., & Mazzeo, C. (2009). *The schools people leave: Teacher mobility in Chicago Public Schools*. Chicago: Consortium on Chicago School Research.
- Baerveldt, C., Van Duijn, M. A. J., Vermeij, L., & Van Hemert, D. A. (2004). Ethnic boundaries and personal choice. Assessing the influence of individual inclinations to choose intra-ethnic relationships on pupils' networks. *Social Networks*, 26(1), 55–74.
- Baerveldt, C., Zijlstra, B. J. H., de Wolf, M., Van Rossem, R., & Van Duijn, M. A. J. (2007). Ethnic boundaries in high school students' networks in Flanders and the Netherlands. *International Sociology*, 22(6), 701–720.
- Bakkenes, I., De Brabander, C., & Imants, J. (1999). Teacher isolation and communication network analysis in primary schools. *Educational Administration Quarterly*, 35(2), 166–202.
- Bauer, T. N., Bodner, T., Erdogan, B., Truxillo, D. M., & Tucker, J. S. (2007). Newcomer adjustment during organizational socialization: A meta-analytic review of antecedents, outcomes, and methods. *Journal of Applied Psychology*, 92(3), 707–721.
- Berg, J., Dickhaut, J., & McCabe, K. (1995) Trust, reciprocity, and social history. *Games and Economic Behavior*, 10, 122–142.
- Bies, R. J., & Tripp, T. M. (1996). Beyond distrust: Getting even and the need for revenge. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 166–195). Thousand Oaks, CA: Sage.
- Bignami-Van Assche, S. (2005). Network stability in longitudinal data: A case study from rural Malawi. *Social Networks*, 27(3), 231–247.

- Bilcer, D. K. (1997). *User's manual, version 1. Improving Chicago's schools: The teachers turn, 1997; The students speak, 1997*. Chicago, IL: Consortium on Chicago School Research, University of Chicago.
- Blau, P. M. (1977). *Inequality and heterogeneity: A primitive theory of social structure*. New York: The Free Press.
- Bobbitt, S. A., Leich, M. C., Whitener, S. D., & Lynch, H. F. (1994). *Characteristics of stayers, movers, and leavers: Results from the Teacher Followup Survey: 1991–92* (NCES 94-337). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.
- Boer, P., Huisman, M., Snijders, T. A. B., Steglich, C. E. G., Wichers, L. H. Y., and Zeggelink, E. P. H. (2006). *StOCNET: An open software system for the advanced statistical analysis of social networks*. Version 1.7. Groningen: ICS/Science Plus. <http://stat/gamma.rug.nl/stocnet/>
- Bond, & Fox. (2007). *Applying the Rasch model: Fundamental measurement in the human sciences* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.
- Borman, G. D., & Dowling, N. M. (2008). Teacher attrition and retention: A meta-analytic and narrative review of the research. *Review of Educational Research*, 78(3), 367–409.
- Brass, D. J. (1995). A social network perspective on human resources management. In G. R. Ferris (Ed.), *Research in personnel and human resources management* (Vol 13, pp. 39–79). Greenwich, CT: JAI Press.
- Brass, D. J., Galaskiewicz, J., Greve, H. R., & Tsai, W. (2004). Taking stock of networks and organizations: A multilevel perspective. *Academy of Management Journal*, 47(6), 795–817.
- Brewer, D. D. (2000). Forgetting in the recall-based elicitation of personal and social networks. *Social Networks*, 22(1), 29–43.
- Brown, J. S., & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organization Science*, 12(2), 198–213.
- Bryk, A. S., & Schneider, B. (1996). *Social trust: A moral resource for school improvement*. Chicago: University of Chicago, Center for School Improvement.
- Bryk, A. S., & Schneider, B. (2002). *Trust in schools: A core resource for improvement*. New York: Russell Sage Foundation.
- Bunker, B. B., Alban, B. T., & Lewicki, R. J. (2004). Ideas in currency and OD practice: has the well gone dry? *Journal of Applied Behavioral Science*, 40(4), 403–422.

- Burk, W. J., Steglich, C. E. G., & Snijders, T. A. B. (2007). Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors. *International Journal of Behavioral Development, 31*(4), 397-404.
- Burke, C. S., Sims, D. E., Lazzara, E. H., & Salas, E. (2007). Trust in leadership: A multi-level review and integration. *The Leadership Quarterly, 18*(6), 606-632.
- Burt, R. S., & Knez, M. (1996). Trust and third-party gossip. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 68-89). Thousand Oaks, CA: Sage.
- Buskens, V. (1998). The social structure of trust. *Social Networks, 20*(3), 265-289.
- Buskens, V., & Raub, W. (2002). Embedded trust: Control and learning. In E. J. Lawler & S. R. Thye (Eds.), *Advances in group processes* (pp. 167-202). Amsterdam: JAI/Elsevier.
- Carrington, P., Scott, J., & Wasserman, S. (2005). *Models and methods in social network analysis*. New York: Cambridge University Press.
- Charters, W. W. (1970). Some factors affecting teacher survival in school districts. *American Educational Research Journal, 7*(1), 1-27.
- Chubbuck, S. M., Cliff, R. T., Allard, J., & Quinlan, J. (2001). Playing it safe as a novice teacher: Implications for programs for new teachers. *Journal of Teacher Education, 52*(5), 365-384.
- Coburn, C. E., & Russell, J. L. (2008). District policy and teachers' social networks. *Educational Evaluation and Policy Analysis, 30*(3), 203-235.
- Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*(Supplement), S95-S120.
- Cook, J., & Wall, T. (1980). New work attitude measures of trust, organizational commitment and personal need non-fulfillment. *Journal of Occupational Psychology, 53*(1), 39-52.
- Crosnoe, R., Frank, K. A., & Mueller, A. S. (2008). Gender, body size and social relations in American high schools. *Social Forces, 86*(3), 1189-1216.
- Faust, K. (2006). Comparing social networks: Size, density, and local structure. *Metodološki zvezki, 3*(2), 185-216.
- Faust, K. (2007). Very local structure in social networks. *Sociological Methods, 37*(1), 209-256.

- Feld, S. L. (1997). Structural embeddedness and stability of interpersonal relations. *Social Networks, 19*(1), 91–95.
- Feld, S. L., Sutor, J. J., & Hoegh, J. G. (2007). Describing changes in personal networks over time. *Field Methods, 19*(2), 218–236.
- Ferligoj, A., & Hlebec, V. (1999). Evaluation of social network measurement instruments. *Social Networks, 21*(2), 111–130.
- Ferrin, D. L., Dirks, K. T., Shah, P. P. (2006). Direct and indirect effects of third-party relationships on interpersonal trust. *Journal of Applied Psychology, 91*(4), 870–883.
- Frank, K. A. (1995). Identifying cohesive subgroups. *Social Networks, 17*(1), 27–56.
- Frank, K. A. (1996). Mapping interactions within and between cohesive subgroups. *Social Networks, 18*(2), 93–119.
- Frank, K. A., & Maroulis, S. (2009). The social embeddedness of natural resource use and extraction. Paper presented at the meeting of the American Fisheries Society, Nashville, TN.
- Frank, K. A., Muller, C., Schiller, K. S., Riegle-Crumb, C., Mueller, A. S., Crosnoe, R., & Pearson, J. (2008). The social dynamics of mathematics coursetaking in high school. *American Journal of Sociology, 113*(6), 1645–1696.
- Frank, K. A., & Yasumoto, J. Y. (1998). Linking action to social structure within a system: Social capital within and between subgroups. *American Journal of Sociology, 104*(3), 642–686.
- Frank, K. A., & Zhao, Y. (2005). Subgroups as a meso-level entity in the social organization of schools. In L. V. Hedges & B. Schneider (Eds.), *The social organization of schooling* (pp. 20–224). New York: Sage Publications.
- Frank, K. A., Zhao, Y., & Borman, K. (2004). Social capital and the diffusion of innovations within organizations: The case of computer technology in schools. *Sociology of Education, 77*(2), 148–171.
- Freeman, L. C. (1979). Centrality in social networks: Conceptual clarification. *Social Networks, 1*(3), 215–239.
- Friedkin, N. E. (2001). Norm formation in social influence networks. *Social Networks, 23*(3), 167–189.
- Friedkin, N. E., & Johnson, E. C. (1997). Social positions in influence networks. *Social Networks, 19*(3), 209–222.

- Friedkin, N. E., & Slater, M. R. (1994). School leadership and performance: A social network approach. *Sociology of Education*, 67(2), 139-157.
- Gargiulo, M., & Benassi, M. (2000). Trapped in your own net? Network cohesion, structural holes, and the adaptation of social capital. *Organization Science*, 11(2), 183-196.
- Guarino, C. M., Santibañez, L., & Daley, G. A. (2006). Teacher recruitment and retention: A review of the recent empirical literature. *Review of Educational Research*, 76(2), 173-208.
- Hansen, M. T., Podolny, J. M., & Pfeffer, J. (2001). So many ties, so little time: A task contingency perspective on corporate social capital in organizations. In S. M. Gabbay & R. Th. A. J. Leenders (Eds.), *Social Capital of Organizations* (pp. 21-57). Oxford: Elsevier Science.
- Harris, D. N., & Adams, S. J. (2007). Understanding the level and causes of teacher turnover: A comparison with other professions. *Economics of Education Review*, 26(3), 325-337.
- Heyns, B. (1988). Educational defectors: A first look at teacher attrition in the NLS-72. *Educational Researcher*, 17(3), 24-32.
- Holland, P. W., & Leinhardt, S. (1981). An exponential family of probability distributions for directed graphs. *Journal of the American Statistical Association*, 76(373), 33-50.
- Hoy, W. K., & Tschannen-Moran, M. (1999). Five faces of trust: An empirical confirmation in urban elementary schools. *Journal of School Leadership*, 9(3), 184-208.
- Igarashi, T., Kashima, Y., Kashima, E. S., Farsides, T., Kim, U., Strack, F., Werth, L., & Yuki, M. (2008). Culture, trust, and social networks. *Asian Journal of Social Psychology*, 11(1), 88-101.
- Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal*, 38(3), 499-534.
- Johnson, S. M., Berg, J. H., & Donaldson, M. L. (2005). Who stays in teaching and why: A review of the literature on teacher retention. Cambridge, MA: Harvard Graduate School of Education.
- Johnson, S. M., & Birkeland, S. E. (2003). Pursuing a "sense of success": New teachers explain their career decisions. *American Educational Research Journal*, 40(3), 581-617.

- Johnson-George, C., & Swap, W. C. (1982). Measurement of specific interpersonal trust: Construction and validation of a scale to assess trust in a specific other. *Journal of Personality and Social Psychology*, 43(6), 1306–1317.
- Jones, G. R., & George, J. M. (1998). The experience and evolution of trust: Implications for cooperation and teamwork. *Academy of Management Review*, 23(3), 531–546.
- Kardos, S. M., & Johnson, S. M. (2007). On their own and presumed expert: New teachers' experience with their colleagues. *Teachers College Record*, 109(9), 2083–2106.
- Kardos, S. M., Johnson, S. M., Peske, H. G., Kauffman, D., & Liu, E. (2001). Counting on colleagues: New teachers encounter the professional cultures of their schools. *Educational Administration Quarterly*, 37(2), 250–290.
- Kramer, R. M. (1999). Trust and distrust in organizations: Emerging perspectives, enduring questions. *Annual Review of Psychology*, 50, 569–598.
- Lazega, E., Lemercier, C., & Mounier, L. (2006). A spinning top model of formal organization and informal behavior: Dynamics of advice networks among judges in a commercial court. *European Management Review*, 3(2), 113–122.
- Lazega, E., & Van Duijn, M. A. J. (1997). Position in formal structure, personal characteristics and choices of advisors in a law firm: A logistic regression model for dyadic network data. *Social Networks*, 19(4), 375–397.
- Lee, V. E., & Loeb, S. (2000). School size in Chicago elementary schools: Effects on teachers' attitudes and students' achievement. *American Educational Research Journal*, 37(1), 3–31.
- Lee, V. E., & Smith, J. B. (1996). Collective responsibility for learning and its effects on gains in achievement for early secondary school students. *American Journal of Education*, 104(2), 103–147.
- Leenders, R. Th. A. J. (2002). Modeling social influence through network autocorrelation: Constructing the weight matrix. *Social Networks*, 24(1), 21–47.
- Lewicki, R. J., & Bunker, B. B. (1996). Developing and maintaining trust in work relationships. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 166–195). Thousand Oaks, CA: Sage.
- Louis, K. S., Mayrowetz, D., Smylie, M., & Murphy, J. (2009). The role of sensemaking and trust in developing distributed leadership. In A. Harris (Ed.), *Distributed leadership* (pp. 157–180). Netherlands: Springer.

- Louis, M. R. (1980). Surprise and sense-making: What newcomers experience in entering unfamiliar organizational settings. *Administrative Science Quarterly*, 25(2), 226–251.
- Lubbers, M. J., & Snijders, T. A. B. (2007). A comparison of various approaches to the exponential random graph model: A reanalysis of 102 networks in school classes. *Social Networks*, 29(4), 489–507.
- Luekens, M.T., Lyter, D.M., & Fox, E.E. (2004). *Teacher attrition and mobility: Results from the Teacher Follow-up Survey, 2000–01* (NCES 2004–301). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.
- Mark, J. H., & Anderson, B. D. (1978). Teacher survival rates - A current look. *American Educational Research Journal*, 15(3) pp. 379–383.
- Maroulis, S., & Gomez, L. M. (2008). Does "connectedness" matter? Evidence from a social network analysis within a small-school reform. *Teachers College Record*, 110(9), 1901–1929.
- Marsden, P. V., & Friedkin, N. E. (1993). Network studies of social influence. *Sociological Methods Research*, 22(1), 127–151.
- Marvel, J., Lyter, D.M., Peltola, P., Strizek, G.A., and Morton, B.A. (2006). *Teacher attrition and mobility: Results from the 2004–05 Teacher Follow-up Survey* (NCES 2007–307). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.
- Mayer, R. C., & Davis, J. H. (1999). The effect of the performance appraisal system on trust for management: A field quasi-experiment. *Journal of Applied Psychology*, 84(1), 123–136.
- Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995) An integrative model of organizational trust. *Academy of Management Review*, 20(3), 709–734.
- McKnight, D. H., Cummings, L. L., & Chervany, N. L. (1998). Initial trust formation in new organizational relationships. *Academy of Management Review*, 23(3), 473–490.
- McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27, 415–444.
- Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). Swift trust and temporary groups. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 166–195). Thousand Oaks, CA: Sage.

- Miller, V. D., & Jablin, F. M. (1991). Information seeking during organizational entry: Influences, tactics, and a model of the process. *Academy of Management Review*, 16(1), 92–120.
- Moody, J. (2002). The importance of relationship timing for diffusion. *Social Forces*, 81(1), 25–56.
- Morgan, D. L., Neal, M. B., & Carder, P. (1991). The stability of core and peripheral networks over time. *Social Networks*, 19(1), 9–25.
- Morrison, E. W. (1993). Newcomer information seeking: Exploring types, modes, sources, and outcomes. *Academy of Management Journal*, 36(3), 557–589.
- Morrison, E. W. (2002a). Information seeking within organizations. *Human Communication Research*, 28(2), 229–242.
- Morrison, E. W. (2002b). Newcomers' relationships: The role of social network ties during socialization. *Academy of Management Journal*, 45(6), 1149–1160.
- Moynihan, D. P., & Pandey, S. K. (2008). The ties that bind: Social networks, person-organization value fit, and turnover intention. *Journal of Public Administration Research and Theory*, 18(2), 205–227.
- Nugent, P. D., & Abolafia, M. Y. (2006). The creation of trust through interaction and exchange: The role of consideration in organizations. *Group & Organization Management*, 31(6), 628–650.
- Ostroff, C., & Kozlowski, S. W. J. (1992). Organizational socialization as a learning process: The role of information acquisition. *Personnel Psychology*, 45(4), 849–874.
- Pitts, V. M., & Spillane, J. P. (2009). Using social network methods to study school leadership. *International Journal of Research & Method in Education*, 32(2), 185–207.
- Pustejovsky, J. E., & Spillane, J. P. (2009). Question-order effects in social network name generators. *Social Networks*, 31(4), 221–229.
- Robins, G., Pattison, P., Kalish, Y., & Lusher, D. (2007). An introduction to exponential random graph (p^*) models for social networks. *Social Networks*, 29(2), 173–191.
- Robinson, S. L. (1996). Trust and breach of the psychological contract. *Administrative Science Quarterly*, 41(4), 574–599.
- Rotter, J. B. (1967). A new scale for the measurement of interpersonal trust. *Journal of Personality*, 35(4), 651–665.
- Rousseau, D. M., Sitkin, S. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of Management Review*, 23(3), 393–404.

- Saks, A. M., & Ashforth, B. E. (1997). Organizational socialization: Making sense of the past and present as a prologue for the future. *Journal of Vocational Behavior*, 51(2), 234–279.
- Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management Review*, 32(2), 344–354.
- Shah, P. P. (2000). Network destruction: The structural implications of downsizing. *Academy of Management Journal*, 43(1), 101–112.
- Smith, T. M., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal*, 41(3), 681–714.
- Snijders, T. A. B., Pattison, P., Robins, G., & Handcock, M. S. (2006). New specifications for exponential random graph models. *Sociological Methodology*, 36(1), 99–153.
- Snijders, T. A. B., Steglich, C. E. G., & Schweinberger, M. (2005). Modeling the co-evolution of networks and behavior. In K. van Montfort, J. Oud, & A. Satorra (Eds.), *Longitudinal models in the behavioral and related sciences* (pp. 41–82). Mahwah, NJ: Lawrence Erlbaum Associates. Prepress copy retrieved 10 June 2008, from http://stat.gamma.rug.nl/snijders/chapter_coevol.pdf
- Snijders, T. A. B., van de Bunt, G. G., & Steglich, C. E. G. (2009). Introduction to stochastic actor-based models for network dynamics. *Social Networks*. Retrieved 7 April 2009, from doi:10.1016/j.socnet.2009.02.004
- Spector, M. D., & Jones, G. E. (2004). Trust in the workplace: Factors affecting trust formation between team members. *Journal of Social Psychology*, 144(3), 311–321.
- StataCorp. (2007). *Stata Statistical Software, Release 10, Base reference manual* (Vol. 3, Q–Z). College Station, TX: StataCorp LP.
- Steglich, C. E. G., Snijders, T. A. B., & Pearson, M. (in press). Dynamic networks and behavior: Separating selection from influence. Retrieved 10 June 2008, from <http://www.stats.ox.ac.uk/~snijders/siena/SteglichSnijdersPearson2007.pdf>
- Steglich, C., Snijders, T. A. B., & West, P. (2006). Applying SIENA. *Methodology*, 2(1), 48–56.
- Suitor, J. J., & Keeton, S. (1997). Once a friend, always a friend? Effects of homophily on women's support networks across a decade. *Social Networks*, 19(1), 51–62.
- Suitor, J. J., Wellman, B., & Morgan, D. L. (1997). It's about time: How, why, and when networks change. *Social Networks*, 19(1), 1–7.

- Tan, H. H., & Lim, A. K. H. (2009). Trust in coworkers and trust in organizations. *The Journal of Psychology: Interdisciplinary and Applied*, 143(1), 45–66.
- Teboul, J. C. B. (1994). Facing and coping with uncertainty during organizational encounter. *Management Communication Quarterly*, 8(2), 190–224.
- Teboul, J. C. B., & Cole, T. (2005). Relationship development and workplace integration: An evolutionary perspective. *Communication Theory*, 15(4), 389–413.
- Thomas, A. (2005). Social networks and career paths of urban teachers: Effects of career decision-related communication networks on teacher retention. (Doctoral dissertation, University of California, Los Angeles). Retrieved July 22, 2009, from Dissertations & Theses: Full Text. (Publication No. AAT 3208375)
- Tschannen-Moran, M., & Hoy, W. K. (2000). A multidisciplinary analysis of the nature, meaning, and measurement of trust. *Review of Educational Research*, 70(4), 547–593.
- Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42(1), 35–67.
- Van Duijn, M. A. J., Snijders, T. A. B., & Zijlstra, B. J. H. (2004). p₂: A random effects model with covariates for directed graphs. *Statistica Neerlandica*, 58(2), 234–254.
- Van Duijn, M. A. J., & Vermunt, J. K. (2006). What is special about social network analysis? *Methodology*, 2(1), 2–6.
- Veenstra, R., Lindenberg, S., Zijlstra, B. J. H., De Winter, A. F., Verhulst, F. C., & Ormel, J. (2007). The dyadic nature of bullying and victimization: Testing a dual-perspective theory. *Child Development*, 78(6), 1843–1854.
- Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York: Cambridge University Press.
- Wellman, B., Wong, R. Y., Tindall, D., & Nazer, N. (1997). A decade of network change: Turnover, persistence and stability in personal communities. *Social Networks*, 19(1), 27–50.
- Weick, K. E., & Roberts, K. H. (1993). Collective mind in organizations: Heedful interrelating on flight decks. *Administrative Science Quarterly*, 38(3), 357–381.
- Zijlstra, B. J. H., & Van Duijn, M. A. J. (2005). Manual p₂. Version 4.0.0.0. Groningen: ICS/Science Plus.
- Zijlstra, B. J. H., Van Duijn, M. A. J., & Snijders, T. A. B. (2005). Model selection in random effects models for directed graphs using approximated Bayes factors. *Statistica Neerlandica*, 59(1), 107–118.

Zijlstra, B. J. H., Van Duijn, M. A. J., & Snijders, T. A. B. (2006). The multilevel p2 model: A random effects model for the analysis of multiple social networks. *Methodology*, 2(1), 42–47.

APPENDIX A

2007 and 2008 network survey instrument

Demographics. *The first section of the survey asks for your name and demographic information. As with all of the data collected in this survey, your answers will be confidential. Only the study investigators and members of the investigators' staffs will have the authority to review your data.*

1. What is your name?
 - a. First name
 - b. Last name
2. What is the name of your current school?
3. In what year were you born? (Please enter a 4-digit number.)
4. What is your gender? Male/Female
5. What is your race? African American/Native American or Alaska Native/Asian American/Asian, including Indian subcontinent/Hispanic, Latino/Mexican American, Chicano/Hawaiian Native or Pacific Islander/Puerto Rican/White or Caucasian/Other (please specify)

Attitudes and Opinions. *The next section of the survey consists of a several sets of questions asking for your views on a variety of topics related to your school environment. These data will be used to understand differences in the work environments of various schools. We realize that some of the questions may seem repetitive; this is because they are intended to measure some subtle differences.*

6. (Collective responsibility - CCSR) How many teachers in this school:
(None/Some/About Half/Most/Nearly All)
- Feel responsible when students in this school fail?
 - Feel responsible to help each other do their best?
 - Help maintain discipline in the entire school, not just their classroom?
 - Take responsibility for improving the school?
 - Feel responsible for helping students develop self-control?
 - Set high standards for themselves?
 - Feel responsible that all students learn?
7. (Collective responsibility - NELS) Please indicate the extent to which you agree or disagree with the following statements. (Strongly Disagree/ Disagree/ Agree/Strongly Agree)
- There is really very little I can do to insure that most of my students achieve at a high level.
 - My success or failure in teaching is due primarily to factors beyond my control rather than to my own efforts and ability.
 - The attitudes and habits students bring to my class greatly reduce their chances for academic success.
 - By trying a different teaching method, I can significantly affect a student's achievement.
 - I am certain I am making a difference in the lives of my students.
 - I sometimes feel it is a waste of time to try to do my best as a teacher.

- g. If I try really hard, I can get through to even the most difficult or unmotivated student.
8. (Teacher control over classroom practice) How much control do you feel you have in your classroom over each of the areas below? (None / A Little / Some / A Great Deal)
- a. Selecting textbooks and other instructional material
 - b. Selecting content, topics, and skills to be taught
 - c. Selecting teaching techniques
 - d. Disciplining students
 - e. Determining the amount of homework to assign
9. Please indicate the extent that you: (None / A Little / Some / A Great Deal)
- a. (Teacher-teacher trust) Feel respected by other teachers
 - b. (Teacher-principal trust) Feel respected by your principal.
10. (Teacher-teacher trust) Please indicate the extent to which you agree or disagree with the following statements. (Strongly Disagree / Moderately Disagree / Slightly Disagree / Slightly Agree / Moderately Agree / Strongly Agree)
- a. Teachers in this school trust each other.
 - b. It's okay in this school to discuss feelings, worries, and frustrations with other teachers.
 - c. Teachers respect other teachers who take the lead in school improvement efforts.
 - d. Teachers at this school respect those colleagues who are experts at their craft.

- e. Teachers at this school really care about each other.
11. (Teacher-principal trust) Please indicate the extent to which you agree or disagree with the following statements. (Strongly Disagree/Moderately Disagree/Slightly Disagree/Slightly Agree/Moderately Agree/Strongly Agree)
- a. The principal has confidence in the expertise of the teachers.
 - b. I trust the principal at his or her word.
 - c. It is okay in this school to discuss feelings, worries, and frustrations with the principal.
 - d. The principal takes a personal interest in the professional development of teachers.
 - e. The principal looks out for the personal welfare of faculty members.
 - f. The principal at this school is an effective manager who makes the school run smoothly.
 - g. The principal places the needs of children ahead of his or her personal interests.
12. (Instructional Leadership) Please mark the extent to which you disagree or agree with each of the following: (Strongly Disagree/Disagree/Agree/Strongly Agree)
- a. The principal at this school communicates a clear vision for our school.
 - b. The principal at this school makes clear to the staff his or her expectations for meeting instructional goals.
 - c. The principal at this school presses teachers to implement what they have learned in professional development.
 - d. The principal at this school sets high standards for teaching.

- e. The principal at this school sets high standards for student learning.
 - f. The principal at this school carefully tracks student academic progress.
 - g. The principal at this school actively monitors the quality of teaching in this school.
13. (**Innovation**) Please indicate the extent to which you agree or disagree with the following statements. (Strongly Disagree/Moderately Disagree/Slightly Disagree/Slightly Agree/Moderately Agree/Strongly Agree)
- a. In this school, teachers have a can-do attitude.
 - b. In this school, all teachers are encouraged to stretch and grow.
 - c. In this school, teachers are continually learning and seeking new ideas.
14. (**Innovation**) How many teachers in this school: (None/Some/About Half/Most/Nearly All)
- a. Are willing to take risks to make this school better?
 - b. Are eager to try new ideas?
 - c. Are really trying to improve their teacher?

Roles. *The next section of the survey asks questions about the job or role you play within your school. If you are a teacher, you will be asked to describe the type(s) of classes you teach. If you have non-teaching duties, it will ask you to describe what those duties are.*

15. Which statement best describes your role during the current school year? (Check one or both.)
- a. I am a teacher assigned to instruct students.
 - b. I am formally assigned to non-teaching duties such as principal, assistant principal, guidance counselor, curriculum coach, or specialist.

16. (Ask if Q17 = a) Which statement best describes your teaching role? (Check only one.)
- a. I instruct several classes of students in one or more subjects (specialized instruction)
 - b. I instruct the same group of students all or most of the day in multiple subjects (core subject teacher or self-contained class)
 - c. I instruct selected students released from their regular classes in specific skills or to address specific needs (pull-out class)
17. (Ask if Q17 = b) Which title best describes your non-teaching duties? Check all that apply: principal/assistant principal/guidance counselor/whole school reform program coach or facilitator/Special program coordinator/Reading, literacy, or English program coordinator/Math program coordinator/other subject area program coordinator (please specify subject area)/school improvement coordinator/Master/mentor teacher/teacher consultant/Sports coach/other (please specify)
18. What percentage of your time is FORMALLY assigned to each of these duties? (Please enter whole number percentages. For example, if you split your time between assistant principal and guidance counselor duties, put "50" for assistant principal and "50" for guidance counselor.) (Filter based on previous question. Include teacher if Q17 = a.)
19. (Ask if Q17 = a) What grade(s) do you teach this school year? Check all that apply: Kindergarten/1st grade/2nd grade/3rd grade/4th grade/5th grade/6th grade/7th grade/8th grade/9th grade/10th grade/11th grade/12th grade

20. With which groups of students do you work this school year? Check all that apply: Gifted students/Special needs students/Students whose native language is not English/Other (please specify)/ All students/I do not work directly with students
21. (Ask if Q17 = a) What subjects do you teach this school year? Check all that apply: Art/Dance, Drama/English/Foreign Language/History/Language Arts/Mathematics/Music/Physical Education, Health/Science/Social Studies/None
22. (Ask if more than one subject checked in Q23 and teacher is not in self-contained classroom) Which of the subjects you checked is the primary subject that you teach to students in the middle grades? (Filter for subjects checked.)
23. (Ask if Q17 = a) What is the total number of hours for which you are the primary instructor during a typical week?
24. Please list below any teams or committees at your school to which you belong.
- a. For each team/committee listed below, please list your title if you hold a leadership position. (Fill in with list from Q26.)
25. (Ask if Q17 = a and not b) Are you formally assigned non-teaching duties at your school this year, such as assistant principal, reform program coach/facilitator, subject area liaison/coordinator/chair, master/mentor teacher, or program coordinator? (Yes/No)
26. (Ask if Q27 = Yes) Which title or titles best describe your non-teaching duties? Check all that apply: principal/assistant principal/guidance counselor/whole school reform program coach or facilitator/Special program

coordinator/Reading, literacy, or English program coordinator/Math program coordinator/other subject area program coordinator (please specify subject area)/school improvement coordinator/Master/mentor teacher/teacher consultant/Sports coach/other (please specify).

27. How much release time from teaching, if any, do you receive for performing these non-teaching duties? (Less than 2 hours per week/2 to 4 hours per week/4 to 6 hours per week/6 to 10 hours per week/more than 10 hours per week)

Advice Networks. *In the next sequence of questions, you will be asked about each of the following subject areas in turn:*

- *Teaching (Primary subject area if not math or Reading/Writing/Language Arts)*
- *Mathematics*
- *Reading/Writing/Language Arts*

For each subject area, you will be asked to name people to whom you have turned for advice or information. These people might be colleagues at your school, other teachers in your district, or other people outside your school or district. You will then be asked several questions about your interactions with the individuals that you name.

Data from this part of the survey will be used to study the networks of professional communication between educators. Please be assured that no individual names or identifying information will ever be revealed in reports produced from these data.

28. (Ask if Q24 filled in and not math and not English/language arts) During this school year, to whom have you turned for advice or information about teaching {fill in primary subject (Q24)? Please write full first and last names, and give a

brief description of that person's role or position. You do not need to fill all 15 spaces. (Includes check box "I have not sought advice from anyone.")

29. Please check the boxes that most accurately describe the advice or information you sought from each person. Boxes: Deepening your content knowledge/Planning or selecting course content and materials/Approaches for teaching content to students/Strategies specifically to assist low-performing students/Assessing students' understanding of the subject/Other. (List from Q30 filled in.)
30. (Filter names based on Q31 = "other".) Please describe the other advice or information you sought from each person.
31. For each person listed below, please describe how often you interact with him or her, and how influential his or her advice is on your work. Frequency: A few times a year/Once or twice a month/Once or twice a week/Daily or almost daily. Influence: 1 = Not at all, 5 = Very influential (List from Q30 filled in.)
32. How satisfied are you with the overall availability of advice and information about teaching {fill in primary subject (Q24)} from colleagues at your school?
33. (Wording depends on previous answers)
- a. (If Q23 includes "math")During this school year, to whom have you turned for advice or information about teaching mathematics? Please write full first and last names, and give a brief description of that person's role or position. You do not need to fill all 15 spaces. (Includes check box "I have not sought advice from anyone.")

- b. (If Q17 includes “teacher” and Q23 does not include “math”) During this school year, to whom have you turned for advice or information about mathematics as it relates to your classroom teaching? Please write full first and last names, and give a brief description of that person’s role or position. You do not need to fill all 15 spaces. (Includes check box “I have not sought advice from anyone.”)
- c. If (Q17 does not include “teacher”) During this school year, to whom have you turned for advice or information about mathematics instruction? Please write full first and last names, and give a brief description of that person’s role or position. You do not need to fill all 15 spaces. (Includes check box “I have not sought advice from anyone.”)
34. Please check the boxes that most accurately describe the advice or information you sought from each person. Boxes: Deepening your content knowledge/Planning or selecting course content and materials/Approaches for teaching content to students/Strategies specifically to assist low-performing students/Assessing students’ understanding of the subject/Other. (List from Q35 filled in.)
35. (Filter names based on Q36 = “other”.) Please describe the other advice or information you sought from each person.
36. For each person listed below, please describe how often you interact with him or her, and how influential his or her advice is on your work. Frequency: A few times a year/Once or twice a month/Once or twice a week/Daily or almost daily. Influence: 1 = Not at all, 5 = Very influential (List from Q35 filled in.)

37. How satisfied are you with the overall availability of advice and information about mathematics from colleagues at your school?
38. (Wording depends on previous answers)
- a. (If Q23 includes “English/language arts”) During this school year, to whom have you turned for advice or information about teaching reading/writing/language arts? Please write full first and last names. You do not need to fill all 15 spaces. (Includes check box “I have not sought advice from anyone.”)
 - b. (If Q17 includes “teacher” and Q23 does not include “English/language arts:”) During this school year, to whom have you turned for advice or information about reading/writing/language arts as it relates to your classroom teaching? Please write full first and last names. You do not need to fill all 15 spaces. (Includes check box “I have not sought advice from anyone.”)
 - c. (If Q17 does not include “teacher”) During this school year, to whom have you turned for advice or information about reading/writing/language arts instruction? Please write full first and last names. You do not need to fill all 15 spaces. (Includes check box “I have not sought advice from anyone.”)
39. Please check the boxes that most accurately describe the advice or information you sought from each person. Boxes: Deepening your content knowledge/Planning or selecting course content and materials/Approaches for teaching content to students/Strategies specifically to assist low-performing

students/ Assessing students' understanding of the subject/Other. (List from Q40 filled in.)

40. (Filter names based on Q41 = "other".) Please describe the other advice or information you sought from each person.
41. For each person listed below, please describe how often you interact with him or her, and how influential his or her advice is on your work. Frequency: A few times a year/Once or twice a month/Once or twice a week/Daily or almost daily. Influence: 1 = Not at all, 5 = Very influential (List from Q40 filled in.)
42. How satisfied are you with the overall availability of advice and information about reading/writing/language arts from colleagues at your school?

Qualifications/Activities. *The next section of the survey will ask you questions about your educational background, teaching experience, and on-going activities in which you may have participated to get information about teaching.*

43. How many years of teaching experience do you have?
44. How many years of school administrative experience do you have?
45. How many years have you been employed at your current school?
46. How many years have you held your current position? (If you hold more than one position, please answer with respect to the position to which most of your time is devoted.)
47. Which degrees have you acquired? Associate's degree/Bachelor's degree/Master's degree/Doctoral degree
48. Please describe the focus of the degrees you have acquired (for example, a B.S. in Chemistry). (Filter based on previous question.)

49. Which teacher certifications do you have? Check all that apply.
- a. Regular or standard state certificate or advanced professional certificate
 - b. National Board teacher certification
 - c. Probationary certificate (issued after satisfying all requirements except the completion of a probationary period)
 - d. Provisional or other type of certificate given to a person who is still participating in an alternative certification program
 - e. Temporary certificate (requires some additional college coursework, student teaching, and/or passage of a test before regular certification can be obtained)
 - f. Waiver or emergency certificate (issued to a person with insufficient teacher preparation who must complete a regular certification program in order to continue teaching)
 - g. Administrative/Principal certification
 - h. None of the above certifications
50. What grade level endorsements do you have?
- a. Elementary endorsement
 - b. Middle school endorsement
 - c. Secondary endorsement
 - d. None of the above endorsements
51. What subject area endorsements do you have?

For each level, select subject areas from: Art/Dance, Drama/English, Language Arts/Foreign Language/History/Mathematics/Music/Physical Education, Health/ Science/Social Studies/None

52. Please list any additional qualifications/endorsements:

53. How often have you participated in the following activities to get advice or information about your teaching? (Never/A few times per year/Once or twice per month/Once or twice per week/Daily or almost daily)

- a. Consulted curricular materials
- b. Reviewed national and/or state academic standards
- c. Reviewed district academic standards
- d. Reviewed standardized test results
- e. Participated in department/team meetings
- f. Attended professional-development sessions, including school or district in-service programs
- g. Participated in web-based professional discussion groups
- h. Other (please specify)

54. Please list the names of any significant school improvement models or reform programs in which your school participated during the past three years.

55. For each program listed, please list the date that implementation began at your school. (Fill in list from Q56.)

Feedback questions. *You have almost reached the end of our survey. Thank you very much for participating! The remaining questions are an opportunity for you to include any additional*

thoughts or information that you would like to share. We would truly appreciate any feedback you may have.

56. How long did it take you to complete this survey, not including interruptions?

57. Please enter any comments, questions, concerns, or feedback regarding this survey below.