

The Ties That Bind: How Social Capital Is Forged and Forfeited in Teacher Communities

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The effects of social capital on school improvement make it important to understand how teachers forge, maintain, or forfeit collegial relationships. Two common explanations focused on formal organizational features and individual characteristics do not address how social capital accrues from informal dynamics of teachers' interactions in communities. Our longitudinal study of teacher networks in four urban public schools finds that teachers in larger communities and communities with stronger cohesion are more likely to interact with each other over time. Teachers who frequently span community boundaries are less likely to continue interacting. These community-level characteristics are stronger predictors than teacher traits and formal organization. Our results have implications for how schools can support teachers in maintaining relationships and generating social capital.

Keywords: elementary schools; hierarchical linear modeling; longitudinal studies; networking; organization theory/change; teacher context

One key lever for school improvement is teachers' relationships with each other (Bryk & Schneider, 2002; Coburn, 2001; Leana & Pil, 2006; Louis & Marks, 1988). Teachers' relationships, such as those in collegial communities, are important sources of social capital, defined as the potential and actual set of cognitive, social, and material resources made available through direct and indirect relationships with others (Bourdieu, 1986; Coleman, 1988; Lin, 2001). Social capital embedded in teacher relationships can lead to teacher learning and changes in practice, collegial knowledge sharing, commitment to student learning, and improved student achievement (Andrews & Lewis, 2002; Frank, Zhao, & Borman, 2004; Louis & Marks, 1998; Vescio, Ross, & Adams, 2008; Yasumoto, Uekawa, & Bidwell, 2001). Moreover, teachers with a close group of colleagues are more likely to have higher job satisfaction and are less likely to leave their schools and the teaching profession (Johnson, Kraft, & Papay, 2012; Skaalvik & Skaalvik, 2011).

The effects of social capital on school improvement have made researchers increasingly interested in understanding how teachers forge, maintain, or sometimes even forfeit the relationships in which social capital is embedded. Some research suggests the relationships teachers form are associated with the

formal aspects of teachers' organizational context, such as grade taught, leadership position, or organizational culture and structure (Coburn, Choi, & Mata, 2010; Spillane, Kim, & Frank, 2012). Teacher ties have also been associated with teachers' individual characteristics, such as race, gender, and social status (Bridwell-Mitchell & Fried, 2015; McPherson, Smith-Lovin, & Cook, 2001; Spillane et al., 2012). Between context factors at the macrolevel and individual characteristics at the microlevel, dynamics among certain individuals within a given context at the mesolevel or middle-range level may also affect their relationships (Boudon, 1991; Frank & Zhao, 2004). Thus, in our study we examine a third important source of social capital: the features of the informal relationships teachers develop as they make choices about the community of colleagues with whom they interact.

We ask three specific research questions, which explore alternative explanations for how teachers make choices about their community interactions: (1) To what extent do the characteristics of teacher communities, such as cohesion, predict the maintenance of community ties over time? (2) To what extent are

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community characteristics more influential for maintaining community ties over time than formal aspects of organizational context, such as grade and subject level taught? and (3) To what extent are community characteristics more influential for maintaining community ties over time compared to teachers' individual traits, such as age, gender, and race?

In the following sections, we first provide a brief introduction to the concept of social capital and factors that may affect access to its resources. Next, we describe the methods for the multisite, longitudinal study of teachers' social networks in four urban schools. We then present the findings for the comparative effects of individual characteristics, formal context factors, and informal dynamics on the extent to which community ties are maintained over time. We conclude with a discussion of the implications for future research and practice.

Theoretical Framework

Access to Social Capital

Social capital provides teachers with key resources for school improvement. For example, cognitive resources exchanged by teachers might include information or expertise for improving instruction (Coburn et al., 2010; Moolenaar, 2012). Social resources exchanged could include trust, esteem, or a sentiment of collective efficacy (Bryk & Schneider, 2002; Moolenaar, Slegers & Daly, 2011). Material resources exchanged could be instructional supplies, curriculum materials, or use of technology, which supports the diffusion of innovations (Frank et al., 2004).

Teachers have a variety of relationships that provide them access to social capital; this includes relationships outside of their schools, such as personal or professional contacts. Collegial relationships within their schools provide teachers with the most accessible source of social capital given colleagues' proximity, frequency of interaction, and common organizational pursuits (Cross & Sproull, 2004). It is often taken for granted that some teachers have more access to social capital than others given serendipitous patterns of collegial relationships. Asked less often is how some teachers come to have relationships that grant them access to social capital and other teachers do not.

The Role of Individual Agency and Demographics

One answer to how some teachers come to have certain patterns of relationships is that some individuals may be better able to establish relationships with others or may be more sought after by others because of their demographic traits or individual efforts. A basic finding in the network literature is that individuals prefer interacting with others they view as having traits similar to themselves (McPherson et al., 2001). Individuals also affiliate with others who have traits that are valued in a given work context. For example, as Spillane and colleagues (2012) demonstrate, individuals' years of experience may influence how much they are solicited, as may broadly valued social characteristics related to race and gender.

Some research suggests that demographic characteristics are important not only for being sought out by others but also for seeking others out. For example, Sun, Penuel, Frank, Gallagher,

and Youngs' (2013) study of teacher professional development suggests teachers with a greater breadth of expertise may help their colleagues more. Bridwell-Mitchell and Lant (2014) show that there can be substantial differences between how much male and female principals seek out others for advice. There is even some research outside of the education literature that suggests personality traits, such as narcissism, may influence how much individuals seek input from others (Clifton, 2011).

The Role of Organizational Context

Another factor affecting how some teachers come to have a certain pattern of network ties is organizational context. For example, in their 3-year study of district reform strategies, Coburn et al. (2010) found that organizational norms and structures influenced how teachers form relationships with colleagues by affecting the level of contact teachers have with each other and the expectations for collaboration. Bridwell-Mitchell and Fried (2015) found that compared to teachers in schools with low performance and strong accountability pressures, teachers in schools with higher performance and weaker accountability were more likely to forge ties with colleagues.

In contrast to the effects of organizational norms, culture, and performance, organizational structure may also influence tie formation. For example, Spillane et al. (2012) found that teachers with formally designated leadership positions, such as assistant principal, coach, subject coordinator, or mentor, were much more likely to forge ties with their colleagues. The way districts and schools structure routines for professional learning may also influence access to social capital in that some routines and facilitative roles, such as having instructional coaches, may influence the depth and strength of teachers' interactions (Coburn & Russell, 2008).

The Role of Informal Social Context

Some studies of teacher communities emphasize that communities are grounded in a particular set of norms and values related to school improvement (Bryk, Camburn, & Louis, 1999; Louis & Marks, 1998). Another view of teacher communities emphasizes not the content of ties between teachers, such as the norms and values they share, but instead the network structure of these relationships (Daly, 2010; Moolenaar, 2012). In this case, community is defined by the pattern of interactions teachers have with each other. Teacher communities are considered informal when relationships are determined by teachers' choices about the reasons for and frequency of their interactions rather than having their relationships be designated by formal roles or assignments by school leaders.¹ Whereas membership in formal communities might be determined by teachers' names appearing on a list of official assignments, informal community is determined by the strength, density, and closure of ties between a group of individuals (Coleman, 1988). *Strength* refers to the level of attachment between individuals. *Density* is the proportion of possible interactions that have actually occurred between the individuals. *Closure*, which is related to density, is how much individuals who are indirectly connected by third parties are also directly connected to each other.

To make these concepts more concrete, imagine there are 20 teachers at a school but 8 of the 20 compose a particular community. This would be the case if the 8 felt a greater sense of attachment or interacted more frequently with each other than with the other 12 teachers at the school, suggesting the 8 have stronger relationships. Whether the eight teachers are a community would also depend on how much each teacher directly interacted with the other seven teachers, resulting in a high density and closure of ties among the group. These strong, dense, closed relationships constitute a network-based view of informal teacher community. We follow this approach in the current work to examine how features of teachers' collegial communities affect tie maintenance.

How Community Features Matter

Consider, for example, that in larger communities it may be difficult for teachers to get to know each other and interact with all of their other community members. This might result in fewer overall interactions and potentially weaker ties as well as less density and closure, since every teacher might not interact with every other community member. One result could be future fracturing or breaking apart of the community among members who are not as well connected. Another community feature that may affect interactions is the degree to which members have affiliations with multiple communities. Because individuals have a finite amount of resources to invest in relationships, boundary spanning between multiple communities means less time and energy to devote to relationships in one's own community (Granovetter, 1973). One potential result is fewer interactions or weaker ties with any one community.

In contrast to the negative effects of community size and boundary spanning, community cohesion may increase teachers' ability to maintain ties. Cohesive communities have many strong ties between all members (Coleman, 1988). Such relationships require a high degree of time and energy such that teachers would have fewer opportunities to interact with those outside of their communities. More frequent interactions in cohesive communities may also result in stronger feelings of emotional attachment and help teachers maintain relationships with their colleagues over longer periods of time (Hammer, 1979). The extent to which teachers maintain relationships with their colleagues over time is important because this determines how integrated teachers are likely to be in their communities. This, in turn, influences the degree to which teachers have sustained and reliable access to social capital.

In the current study, we examine whether the features of teacher communities are associated with their maintenance of community ties over time. We also examine these effects relative to the effects of individual characteristics and organizational context factors over time. An illustrative model of how these three factors influence community ties and social capital is presented in Figure 1. It is important to note that our approach differs from and extends much existing research on network evolution among teachers. Typically, research on how network ties evolve among teachers' examines how dyadic or one-to-one ties between teachers are formed (Coburn et al., 2010; Moolenaar, 2012; Spillane et al., 2012). In other words, these studies ask,

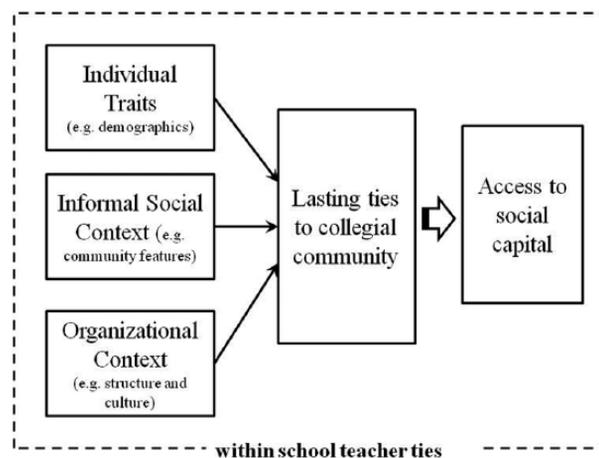


FIGURE 1. *Conceptual model for teacher ties to collegial community*

“To what extent does Teacher A form or maintain a relationship with Teacher B?” Since communities can be conceptualized as sets of dyadic ties, the approach taken by existing research is reasonable. However, we take a more direct approach that makes fewer assumptions about how dyadic interactions translate into community dynamics. We do this by examining teachers' ties to a community rather than an individual. In other words, we answer the question, “To what extent does Teacher A maintain relationships with her or his *community*, which is composed of Teacher B but also Teachers C, D, and E?”

Method

Data and Measures

We draw on data from a larger longitudinal study of teacher networks in four public elementary schools in a large northeastern city. The data for this study were collected from 2005 to 2007 as part of a broader research project on how teacher experiences mediate school response to accountability pressures. The schools were selected from a stratified random sample of elementary schools such that the sample schools represented organizational archetypes in terms of the intersection of high, low, and median student performance and strong, weak, and typical accountability pressures based on federal, state, and city mandates.

Two schools—referred to as Endeavor and Strive Elementary—are from the strata of lowest-performing schools, facing the highest accountability pressures from federal, state, and city authorities. The third school, Paramount Elementary, is from the strata of highest-performance schools with the least accountability pressure because they do not receive federal Title I funds, accepted a waiver from city-mandated reforms, and were well above state operating license requirements. The fourth school, Everyday Elementary, is from the strata of schools in the middle two performance quartiles and facing typical accountability pressures in that these schools were required to meet city and federal accountability requirements. Demographic information on student and teachers in the schools is provided in Table 1.

We administered a questionnaire to teachers from the four schools during seven after-school meetings in the spring of 2005;

Table 1
Descriptive Summary of Student and Teacher Characteristics of Sampled Schools

Variable	Endeavor	Everyday	Paramount	Strive
Student characteristics				
Total enrollment	364	498	356	339
% Female	45.9	48.4	46.6	47.8
% Asian	1.9	1.4	37.6	0.6
% Black	57.1	11.0	21.9	18.0
% Hispanic	35.4	86.9	17.7	81.1
% White	5.5	0.6	37.6	0.3
% ELL	6.9	21.9	1.4	21.8
% Free lunch	93.6	95.2	27.2	93.4
% ELA ^a	31.4	32.4	86.0	22.9
% Math ^a	43.4	46.6	85.1	31.3
Teacher characteristics				
Number of teachers	31	36	20	34
% Teachers >5 years of experience	77.4	50.0	90.0	32.4
% Master's or higher	87.1	69.4	100.0	61.8

Note. All information is based on 2004 annual school reports. ELL = English language learner; ELA = English language arts.
^aIndicates percentage of students who meet or exceed standards on the ELA and mathematics state exams.

in the fall, winter, and spring of 2006; and the fall, winter, and spring of 2007. The questionnaire, which was developed and validated by the researchers in a previous pilot study at one of the four schools, had a total of 62 items, of which the nine described below are relevant to the current study. The survey response rate varied across schools and survey administrations from a low of 62.8% to a high of 86.0%, resulting in a total of 781 repeated observations for 215 teachers. The questionnaire included seven items asking respondents to report demographic characteristics, including age, gender, race, years of experience as a teacher at their current school, their occupational status as a main classroom teacher versus teaching assistant or paraprofessional, and their grade and subject taught. Teachers were also asked to complete one item rating the status of other teachers based on whether they should receive a Teacher of the Year award given their strength, competence, and talent as a teacher relative to other teachers at the school.

Had we been interested mainly in teachers' formal communities, we could have used teachers' assignment to grades or subjects to indicate community, where all teachers in the same grade or subject would constitute a community. However, we are interested in the interactions teachers select, not only those to which teachers have been assigned. Therefore, the questionnaire included one item that asked respondents to indicate how frequently they had a social and/or professional conversation with all other teachers at their school on a scale of 1 (*less than once a month*) to 7 (*multiple times a day*).² Because these data are teachers' reported affiliations rather than their formal assignment to grades, subjects, or other official roles, we use them as the basis for constructing teachers' informal collegial communities.

Dependent variable: Community ties. To identify teachers' communities, we construct a single-mode *i*-by-*j* square adjacency matrix for each school at each time period. The rows *i* are respondents and the columns *j* are all other teachers at the school, and the cells x_{ij} are values (1–7) for teacher *i*'s reported frequency of interaction with teacher *j*. Because missing data can be

problematic for identifying clusters in sociometric data, missing values for x_{ij} were imputed from the average reported frequency of interaction between *i* and *j* across the time periods for which there were data on *i*-*j* interactions (Kossinets, 2006). According to Freeman, Romney, and Freeman (1987), respondent recall and reports of relationships are linked to long-range stable patterns in social structure; thus, the average of such reports over time provides a relatively accurate representation of the underlying or "true" network (Wasserman & Faust, 1994, p. 56).

Network studies typically use the above matrix to provide descriptive network statistics, such as centrality or density (Wasserman & Faust, 1994). We also use this matrix to identify each respondent's collegial community for school *s* at time *t* using the iterative partitioning routine *KliqueFinder* (Frank, 1995). Among methods for identifying clusters in network data, *KliqueFinder* is an improvement because it identifies and provides a stochastic goodness-of-fit test for unique, nonoverlapping cohesive subgroups based on the specified criteria, including the number, density, and reciprocity of ties. Illustrative demographic data for a representative subsample of the 197 communities are provided in Table 2. For example, Table 2 indicates that younger teachers, in terms of age and teaching experience, are more likely to be in more cohesive communities.

Figure 2 illustrates a snapshot of community demographics at Everyday Elementary at the start of the first full year of the study (fall 2005). We see that community members may share many similarities, some tied to formal school characteristics, such as grade, but also to individual demographics, such as race. Yet, Figure 2 also indicates that the most similar communities are not necessarily the most cohesive communities. Community G, for instance, is one of the most diverse communities but also one of the most cohesive (cohesion: 5.38).

Our key outcome is whether teachers maintain relationships with their collegial communities. We measure this outcome with an indicator of whether a teacher at time *t* participated in a community with at least three or more of the members from their

Table 2
A Comparison of Teacher Characteristics by Affiliation With Low-, Middle-, and High-Cohesion Communities

Teacher Characteristic	Low Cohesion		Middle Cohesion		High Cohesion	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	43.72	12.39	40.75	12.45	38.69	13.14
Gender: Female	0.91	0.28	0.89	0.31	0.95	0.21
Race: Non-White	0.43	0.50	0.46	0.50	0.41	0.49
Grade: PreK–2	0.66	0.47	0.66	0.48	0.74	0.45
Grade: 3–5	0.62	0.49	0.56	0.50	0.43	0.50
Subject: ELA or math	0.72	0.45	0.73	0.44	0.82	0.39
Status	2.78	1.59	2.89	1.53	3.01	1.55
Years teaching at school	7.38	8.06	7.09	7.55	6.00	7.21
Occupation: Main teacher	0.71	0.45	0.68	0.47	0.65	0.48

Note. Low-, middle-, and high-cohesion communities are defined by the quantile distribution of community cohesion. ELA = English language arts.

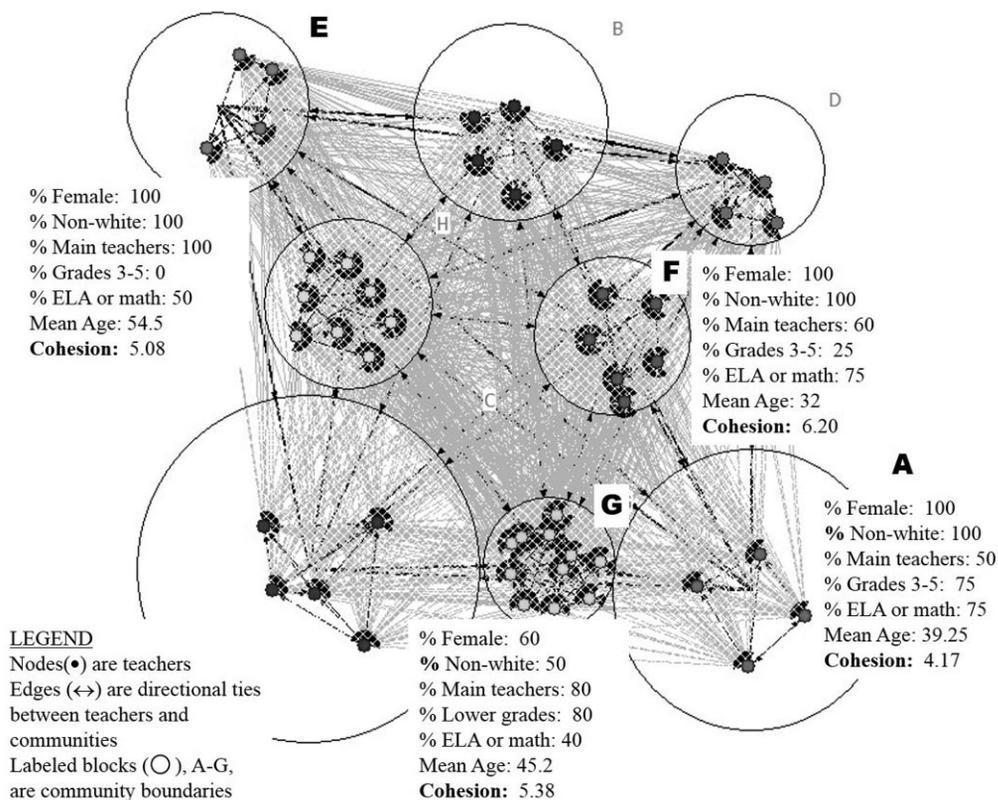


FIGURE 2. An illustration of selective community demographics at Everyday Elementary in fall 2005

community at time $t - 1$. We based this decision on the social network literature, which describes three individuals as the “minimal clique” or community (Wasserman & Faust, 1994). We also based this decision on descriptive results from our own study indicating that teachers, on average, knew about three colleagues from their previous community.

Independent variables: Informal social context features. We focused on three key community characteristics computed using KliquesFinder: community size, cohesion, and average boundary spanning of members. Community size is the number of individuals in each identified community. Community cohesion is the proportion of all possible ties that are actualized in a given

community at school s and time t , weighted by the frequency of interaction between every member of the community (i.e., valued density). The boundary-spanning measure is the sum of reported interactions between i and all communities at school s at time t (less i 's association with his or her own community), divided by the total number of communities at school s and time t (less i 's community). Since the outcome is whether teachers maintained community interactions from the *prior* period, we used lagged community traits as predictors, meaning predictors from $t - 1$. In cases where teachers did not return a survey in the previous period, we used lagged predictors from most recently available survey results. We summarize the teacher and community variables in Table 3.

Table 3
Descriptive Summary of Sampled Teachers (n = 215) and Community Characteristics

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Age	40.11	12.74											
2. Gender: Female	0.90	0.30	-.04										
3. Race: Non-White	0.45	0.50	-.01	.06									
4. Grade: PreK-2	0.70	0.46	.11	.04	.14								
5. Grade: 3-5	0.55	0.50	.03	-.21*	-.10	-.60***							
6. Subject: ELA or math	0.73	0.44	-.11	.10	-.01	-.24**	-.16*						
7. Status	2.27	1.44	.06	.06	-.04	.05	-.11	.15					
8. Years teaching at school	5.71	7.45	.56***	.00	.00	.05	.01	.06	.19**				
9. Occupation: Main teacher	0.68	0.47	-.28***	.00	-.11	-.10	-.15	.18	.30***	-.05			
10. Community size	8.11	3.78	.18**	-.01	-.32***	-.11	.06	.04	.13	.23***	.15*		
11. Community cohesion	5.60	0.61	-.12	.05	-.15*	.12	-.16	.04	.15*	-.04	.06	.19**	
12. Boundary spanning	4.29	0.63	.01	.08	-.19**	.09	-.15	-.03	-.06	-.07	-.12	-.12	.24***

Note. Community characteristics are averaged across communities and teachers. ELA = English language arts.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

Independent variables: Individual characteristics and formal context factors. To understand the influence of teacher demographic traits and formal school positions, we included the following measures: respondents' age, gender, race, occupation as main or supporting classroom teacher, grade and subject taught, and experience as a teacher at the school in years. We also include an indicator of teachers' social status, as measured by respondents' quintile rank (i.e., top 100%–80%; next 79%–60%, etc.) in the total number of nominations made by colleagues for the above-described Teacher of the Year award. Given that the four schools sampled in this study represent four types of organizational contexts based on performance history and accountability pressures, we use indicator variables for each school to represent and assess the effects of different school contexts. Because of the limited sample size for schools, we acknowledge that our fixed-effects approach is limited in that it necessarily conflates a variety of contextual factors, including school size, structure, culture, leadership style, performance, and accountability.

Analysis

Our data set involves multiple observations of the same teachers in different communities over time. That is, we have observations nested within teachers who are *cross-classified* by community. For our research questions, we formulated a logistic cross-classified model as a constrained hierarchical model using xtmixed in Stata 13.1 (Rasbash & Goldstein, 1994). More specifically, we modeled teacher observations (Level 1) as nested within teachers in communities (Level 2) who are nested within a single artificial supercluster (Level 3) to which the teachers in the study belong (Rabe-Hesketh & Skrondal, 2008). We expressed the composite model using standard hierarchical notation (Leckie, 2013):

$$\text{logit}(p_{itk}) = \beta_0 + \eta X_{itk} + \gamma Y_{itk} + s1_{itk} v_{1k} + s2_{itk} v_{2k} + \dots + s197_{itk} v_{197k} + \mu_{ik} \quad (1)$$

$$\begin{pmatrix} v_{1k} \\ v_{2k} \\ \vdots \\ v_{197k} \end{pmatrix} \sim N \left\{ \begin{pmatrix} 0 \\ 0 \\ \vdots \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_v^2 & & & \\ 0 & \sigma_v^2 & & \\ \vdots & \vdots & \ddots & \\ 0 & 0 & \dots & \sigma_v^2 \end{pmatrix} \right\}$$

$$\mu_{ik} \sim N(0, \sigma_\mu^2),$$

where p_{itk} is the probability that teacher i at time t is in a community with at least three of the members from time $t - 1$, all nested within the single artificial super cluster k . We denote teacher-level covariates with vector X and community-level covariates with vector Y . The associated slope parameters, η and γ , respectively, are of interest for our research questions. Next, $s1_{itk}, s2_{itk}, \dots, s197_{itk}$ represent a series of 197 community binary indicator variables, one for each teacher community. The parameters $v_{1k}, v_{2k}, \dots, v_{197k}$ are 197 Level 3 random coefficients for the 197 community effects. The 197 Level 3 random coefficients give rise to a 197-by-197 variance-covariance matrix where variances are constrained to be equal while all covariances are constrained to be zero. Last, μ_{ik} is a teacher random effect that is assumed to be independent and normally distributed with a mean of zero and constant variance. We fit the above model using maximum likelihood estimation. To test the robustness of the model results for the dichotomous outcome measure of tie maintenance, we also used a Poisson model where the outcome is total number of teachers that one knows from the previous period. This model is based on the skewed distribution where almost one third of teachers were not in the community with anyone from their previous community.

Results

We first present a brief summary of how teachers' community membership changes from each period. The second column of Panel A in Table 4 shows that each teacher in Time 2 (T2),

Table 4
Changes in Community Membership Over Time

Time (T)	Panel A					Panel B									
	M	SD	Min	Max	Obs.	0	1	2	3	4	5	6	7	8	18
T1 to T2	2.55	3.03	0	8	83	38.6	14.5	18.1	—	—	—	8.4	9.6	10.8	—
T2 to T3	5.33	6.62	0	18	98	24.5	18.4	12.2	—	10.2	—	7.1	8.2	—	19.4
T3 to T4	2.76	2.65	0	8	90	25.6	20	13.3	4.4	5.6	13.3	7.8	—	10	—
T4 to T5	0.88	1.09	0	3	68	52.9	17.7	17.7	11.8	—	—	—	—	—	—
T5 to T6	1.54	1.61	0	5	69	36.2	20.3	21.7	5.8	7.3	8.7	—	—	—	—
T6 to T7	1.72	1.43	0	4	79	24.1	27.9	19	10.1	19	—	—	—	—	—

Note. Panel A shows a summary of the average number of community members from the previous time period who are also community members in the current period. Panel B shows a by-period comparison of the percent of community members from the previous time period who are also community members in the current period. T1 is the survey administration from spring 2005 of the 2004–2005 school year, T2 through T4 are, respectively, the fall, winter, and spring survey administrations of the 2005–2006 school year; T5 through T7 are the fall, winter, and spring survey administrations of the 2006–2007 school year, respectively. Obs. = observations.

which was near the start of the 2005–2006 school year, had an average of 2.55 community members in his or her current community from Time 1 (T1), which was near the end of the previous school year. In Time 3, which reflects the survey conducted in winter 2005, teachers had an average of 5.33 community members from the previous period. The smaller value for T1 to T2 suggests that teachers are more likely to maintain community ties during the school year (T2 to Time 4) than from year to year. The results for the other periods in Table 4, Panel A, follow a similar pattern. This pattern might be due, in part, to teachers changing grades, subjects, or classrooms from year to year (Reagans, 2010). Yearly change in community membership might also reflect teacher attrition since, in the two school years of the study, an average of 18% of teachers across the four sites left their schools. This level of attrition is similar to that of other New York City schools during the study period (Roy, 2014), and our follow-up analyses indicated there were no significant differences across schools in the number of teachers attrited or in the characteristics of teachers who attrited.

Note that the average number of community members from the previous period who are in a teacher's current community ranges from about one to five. Also, the standard deviation indicates that there is some variation across teachers in the frequency with which they change community interactions from period to period. We found a similar pattern in Panel B of Table 4, which reports the percentages of teachers who maintain ties to the given number of teachers in their previous community. For instance, in the first row of Table 4, Panel B, 10.8% of teachers knew at least eight peers from their previous community.

In Table 5, we present cross-classified regression models examining the predictors of teacher community membership over time. Models 1 through 4 are the main results for the logistic models; Models 5 through 8 are the results of the Poisson models used for the sensitivity analyses. In Model 1, we found that change over time (measured in months after the first data collection period) is not related to whether teachers maintain ties with previous community members. This indicates that while the descriptive statistics from Table 4 suggest teachers may be more likely to maintain ties within a school year than from year to year, there is no growth effect on community membership. In other words, each additional month of being at a school, which might be taken as a

measure of overall school integration or socialization, is not associated with maintaining community interactions.

In Model 2, we added teacher-level covariates and found that older teachers are less likely to interact with previous community members ($\hat{\beta} = -0.37, p < .10$), while women are more likely to interact with previous community members than men are ($\hat{\beta} = 19.60, p < .01$). We also found that teachers with higher status were more likely to interact with previous community members. Meanwhile, classroom teachers were less likely to interact with previous community members compared to teaching assistants and paraprofessionals.

In Model 3, we replaced the teacher-level covariates with community-level characteristics and found that teachers in communities with strong cohesion are more likely to interact with each other in the next period ($\hat{\beta} = 32.6, p < .01$). The size of this coefficient indicates that even very small changes in cohesion are associated with large effects. So imagine, for example, that in a community with cohesion at the sample mean of 5.6, two teachers began interacting more frequently so that community cohesion increased by one tenth of a standard deviation to 5.661. This small change would make the odds more than 7 times greater that any given teacher in that community would stay connected to at least three other community members over time.

As expected, teachers in communities with high boundary-spanning scores were less likely to interact the following period; however, this effect is marginally significant ($\hat{\beta} = -4.685, p < .10$). Contrary to our expectations, teachers in larger communities were more likely to maintain community ties. One explanation for this may be a straightforward base rate effect, meaning that in larger communities, there are simply more teachers with whom one might maintain ties. Thus, the likelihood that teachers maintain ties with three or more members is greater in communities with more members. Note also, that in Model 3, teachers at Paramount Elementary are significantly more likely to maintain ties than teachers at Strive Elementary ($\hat{\beta} = 24.732, p < .01$). This suggests there are some effects for school context factors, but these effects appear conflated with differences in the individual characteristics of teachers at each school since there were no significant school context effects in Model 2.

The improvement in the $-2 \log$ likelihood ($-2LL$) fit statistic, or the deviance, from Model 2 ($-2LL = 146$) to Model 3 ($-2LL = 99$)

Table 5
Cross-Classified Logistic (1–4) and Poisson (5–8) Models Predicting Whether Teachers Interact With Community Members From the Previous Period

Variable	Logistic Model				Poisson Model			
	1	2	3	4	5	6	7	8
Fixed effects								
Months	-0.022 (0.152)	-0.258 (0.598)	0.775 (0.396)	— —	-0.003 (0.018)	-0.011 (0.019)	-0.019 (0.017)	-0.012 (0.017)
Age		-0.370~ (0.205)		-0.059 (0.180)		-0.005 (0.004)		-0.004 (0.004)
Gender: Female		19.559* (9.216)		-2.156 (7.306)		0.177 (0.156)		0.127 (0.157)
Race: Non-White		-2.391 (3.686)		-1.103 (3.186)		-0.055 (0.095)		-0.003 (0.094)
Grade: PreK–2		-0.954 (3.388)		-0.409 (4.333)		0.031 (0.105)		0.034 (0.110)
Grade: 3–5		4.272 (2.953)		0.322 (3.609)		0.040 (0.091)		0.026 (0.094)
Subject: ELA or math		-1.093 (3.331)		-0.437 (3.177)		0.062 (0.085)		0.052 (0.086)
		4.055** (1.409)		0.312 (1.085)		0.042 (0.027)		0.020 (0.027)
Years teaching		0.333 (0.210)		0.156 (0.344)				0.001 (0.005)
Main teacher		-11.800* (4.629)		-0.443 (3.275)				-0.015 (0.098)
School: Everyday		1.901 (10.087)	8.149 (12.989)	-27.037* (13.361)		0.441 (0.403)	0.484 (0.341)	0.427 (0.372)
School: Paramount		10.556 (10.635)	24.732** (9.313)	16.167 (13.746)		0.894* (0.425)	1.212*** (0.364)	0.994** (0.385)
School: Endeavor		-5.352 (9.124)	-3.566 (6.799)	-4.443 (9.090)		0.285 (0.404)	0.389 (0.328)	0.259 (0.359)
Cohesion lag			32.600*** (8.327)	45.816*** (10.504)			0.823*** (0.147)	0.697*** (0.164)
Boundary span lag			-4.685~ (2.790)	-8.230 (7.878)			-0.095 (0.130)	-0.079 (0.134)
Community Size 2 lag			16.340* (6.472)	20.687 (10.638)			0.163 (0.172)	0.302 (0.197)
Community Size 3 lag			23.190* (11.080)	5.132 (10.954)			0.904*** (0.197)	1.080*** (0.237)
Constant	-11.349*** (3.004)	-35.679* (17.139)	-239.500*** (57.970)	-274.894*** (60.342)	-0.259 (0.328)	-0.572 (0.493)	-4.998*** (0.883)	-4.506*** (0.985)
Random effects (variance)								
Community	572.27 (373.37)	11622.63 (11924.16)	8566.42 (9529.94)	27806.79 (36148.51)	1.311 (0.260)	1.248 (0.258)	0.832 (0.175)	0.803 (0.178)
Teacher	16.05 (16.99)	281.40 (308.87)	8.36 (19.22)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
-2 Log likelihood	214.80	145.94	98.92	82.90	1592.8	1281.01	1450.93	1183.17

Note. Standard errors in parentheses. ELA = English language arts. Community Size 1 = one to five teachers (reference group); Community Size 2 = six to nine; Community Size 3 = more than 10.

~ $p \leq .1$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

supports the finding that community-level characteristics are stronger predictors of interacting with previous community members than teacher traits. In other words, features of teachers' communities better explain variation in maintaining community ties than do teachers' individual characteristics. In Model 4, we examined the marginal effects of community features, individual characteristics, and formal organization factors simultaneously. We found that unlike in Model 2, age and gender are no longer statistically significant, and neither are any of the other individual characteristics. Likewise, none of the formal organizational factors were significant, including the number years spent teaching at a school, which was significant in Model 3. Only community characteristics, namely, cohesion in the previous period, remain significant ($\hat{\beta} = 45.82, p < .001$).

We checked the robustness of our results using the total number of colleagues whom teachers still knew from their previous community as the dependent variable in Models 5 through 8. In contrast to the logistic model, the results show that teacher characteristics did not predict whether teachers stayed with previous colleagues in Model 6. However, we found consistency in the community-level characteristics in Models 7 and 8, where community cohesion in the previous period has a large and statistically significant effect on the number of relationships teachers maintained from their community in the previous period. The significant effects for community size in Models 7 and 8 appear to support our previous supposition that base rate effects may explain why community ties are more likely to be maintained in larger communities. Specifically, the results indicate that the number of ties a teacher has to previous community members is higher when the community size is larger. Compared to Models 1 through 4, Models 5 through 8 have more consistent school effects for Paramount Elementary. This is likely due, in part, to Paramount having much greater variation in the size of its communities ($SD = 9.156$) compared to Strive ($SD = 4.154$), which is captured by the count data used for the Poisson models.

Discussion

Our research makes several contributions to the extant literature on social capital and network evolution. First, in conceptualizing network evolution and social context, we focused on the informal choices that teachers make. Prior research often neglects this more common and local form of social context in favor of looking mainly at formal context factors. Second, we found that time played no significant role in community participation, which from a developmental perspective, suggests that teacher interaction and tie formation are motivated by factors aside from how long teachers are in the same school. Third, we examined the competing influence of individual traits, organization factors, and community features in shaping membership in teacher communities.

Consistent with previous research that has demonstrated individual characteristics are associated with how teachers form communities, our findings indicate that teachers' gender, age, and status are associated with their maintaining community ties (Bridwell-Mitchell & Fried, 2015; Spillane et al., 2012). Also consistent with previous research, we find that formal organizational factors, such as whether a teacher is a main classroom

teacher versus a teaching assistant or paraprofessional, are associated with maintaining community ties (Coburn et al., 2010). However, what is important to note about our findings is that in contrast to previous research, there are no effects for individual characteristics or formal organizational factors on teachers' community relationships when the features of teachers' informal communities are taken into account. In other words, the degree of cohesion in teachers' communities appears to matter more than individual or formal organizational factors for whether teachers maintain community ties.

Still, it is also important to point out that our study examines *maintenance* of community ties. This means we are examining community dynamics after teachers have already made their initial choices of community. Existing research on social networks suggest that teachers, like all individuals, are more likely to form close relationships with individuals with whom they share similar characteristics (McPherson et al., 2001). Thus, teachers' initial decisions to form relationships may, in fact, be based on individual characteristics or organizational factors. As a result, there may be little variation in individual or organizational characteristics within communities once communities have been selected. This was suggested somewhat by the similarity in community demographics illustrated for Everyday Elementary in fall 2005 (Figure 2).

It is also important to note that while maintaining community ties may have positive social capital benefits for individual teachers and for their communities, there may also be trade-offs in certain forms of social capital for the school as a whole. In particular, cohesion can undermine instructional innovation since teachers maintaining cohesive community ties may be less likely to come up with new ideas because of their increasing similarity (i.e., given group learning); also, overlapping relationships mean teachers are repeatedly exposed to and reinforce the same knowledge (Burt, 2004). This could result in increased pressures for conformity and commitment to an unproductive status quo (Achinstein, 2002; Bridwell-Mitchell, 2015). To the extent that teachers in cohesive communities come up with new instructional approaches or are introduced to them as part of reform initiatives, new approaches may be less likely to spread to other teachers because teachers in cohesive communities may be less well connected to other teachers given constraints on time and energy, excessive identification with the community, and a tendency to exclude outsiders (Granovetter, 1973; Portes, 1998).

Despite these cautions, there is considerable evidence that strong teacher relationships and communities have benefits for schools (Bryk & Schneider, 2002; Frank et al., 2004; Leana & Pil, 2006). Thus, our findings have potentially important practical implications for the development of teachers' social capital. In particular, our results indicate that school policies directed at reorganizing formal structures, such as grades or subjects, may be less helpful in fostering social capital if teachers are part of informal communities. Instead, policymakers and school leaders seeking to increase social capital in schools should carefully consider how to help teachers foster community cohesion.

More specifically, cohesion in our study is not simply about the strength of teachers' relationships given their frequency of interaction or feelings of attachment. Cohesion is also the degree of overlapping and mutually reinforcing ties among community members. This means that in cohesive communities, every

member tends to interact with every other member; in less cohesive communities, each member mainly interacts with only a subset of other members.

Thus, one way to encourage community cohesion might be to design professional tasks so that community members have the opportunity to “mix it up” in terms of their typical patterns of interactions with colleagues in their communities. At the school level, this could include special assignments, work groups, or even casual gatherings, which put colleagues in closer physical proximity and give them the opportunity to learn more about what they have in common (Reagans, 2010). At the district level, this might include providing instructional coaches or mentors who can facilitate interactions among colleagues in communities and help them engage in particular interaction routines (i.e., Coburn & Russell, 2008).

There are limitations to this study that can guide future work. Primarily, our study cannot address why certain communities are more cohesive than others; yet, the results show that community cohesion—over and above school effects, which are controlled for in the models—is a key factor for determining whether teachers maintain community ties. This suggests that one potentially important area for future research is examining the factors that influence community cohesion. An ethnographic study of a new school would, for example, be particularly useful for examining the evolution of cohesive communities. Likewise, a study examining how new teachers first make choices about community membership would help disentangle the relative effects of individual, organizational, and community factors on tie formation versus tie maintenance. And, importantly, our study does not indicate how cohesion in teacher communities impacts student and school outcomes. This is another important area for future research.

Conclusion

Increasingly, schools are relying on the resources embedded in teachers’ relationships as drivers of school improvement (Penuel, Riel, Krause, & Frank, 2009). In this study, we examined how fundamental features of teachers’ communities, such as cohesion, have effects on teacher relationships over and above individual characteristics or formal organizational factors. Ultimately, our work suggests that the most important factor for teachers maintaining community ties is the level of cohesion in their communities. Thus, to the extent that schools and districts hope to drive improvement by leveraging teacher communities and the social capital embedded in them, they cannot rely entirely on formal restructuring. Instead, school and district leaders will have to pay much more attention to how they can support teachers in developing strong, overlapping, and mutually reinforcing relationships among the colleagues with whom they already tend to interact. To the extent that these informal organizational conditions play as important a role in teachers’ experiences as formal organizational conditions, then informal conditions may not only help improve schools but also help keep teachers in the schools they have worked so hard to improve (Ingersoll, 2001).

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¹Because teachers are working in the same organization and because similarity and proximity are two of the strongest predictors of relationships, there tends to be overlap between teachers’ formal and informal relationships (Reagans, 2010). Thus, informal communities might be composed of individuals who are in the same grade or who have been assigned to nearby classrooms or who have similar schedules. In addition, the topic of teachers’ conversations in communities may be expressive—meaning related to personal, casual, or emotional content—but may also be instrumental, meaning focused on work-related topics. Thus, the key distinction between formal and informal relationships is whether relationships have been formally designated by school leaders or that teachers choose to interact for any number of reasons and with greater frequency than they might given formal role requirements.

²A question of interest to some researchers is the nature of individuals’ ties outside of their organizations, such as teachers’ relationships with colleagues at other schools (Geletkanycz & Hambrick, 1997). In contrast, in this research, we are interested only in teachers’ within-school ties. We focus on within-school relationships in part because they provide teachers with the most accessible source of social capital (Cross & Sproull, 2004). We also focus on within-school relationships because of the empirical complications of collecting whole-network data to identify teacher communities across school boundaries (cf. Laumann, Marsden, & Prensky, 1983).

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