

Exchange quality in teacher leadership ties: examining relational quality using social network and leader-member exchange theories

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Abstract

Purpose – This study examines the relational dynamics between teachers and formal teacher leaders (TLs). We examine the association between relationship structure and leader-member exchange (LMX) quality and the extent to which LMX mediates the relationship between social network (SN) measures of dyadic relationships and TL influence.

Design/methodology/approach – Using survey data from 1,895 teacher-TL relationships, we employ path mediation analysis using hierarchical linear modeling.

Findings – Our results indicate that voluntary advice-seeking and multiplex ties are associated with stronger exchange quality between teachers and TLs. In addition, LMX partially mediates the relationship between voluntary ties and TL influence.

Originality/value – SN and LMX theories offer two complementary lenses for studying relational dynamics in organizations, though they seldom are used together, especially in education. This study bridges SN and LMX theories and measures to bolster studies of relational dynamics in organizations and highlights that in the case of formal teacher leadership, there is a need for school structures that enable teachers and TLs to seek out one another informally and develop strong social exchanges.

Keywords Social network theory, Leader-member exchange theory, Social network analysis, Teacher leadership, Educational leadership, Social capital

Paper type Research paper

Relationships are increasingly recognized as important contributors to individual and organizational outcomes across a variety of fields (Borgatti and Foster, 2003; Cross *et al.*, 2005). In the area of teacher leadership, scholars have examined the tradeoffs in relational dynamics between formal teacher leadership (i.e. teachers in formally designated roles; Supovitz and Comstock, 2021) and informal or naturally occurring teacher leadership (i.e. teachers who have social influence in their schools without a formal leadership title; Nguyen *et al.*, 2019). Teacher leadership scholarship suggests that, while formal designations recognize strong teachers, they may constrain the relational dynamics necessary for teacher leadership to influence instruction (Comstock and Margolis, 2020). As such, there is tremendous practical and theoretical value in understanding how relational quality and formal roles intersect to influence instructional practice in the context of formal teacher leadership programs.

Given the continued expansion of formalized teacher leadership initiatives by districts and states across the US, we argue that understanding the relational mechanisms at play



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between teachers and formal teacher leaders (TLs) is important for informing how to best support implementation of these initiatives. Acknowledging previous scholars who argue for clear definitions of teacher leadership (Berg and Zoellick, 2019), we focus on formal TLs, defined as teachers who, in addition to their typical teaching responsibilities, hold official leadership roles, which are granted by their district or school leaders and aimed at influencing their colleagues' instruction (Supovitz and Comstock, 2021).

In this paper, we examine which aspects of teacher-TL relationships are associated with TLs' influence on teachers' instructional practices. To do so, we draw on two different, yet complementary, theoretical perspectives: social network (SN) theory and leader-member exchange (LMX) theory (Sparrowe and Liden, 1997). SN theory is rooted in structuralism: particular features of social structure, such as reciprocal advice-seeking behavior, serve as proxies for determining the quality of relationships (Borgatti and Foster, 2003; Rodway and Daly, 2019). LMX theory describes the relationships that develop between leaders and those they lead (i.e. "members;" Graen and Uhl Bien, 1995). According to LMX, leaders and members engage in exchanges of resources, and the nature of the exchange differs depending on qualities of the relationship (Liden and Maslyn, 1998). Thus, SN research uses the structure of social interactions to make inferences about relationship quality, whereas LMX research directly investigates the quality of the exchange process within a predefined formal leadership structure (Sparrowe and Liden, 1997). Together, these two theories enable us to examine the nature of social structures between teachers and formal TLs.

This study contributes both empirically and conceptually to the literature. First, by focusing on relationships between teachers and formal TLs, we uncover what relational conditions support formal teacher leadership. Second, we further SN theory by empirically examining the connection between structural measures of social networks and the exchange quality of relationships. While a growing body of education research leverages SN theory and measures, LMX has rarely been applied to education contexts. To do so, we examine the following research questions:

- (1) How are LMX measures of exchange quality and SN measures of relationship structure related?
- (2) Are SN measures of leader-member dyadic relationships associated with TL influence, and to what extent do LMX measures mediate those associations?

To address these questions, we first position this study in the teacher leadership literature, describe the two theories of relational dimensions that ground this analysis, and present the conceptual framework guiding this study. We then describe the study context and research methods and present results. We conclude with study limitations and discussion of the findings.

Relationships and teacher leadership

Quality of teacher-TL relations is a central theme in the teacher leadership scholarship (Nguyen *et al.*, 2019; York-Barr and Duke, 2004). Studies of teacher leadership implementation consistently suggest that supportive and trusting relationships between teachers and TLs are critical for facilitating professional growth for teachers and can make or break the potential for teacher leadership to influence teacher practice (Margolis, 2012; Nguyen *et al.*, 2019; Wenner and Campbell, 2017; Yost *et al.*, 2009). Indeed, York-Barr and Duke (2004) argue that for TLs, relationships with colleagues are "a primary means of exerting influence" (272). Quality of relationships is an especially important consideration for formal teacher leadership initiatives, where the hierarchical role designation can stand in tension with the typically egalitarian dynamic among teachers in schools (Comstock and Margolis, 2020; Wenner and Campbell, 2017). Thus, in order to understand formal TLs' influence, we must attend to the nature and quality of relations between teachers and TLs.

Two theories of relational dynamics

Given the importance of relational dynamics for TLs' work, we ground our study in SN and LMX theories, which offer two different, yet complementary, lenses into relational dynamics in organizations.

Social network theory

SN theory is a lens for understanding social interactions in organizations. The core of this theory holds that structural features of networks and relationships, derived from the relative positions of individuals within their networks, offer insights into the nature of relational dynamics in organizations (Borgatti and Ofem, 2010). A primary contribution of SN theory and measures to the study of organizations is that it reveals the informal structure of organizations, distinct from the formal organizational hierarchy.

In the seminal SN theory, relationship quality is commonly discussed in terms of the strength of social interactions—or *tie strength* (Coleman, 1988; Marsden and Campbell, 1984). Tie strength refers to both frequency of interaction and “social closeness” between individuals (Coburn and Russell, 2008; Granovetter, 1973; Marsden and Campbell, 1984). A long line of research discusses the benefits and drawbacks to ties of varying strengths. While weak ties offer access to novel information (Burt, 1992; Granovetter, 1973; Reagans and McEvily, 2003), strong ties allow for transfer of complex knowledge (Hansen, 1999) and influence through peer and group norms (Coleman, 1988). Individuals might be more motivated to provide information to a stronger tie and are more likely to trust that the receiver of their information will use the knowledge effectively when ties are strong (Reagans and McEvily, 2003). Strong ties may lower the “transaction costs” associated with knowledge transfer, as individuals sharing and receiving knowledge have effective communication strategies and can predict how the knowledge source will respond to requests (Hansen, 1999; Reagans and McEvily, 2003; Rodway and Daly, 2019). Thus, SN theory offers a lens into the relational dynamics in organizations by mapping connections between individuals.

In education, SN theory has enabled studies of how teachers' collegial relationships relate to innovation use, school reform efforts, and policy implementation (Coburn and Russell, 2008; Penuel *et al.*, 2009). In addition to examining relational structure, a few qualitative SN studies in education attend to the content or nature of interactions (e.g. Coburn *et al.*, 2013; Coburn and Russell, 2008). For instance, in their study of math reform, Coburn *et al.* (2013) examined the structure and content of teachers' social networks, finding that instructional policy can influence both who teachers turn to for advice (i.e. the structure of their networks), as well as the types of instructional talk that teachers engage in (i.e. the content and depth of those interactions). In a quantitative study, Moolenaar and Slegers (2010) found that teachers' perceptions of trust in their schools was a mediator of the relationship between network density and innovative climate in advice networks, indicating that structural network features are related to organization-level outcomes *through* trust. Thus, rather than relying solely on network structures to infer the activities, processes, and conditions in social interactions, these authors illustrate the value of examining the nature of interactions more closely and the means through which relational structure is connected to outcomes.

Leader-member exchange theory

Hailing from organizational management, LMX theory explains the development of relationships between formal leaders and those they lead. The seminal LMX theoretical scholarship is grounded in the conception that leaders form different relationships with different members and those relationships are a social exchange (Dansereau *et al.*, 1975; Dienesch and Liden, 1986; Graen and Uhl Bein, 1995). The qualities of the exchange differ depending on features of the relationship, such as the extent of loyalty, professional respect,

affect, honesty, and trust (Bernierth *et al.*, 2007; Matta *et al.*, 2015). According to LMX theory, as a relationship grows stronger, it progresses from a relationship of supervision and contractual obligations to one of “influence without authority” that privileges social-emotional dynamics (Dansereau *et al.*, 1975, p. 46). Ultimately, exchange processes in relationships with stronger LMX are more informal and ad hoc in nature, rather than formally defined and contractually executed. Over the course of LMX’s decades-long history, several LMX survey scales have evolved to measure leader-member relationships (Dienesch and Liden, 1986; Liden and Maslyn, 1998). While LMX has been applied to organizational management studies for decades, LMX theory has rarely been applied to an education context, especially to K-12 schooling (however, for examples, see Erdogan *et al.*, 2006 and Vermeulen *et al.*, 2020).

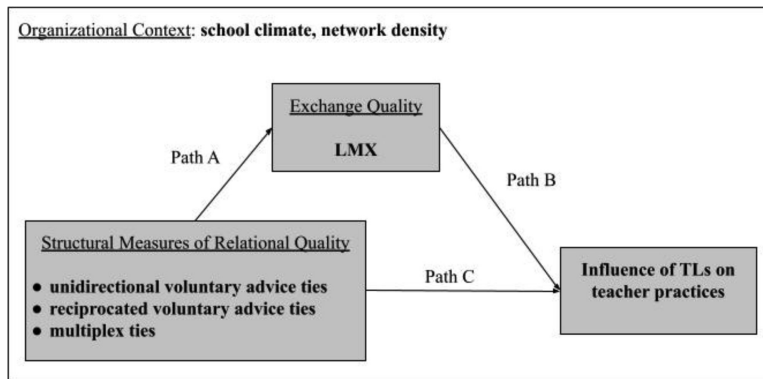
LMX theory offers a close look at the nature of relational dynamics, and more recent LMX scholars have called for bridging SN and LMX theories to better understand LMX relationships in context (e.g. Balkundi and Kilduff, 2006; Erdogan *et al.*, 2015; Zagenczyk *et al.*, 2015). Studies leveraging both theories have identified that leader and member centrality are related to LMX quality (Goodwin *et al.*, 2009), that members’ network connections influence their LMX ratings of their leaders (Zagenczyk *et al.*, 2015), and that organizational culture moderates the relationship between fairness and LMX (Erdogan *et al.*, 2006). Collectively, these studies highlight the importance of attending to the social networks and organizational contexts within which LMX dyadic relationships are situated.

Bridging SN and LMX theories by examining Teacher-TL relationships

This study bridges structure with exchange quality to understand dynamics between teachers and formal TLs. We used dyadic measures of structure and exchange quality. Two dyad-level structural features that commonly arise in the SN literature as indicative of strong relationships are voluntary advice ties and multiplex ties. Theory suggests that the presence of voluntary advice ties indicates stronger relationships because individuals must feel a certain amount of trust and comfort with a colleague if they solicit advice from them (Rodway and Daly, 2019). The directionality of advice ties also serves as an indicator of strength. *Unidirectional ties* are those in which only one individual in a pair seeks the other. *Reciprocated ties* are those in which individuals share a mutual relationship and thus benefit from a stronger relationship with one another than a one-sided relationship (Lin, 2002). *Multiplex ties* are those that serve more than one purpose, such as friendship and professional advice (Ibarra, 1993). According to SN theory, relationships that have multiple purposes are stronger because they allow for the “appropriation” of resources for multiple uses and are more likely to endure in the face of challenges (Coleman, 1988; Rodway and Daly, 2019). Thus, we expected teachers and TLs who share voluntary advice ties, especially reciprocated advice ties and multiplex ties, to have a stronger LMX relationship. Given the complexity of instructional change, we also theorized that strong ties are important for TLs to influence teachers’ practice and that the quality of the social exchange between teachers and TLs explains a positive association between reciprocal voluntary advice ties and leader influence—i.e. LMX mediates the relationship between voluntary ties and TL influence.

Conceptual framework

Figure 1 displays the conceptual framework grounding this study. Path A represents the association between structural measures of relational quality and exchange quality. Path C represents the relationship between structural measures of relational quality and the influence of TLs on teacher practices. Finally, Path B via Path A represents that exchange quality mediates the relationship between structural measures of relational quality and TL influence. Surrounding these relationships is organizational context, which acknowledges how school climate and network density may influence each of these relationships.



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Figure 1.
Conceptual framework

Study context

This study examines features of teachers' social networks in 58 schools in seven districts in three states in the US. The data were part of a mixed-methods study of district-based teacher leadership programs. For our broader study, we conducted a national scan of teacher leadership initiatives in the United States (Berg *et al.*, 2019). We selected district programs for in-depth study that prepared teachers with knowledge and skills to lead, positioned them in leadership roles to capitalize upon their expertise, and recognized them as leaders through awards and other forms of appreciation or acknowledgement. In each district, TLs held a formal designation (e.g. instructional coach, content area specialist, data coach) which was designed to support their colleagues' instruction. TLs engaged in a range of activities with teachers, including instructional planning, observations and feedback, and data analysis in both group and one-on-one formats (Supovitz and Comstock 2021).

The schools in this study represented a range of demographic characteristics. Of the 58 schools, 39 were elementary schools (pre-k to 5th grade), 12 were middle schools (6th to 8th grade), and 7 were high schools (9th to 12th grade). Schools ranged in size from a student enrollment of 120–2076, with an average of 538 students and a median of 463. On average, density of school-level instructional networks was 7%, ranging from 1% to 33%, and with a median of 6%. Student performance data was unavailable for four schools. Among the remaining 54 schools, an average of 48% of students and median of 40% of students achieved proficiency on state assessments in English language arts; proficiency ranged from 15% of students to 85% of students. Regarding student composition, schools served between 1% and 95% students of color, with an average of 36% and median of 34%, and between 2% and 100% students who qualify for free-or-reduced-price lunch, with an average of 39% and median of 34%. Schools were located in various geographic regions across the country, representing urban, suburban, and rural locales.

Research methods

Sample

The dataset for this study consisted of 1,895 teacher-TL dyads, derived from a survey of teachers and TLs in the 58 schools in the 2018–19 school year. The overall response rate was 68%, with a minimum school response rate of 42% and a maximum of 100%.

Dyads were based on teachers' responses to a survey item, which asked them to list the TLs from their school roster with whom they had worked during the 2018–19 school year, from most to least frequent. This item represented teachers' connections with formally designated TLs in their schools. Teachers were then asked to report their perceptions of the

quality of their exchange relationship (i.e. LMX) with each of the top three TLs whom they listed. The resulting dyadic dataset contains up to three dyads per teacher, representing relationships between teachers and formally-designated TLs, with a unique measure of social exchange quality per dyad from the teacher perspective.

A total of 1,420 teachers completed the survey. Of those teachers, 363 teachers were dropped from the sample because they did not list any connections to a TL (indicating they did not work with a TL during the 2018–19 school year). An additional 69 teachers were dropped because of nonresponse, leaving 988 teachers. The final dataset of 1,895 dyads represents 988 unique teachers connected with a total of 383 unique TLs.

Measures

Teachers and TLs in participating schools in the seven districts completed an online survey between November 2018 and May 2019. On the survey, we asked teachers about their collegial networks in their schools: who they *voluntarily* went to for assistance on particular instructional matters and the reasons they went to them (Supovitz, 2008). Teachers were provided with school rosters of educators (including teachers, TLs, and administrators). For three separate questions, teachers were asked to list individuals to whom they went to for support regarding: instruction in their major subject area, strategies to assist students at risk of not meeting standards, and classroom management (Supovitz *et al.*, 2016). We considered teachers' responses to these items to be their *voluntary ties*—i.e. ties they shared due to voluntary advice requests.

After the SN questions, the survey asked teachers to list specifically the TLs with whom they had worked during this school year and their perceptions of the quality of their exchange relationship with each of the top three TLs whom they listed.

Finally, the survey asked about teacher background characteristics (e.g. education, race, gender), teaching assignment, perceptions of school culture, and the influence of teacher leadership.

Key variables. Key variables of interest for this study were:

- (1) *LMX scale* ($\alpha = 0.84$), which operationalized the quality of exchange relationships. This six-item composite was an adaptation of well-studied LMX scales: LMX7, the LMX-MDM, and the LMSX (Bernerth *et al.*, 2007; Liden and Maslyn, 1998; Scandura and Graen, 1984). The response options were a six-point Likert agreement scale for five items and a six-point Likert effectiveness scale for the sixth item.
- (2) *Teacher leadership influence scale* ($\alpha = 0.92$), a 10-item composite representing teachers' perceptions of teacher leadership influence, based on Marsh *et al.* (2010) items. On a six-point Likert agreement scale, teachers were asked how their work with their TL(s) influenced their practice.

The following three variables served as key explanatory variables.

- (1) *Unidirectional voluntary ties* was a binary variable that indicated whether or not the dyad shared at least one unidirectional voluntary tie, from the teacher to the TL.
- (2) *Reciprocated voluntary ties* was a binary variable that indicated whether or not the dyad shared at least one reciprocated voluntary tie. In practice, this meant that both the teacher and TL of the dyad listed one another on at least one of the three SN advice questions.
- (3) *Multiplex ties* was a binary variable that indicated whether or not the teacher requested advice from the TL due to friendship, which suggested that a dyad's ties served both expressive and instrumental purposes (Ibarra, 1993; Rodway and Daly, 2019).

Covariates. To account for organizational context in which relationships were embedded, we included the following variables in the regression analyses:

- (1) Teachers' perceptions of school climate: *trust* ($\alpha = 0.83$), *reflective dialogue* ($\alpha = 0.66$), and *teacher influence on decision-making* ($\alpha = 0.76$) (see Bryk and Schneider, 2002; Sebastian *et al.*, 2016)
- (2) *Network density* at the school level in teachers' instructional networks: To calculate network density, we used an SN question from the survey (i.e. to whom teachers and TLs went for advice on instruction in their major subject area). We divided the total actual ties in this network by the total potential ties. To calculate potential ties, we multiplied the total surveyed individuals in the network (N) times $N-1$ and divided by 2.
- (3) School characteristics: school enrollment, percent of students who qualify for free-and/or-reduced-price lunch, and percent of students of color in student population.

In addition, we controlled for:

- (1) Teachers' *average out-ties*, an average of the number of people teachers reported turning to for advice on the SN survey questions
- (2) *Duration of relationship*, a binary variable indicating the relationship's span (1 = longer than the current school year; 0 = just the current school year), and
- (3) Teacher characteristics: *education*, *years of teaching experience*, and *gender*.

Analytic approach

We applied a path analysis (Baron and Kenny, 1986) using multilevel models to examine the relationship between SN and LMX measures, and to assess the extent to which LMX mediated the relationship between SN measures and TL influence. Path analysis requires three consecutive regression analyses: (1) regressing the outcome of interest (TL influence) on the explanatory variables (SN dyad measures; Path C), (2) regressing the hypothesized mediator on the explanatory variables (LMX; Path A), and (3) regressing the outcome of interest on both the explanatory variables and the hypothesized mediator (Path B). Path A offers evidence for any association between SN measures and LMX. The clearest evidence of complete mediation occurs when the explanatory variable(s) are significant in regressions 1 and 2, and null in regression 3, with a significant relationship between the mediator and outcome variable in regression 3. Evidence of partial mediation occurs when the coefficient of the explanatory variable is significant in all models but decreases in magnitude in regression 3 (Baron and Kenny, 1986; see Moolenaar and Slegers, 2010 for a relevant application). To account for non-independence of observations (since both teachers and TLs are repeated in the dataset), we employed three-level hierarchical linear models, where teachers were nested in TLs, nested in schools.

Finally, we employed bootstrapping procedures to test the significance of the indirect effect of each dyadic SN measure on TL influence through LMX (Bollen and Stine, 1990). Indirect effects were calculated from 1,000 resamples by multiplying each of the estimates for the explanatory variable of interest in Path A by the mediator effect in Path B (MacKinnon *et al.*, 2002). Using the resulting sampling distributions, we generated confidence intervals for each indirect effect to assess significance.

Descriptive statistics

Table 1 presents descriptive statistics for the variables included in the analyses. The average response on the TL influence scale was 4.41, indicating that the teacher in the average dyad

JPCC	
TL influence scale	4.41(0.95)
<i>Nature of voluntary ties</i>	
No voluntary ties: formal only	44.12
Unidirectional voluntary ties	50.82
Reciprocated voluntary ties	5.07
Multiplex ties	9.02
LMX	5.13(0.80)
<i>Teacher perceptions of school climate</i>	
Reflective dialogue	4.10(0.69)
Trust	4.99(0.80)
Influence on decision-making	3.06(0.85)
Average teacher out-ties	1.88(1.18)
Density of instructional support network	0.07(0.05)
<i>Relationship duration</i>	
Just this school year	29.97
Longer than this school year	70.03
<i>Education</i>	
Associates or bachelors	41.69
Masters	37.94
Masters plus or above	20.37
<i>Gender</i>	
Female	88.50
Male	11.50
<i>Race</i>	
Teachers of color	8.92
White	91.08
<i>School demographics</i>	
School enrollment (in hundreds)	6.82(4.38)
Percent free-and-reduced price lunch	32.17(22.81)
Percent students of color	36.18(23.68)

Table 1.
Descriptive
statistics ($N = 1895$)

Note(s): All descriptive statistics are reported as % or $M(sd)$

somewhat agreed/agreed that teacher leadership influenced their practice. Approximately 44% of the dyads were not connected through voluntary ties—i.e. the individuals in the dyad did not indicate requesting voluntary advice from their partner in the dyad. The remaining dyads (about 56%) were connected through voluntary ties—51% of these through unidirectional ties from the teacher and 5% of these through reciprocated ties [1]. Approximately 9% of dyads had a relationship in which the teacher solicited advice and also characterized the relationship as a friendship, indicating a multiplex tie. Most dyads (70%) had worked together for longer than the current school year.

Teachers were generally positive about their school climate. On average, teachers agreed that their school climate consisted of reflective dialogue and trust (4.10 and 4.99, respectively) and that teachers were somewhat influential on school decision-making (3.06). On average, teachers taught in schools with low school-level instructional support network density (7%). The average out-degree centrality among teachers was approximately two ties, indicating that most teachers sought advice from two other individuals for various instructional needs.

Teachers in the dyads were predominantly white (91%) and female (89%). A majority of teachers held a master's degree or above (58%). The average teacher taught in a school with approximately 680 students and in which about a third of students qualified for free-and-reduced price lunch (32%). Thirty-six percent of schools' student population were students of color.

Finally, we ran point-biserial correlations between each dyadic SN measure of interest (unidirectional voluntary ties, reciprocated voluntary ties, and multiplex ties) and LMX. The resulting correlations were 0.174, 0.115, and 0.163, respectively, indicating that they measure substantively different things.

Results

Overall, our results suggested that teachers in dyads that shared a voluntary tie well as those that shared a multiplex tie reported higher LMX relationship quality than those who did not report such relationships. In addition, the results suggested that LMX partially mediated the relationship between unidirectional ties and TL influence, as well as between reciprocated ties and TL influence. The models described next refer to [Table 2](#).

Path C: relationship between SN measures and TL influence

The first model investigated the relationship between the SN measures and TL influence, excluding LMX ([Table 2](#)). Results indicated that both unidirectional and reciprocated ties had a statistically significant relationship with TL influence: dyads sharing unidirectional voluntary ties were associated with a mean TL influence that was 0.259 units greater than dyads that did not share voluntary ties, net all other variables in the model. Likewise, dyads sharing reciprocated voluntary ties were associated with a mean TL influence that was 0.441 units greater than dyads that did not share voluntary ties. Thus, as theory would predict,

Variables	Model 1 (path C) (DV = TL Influence)	Model 2 (path A) (DV = LMX)	Model 3 (path B) (DV = TL Influence)
<i>Nature of voluntary ties (formal ties omitted)</i>			
Unidirectional ties	0.259*** (0.040)	0.290*** (0.038)	0.192*** (0.040)
Reciprocated ties	0.441*** (0.083)	0.490*** (0.080)	0.332*** (0.082)
Multiplex ties	-0.039 (0.064)	0.226*** (0.061)	-0.086 (0.063)
LMX	-	-	0.225*** (0.024)
<i>Teacher perceptions of school climate</i>			
Reflective dialogue	0.300*** (0.030)	0.119*** (0.028)	0.275*** (0.030)
Trust	0.197*** (0.026)	0.192*** (0.025)	0.153*** (0.026)
Influence on decision-making	0.262*** (0.024)	0.153*** (0.022)	0.228*** (0.023)
Density of instructional support network	-0.301 (0.734)	-0.361 (0.629)	-0.302 (0.706)
Average teacher out-ties	0.060*** (0.017)	-0.025 (0.015)	0.066*** (0.016)
Relationship duration: longer than this school year	-0.112** (0.040)	0.084* (0.038)	-0.132*** (0.039)
Controls for teacher demographics (education, gender, race/ethnicity)	Yes	Yes	Yes
Controls for school demographics (size, percent free/reduced lunch, percent students of color)	Yes	Yes	Yes
Constant	1.318*** (0.200)	3.075*** (0.174)	0.637** (0.207)
N	1895	1895	1895

Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 2.
Regression results

teacher-TL relationships that shared voluntary advice-seeking behavior were associated with higher perceived TL influence than relationships that did not have these features. Furthermore, teacher-TL relationships in which voluntary advice-seeking behavior was reciprocated had the strongest association with perceptions of TL influence, relative to unidirectional relationships in which teachers voluntarily requested advice from the TL. Multiplex ties, however, were not related to TL influence, suggesting that friendship may not benefit teachers' instructional practice.

Path A: relationship between SN measures and LMX

Model 2 investigated the relationship between SN measures and LMX. The results showed that both unidirectional and reciprocated voluntary ties were significantly associated with higher mean LMX values compared to dyads without voluntary ties, and the predicted LMX value for reciprocated ties was much larger in magnitude than that of unidirectional ties. In addition, multiplex ties significantly predicted higher mean LMX values, on average, compared to ties not characterized by multiplexity. These results suggest that each of these measures of relationship structure was associated with stronger exchange quality.

Path B: relationship between SN measures and TL influence, with LMX as a mediator

Finally, Model 3 investigated the relationship between SN measures and TL influence, including LMX in the model. Because unidirectional ties and reciprocated ties were significantly associated with the outcome variable and the mediator in Models 1 and 2, the results in Model 3 provided information for assessing the potential mediation effect of LMX on those variables. Because the estimate for multiplex ties was not significant in Model 1, a precondition for mediation, the results suggested that LMX did not mediate multiplexity.

Model 3 showed a significant relationship between unidirectional ties and reciprocated ties, and the magnitude of each coefficient decreased relative to Model 1. The relationship between LMX and TL influence was positive and significant, indicating that each unit increase in the LMX scale was associated with a 0.225-unit increase in TL influence. Given their statistical significance and the decrease in magnitude of the explanatory variable coefficients, Model 3 provided evidence that LMX partially mediated the relationship between unidirectional ties and TL influence, as well as reciprocated ties and TL influence.

It is also worth noting that Models 2 and 3 showed that teachers' perceptions of the three dimensions of school climate were significantly related to both TL influence and LMX across models. These findings are consistent with LMX literature that identifies organizational climate as an antecedent to LMX. In contrast, network density was not related to either outcome, which may be attributable in part to the somewhat low levels of network density among schools in the study (an average of 7%) relative to other recent SNA education studies (e.g. [Siciliano et al., 2017](#); [Supovitz et al., 2016](#)).

Significance test of indirect effect

Finally, we conducted a significance test of LMX as a partial mediator of unidirectional voluntary ties and TL influence, as well as reciprocated ties and TL influence. [Table 3](#)

SN measure of voluntary ties	Standard error of indirect effect	Confidence intervals (lower bound, upper bound)		
		95%	99%	99.9%
Unidirectional	0.0130	(0.042, 0.093)	(0.036, 0.106)	(0.033, 0.110)
Reciprocated	0.0217	(0.078, 0.162)	(0.064, 0.171)	(0.049, 0.179)

Table 3.
Bootstrapping results

reports the estimate of the indirect effect for unidirectional and reciprocated voluntary ties. Based on the bootstrapped samples, the confidence intervals for each indirect effect indicated that both are statistically significant at the 0.001 alpha level. These results support findings that LMX partially mediates the relationship between unidirectional voluntary ties and TL influence, as well as reciprocated ties and TL influence.

Limitations

The primary limitations of this study relate to causality. A precondition for mediation is that the dependent variable does not cause the mediator (Baron and Kenny, 1986). The data presented here is correlational in nature and relies on cross-sectional data, so we cannot establish directionality required for this causality argument. Further, given that we could not control for all potential confounding variables, our study may include omitted variable bias. For instance, we were unable to control for TL background variables. Characteristics such as TLs' years of experience and TL race/ethnicity—and the alignment between teacher and TL characteristics (e.g. racial matching, see Steinberg and Sartain, 2021)—could influence relational dynamics. Despite these drawbacks, our findings present initial evidence of LMX as a mediator of dyadic SN measures and an opportunity for future longitudinal and causal research.

Discussion and conclusions

This study's findings suggest that bridging SN and LMX theories deepens our understanding of relational dynamics in organizations and of leadership in schools. We provide empirical evidence for inferences in SN studies that common structural measures (i.e. presence of advice-seeking ties, reciprocated ties, multiplex ties) indicate stronger relationships (Rodway and Daly, 2019). Relationships in which teachers voluntarily sought TLs' support were associated with higher-quality LMX, especially when those relationships were mutual (i.e. reciprocated). Likewise, the findings also provided empirical evidence that multiplex ties—those that had multiple purposes—also indicated stronger exchange quality. Thus, in the case of teacher leadership, teacher-TL relationships were stronger when teachers saw their TLs as friends as well as colleagues.

The findings also indicated that voluntary advice-seeking ties were associated with greater perceptions of TL influence on teachers' practice, but multiplex ties were not. Thus, while multiplexity plays a role in the strength of the relationship, sharing a multiplex tie was not related to perceptions of TLs' influence on teachers' instructional practices. This finding resonates with SN studies that suggest that too much "bonding social capital" (Coleman, 1988; Rodway and Daly, 2019) can actually inhibit change and may insulate individuals from novel ideas (Bridwell-Mitchell and Cooc, 2016). Individuals who share close relationships may be less likely to give and receive advice from one another that would lead to changes in practice because, for instance, they have reached a saturation point in their advice sharing or may be hesitant to critique a friend's practice. These findings suggest that school leaders who leverage TLs for instructional support should make intentional efforts to simultaneously foster strong ties as well as a culture of critique and continuous improvement. Qualitative studies that leverage the theoretical framework tested in this study and examine the dynamics at play in schools with especially strong ties would help to extend these potential explanations.

Further, results of the path analysis indicated that LMX partially mediated the relationship between unidirectional voluntary ties and TL influence, as well as reciprocated voluntary ties and TL influence. Collectively, these results suggest that voluntary advice-seeking behavior, especially when mutual between teachers and TLs, may lead to TLs' influence on teachers' practice due to high-quality social exchanges. While this study was not causal, the results provide exploratory evidence of this mediating effect. These results suggest that the social structures that scholars highlight as important for organizational

learning may indeed be important *due to* the quality of the social exchange that occurs within those structures. As others have similarly concluded (e.g. Coburn, 2005; Kaul *et al.*, in press; Johnson, 2019), school leaders, then, can consider how to foster these types of relational dynamics, such as by establishing organizational routines and structures that allow sufficient time for teachers and TLs to voluntarily seek advice when needed. Subsequent studies might test the causality of these relationships and might also examine systematically how these relational dynamics vary in different contexts, such as elementary versus secondary schools.

Finally, our findings corroborate other scholarship that suggests that SN and LMX theories are a useful pairing (Balkundi and Kilduff, 2006; Goodwin *et al.*, 2009; Sparrowe and Liden, 1997). Rather than assume strength of relationships by presence of ties, as in SN theory, scholars might use LMX to examine the strength of relationships empirically. Thus, LMX provides a way for SN researchers to examine not just the structure, but the quality and content of relationships in organizations. And rather than study LMX relationships in a vacuum, SN theory offers a way to consider how the broader organizational context relates to leader-member relations. Thus, using both LMX and SN measures bolsters the study of leadership beyond what either lens can accomplish alone. An important future study, then, is to apply this framework to the study of informal teacher leadership. A unique benefit of SN theory and analysis is its ability to examine leadership practice from a social influence perspective—i.e. to attend to informal leadership in organizations in addition to formal, role-based leadership (Balkundi and Kilduff, 2006; Supovitz and Tognatta, 2013; Uhl-Bien, 2006). Future studies might use SN measures to identify informal leaders in schools (e.g. those teachers most central in advice networks) and then use LMX measures to understand the nature of teachers' relationships with those informal leaders. Another line of research might compare the nature of relationships between formal and informal TLs in schools using this same methodological approach. Such studies would help the field understand the full range of resources that exist in schools and inform changes to organizational structures that enable schools to take full advantage of them in service of instructional improvement.

Note

1. For context, among the teachers in the sample, there were 2,444 unique ties in their instructional support networks, which could include teachers or TLs. Thus, approximately 23% of voluntary ties (553/2,444) were between teachers and TLs.

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