

# Quasi-Ties

## Directing Resources to Members of a Collective

Kenneth A. Frank

*Michigan State University, East Lansing*

Research on social capital has found that individuals who access resources through social relations gain competitive advantage and systems with high levels or desirable distributions of social capital are more effective. These effects depend on actors allocating resources to others in their social system at-large instead of to others with whom they share specific social relationships. It is hypothesized that actors who identify with others in a social system as a collective are more likely to allocate resources uniformly throughout the system. Thus, identification with the collective can serve as a quasi-tie, directing the allocation of resources, but not defined by specific social relations. Findings from a longitudinal, multilevel network study of teachers' use of computers support multiple theories of resource allocation and, in particular, confirm that teachers who identify with the collectives of their schools are less likely to favor close colleagues and close colleagues of close colleagues, in their provision of help.

**Keywords:** *identification; resource allocations; social ties; social exchange*

### Introduction: Social Capital and the Allocation of Resources

This article extends social capital theory by focusing on to whom actors allocate resources. In particular, I hypothesize that an actor who identifies with members of

---

**Author's Note:** This work was supported primarily by a grant from the Spencer Foundation/National Academy of Education. A pilot study, extra research costs, and compensation for schools were funded by a grant from the Social Capital Initiative at Michigan State University. Schools were also compensated with funds from the College of Education at Michigan State University. Travel to two sites was supported by the National Science Foundation (9874246). Thanks to Andrew Topper for helping develop and pilot the instrument. The ideas presented here have benefited greatly from discussions at meetings of the social capital initiative at Michigan State University and presentations at interdisciplinary colloquia at Stanford University, the University of Wisconsin in Madison, the University of Groningen, and the University of Washington and at the Social Capital and Social Networks Conference at The Ohio State University, June 2005. I thank Nancy R. Buchan, Joe Byers, Nicole Ellefson, James Moody, and Yong Zhao for specific comments on this article. An earlier version of this article was presented at the annual meeting of the American Sociological Association, Washington, D.C., 2000. Address correspondence to Ken Frank, Room 462 Erickson Hall, Michigan State University, East Lansing, MI 48824-1034; phone: (517) 355-9567; fax: (517) 353-6393; e-mail: [kenfrank@msu.edu](mailto:kenfrank@msu.edu).

a social system as a collective should allocate resources uniformly throughout the social system. Thus, identification can serve as a quasi-tie, reducing actors' tendencies to favor direct social relationships, defined as those with whom they interact (e.g., friend) or share an objective social relation (e.g., kin), in their allocation of resources. Consequently, identification with a collective can facilitate the efficient allocation of resources within large and open social systems.

In spite of the occasional observation regarding the constraints or limitations of social capital (e.g., Lin, 2001; Portes, 1998, 2000; Portes & Sensenbrenner, 1993), the social capital literature is replete with the advantages of social capital. Individuals who access resources through social relationships have gained competitive advantage in their systems (Baker, 2000; Bian, 1997; Burt, 1992, 2000; Erickson, 2001; Fernandez & Castilla, 2001; Flap & Boxman, 2001; Flap & DeGraaf, 1986; Lin & Bian, 1991; Marsden & Gorman, 1999; Useem & Karabel, 1986; Uzzi, 1999), and systems with high levels or desirable distributions of social capital embedded within social relationships have been found to be more effective (Coleman, 1988; Gabbay & Leenders, 1999; Gittell & Vidal, 1998; Putnam, 2000; Woolcock, 1998).

Many of the advantages attributed to the manifestation of social capital are due to resources that flow between subgroups within a larger social system. Such resources typically give individuals unique advantages over their competitors (Burt, 1992, 2000). Furthermore, resource flow between subgroups is considered critical to the functioning of systems, establishing a means for coordination and reorganization of resources in response to large external disturbances (Gabbay & Leenders, 1999; Gittell & Vidal, 1998; Putnam, 2000; Woolcock, 1998).

Attention to the resources that flow between subgroups is critical to understanding how social capital facilitates transitions between individuals and the larger social systems in which they might be embedded (Coleman, 1990). Without attention to these between-subgroup flows, resources would be isolated within small pockets in the social space, such as are conveyed by social exchange (Blau, 1967), exchange in small closed social systems (Coleman, 1990), or generalized exchange (Bearman, 1997; Ekeh, 1974; Emerson, 1979; Yamagishi & Cook, 1993). Therefore, theory must attend to how and why resources might flow throughout a larger system, counteracting tendencies for resources to remain confined in relatively small social spaces defined by direct and dense social relations.

Focusing on resource flows, theoretical attention turns to those who allocate resources instead of to those who benefit from resource allocations. An actor who gains individual advantage by drawing on social capital does so because others allocate resources to the actor without immediate compensation (Coleman, 1990). Similarly, when social capital helps systems become more effective, it is because one member of a system allocates resources to another member without immediate compensation. In other words, the presence of social capital can reduce free riding and social dilemmas in social systems.

Return now to the issue of the flow of resources between subgroups. If we take as given the amount of control over resources an actor is willing to relinquish to others in his or her social system, the question then is why an actor would allocate resources to members of the social system at-large instead of to others with whom he or she shares specific social relations or who are members of his or her subgroup by virtue of a concentration of dense relations. The answer developed here depends on actors' identification with a larger social system that can transcend immediate social relations (Stryker, 1980) and on the implications of identity for resource allocation. The theory and empirical results then have important implications for who gains competitive advantage in a system and for the ultimate distribution of resources within a given social system.

### **Empirical Example: The Implementation of Technology in Schools**

The empirical example of this article focuses on the help teachers provide other members of their schools to implement computer technology in the classroom. When teachers help one another, innovations can diffuse more extensively throughout a school. Thus, help can accentuate the effectiveness of an educational innovation by increasing its implementation.

I focus on the implementation of computer technology (e.g., the Internet, educational software, and the digital camera) because computer technology is valuable for schools to implement, either because it enhances productivity or because of strong institutionalized legitimacy (Budin, 1999; Cuban, 1999; Loveless, 1996; Norris, Smolka, & Soloway, 1999; President's Committee of Advisors on Science and Technology, 1997; Rowan, 1995). Correspondingly, teachers who implement computer technology are more successful in accommodating the demands of schools and communities, giving them more job security and status (Cuban, 1999), if not directly affecting student achievement.

I focus on schools because they constitute a large enough body of organizations to be of theoretical interest. Furthermore, the social organization of schools represents that of many other types of organizations. Indeed, historically, many organizational theories have emerged from studies of schools (see Bidwell & Kasarda, 1987; Bolman & Heller, 1995; Perrow, 1986, for reviews), from control theory (Callahan, 1962) to contingency theory (e.g., Greenfield, 1975) and new institutionalism (Meyer & Rowan, 1977; Rowan, 1995). In particular, in their press to adopt computers, schools are typical of other organizations. In fact, one frequently cited reason for demands on schools to implement computer technology is that computer technology skills are increasingly required in the workplace (Cuban, 1999).

Most relevant for the purpose here is that there has been considerable recent attention to encouraging collaboration among teachers generally, and specifically

with regard to the implementation of computers (Bryk & Schneider, 2002; Darling-Hammond & McLaughlin, 1995; K. A. Frank & Fahrback, 1999; K. A. Frank & Zhao, 2005; McLaughlin & Marsh, 1979; Zhao & Frank, 2003). This collaboration can improve coordination in instruction and can more efficiently distribute resources such as expertise. Thus, collaboration has the potential to improve the effectiveness of schools. In the particular case of technology, recent research has established that teachers who receive help from colleagues are more likely to implement computers in their classroom (K. A. Frank, Zhao, & Borman, 2004; Zhao & Frank, 2003).

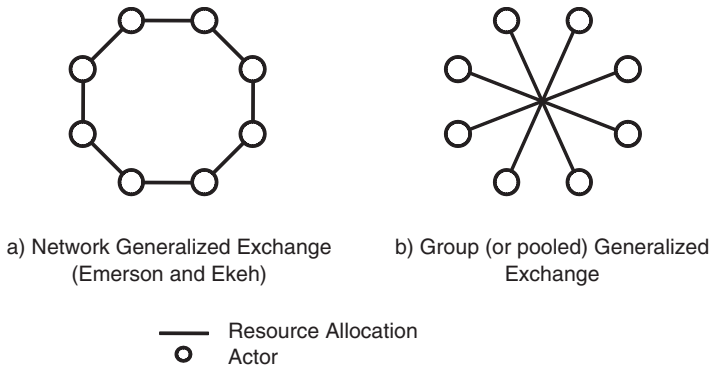
But the issue of collaboration is poorly theorized in terms of the distribution of expertise as a resource through the social system of the school. Following the social capital literature, either the focus is on how to elicit more interest in collaboration from the typical teacher or on how to cultivate collaboration at the school level (Bryk & Schneider, 2002; Little, 2003; Stainback & Stainback, 1984; Will, 1986). But defined by dyadic relationships, collaboration has a network structure within a school. In some schools, collaboration may be confined to specific partnerships between close colleagues or may be concentrated within small pockets in the social space, whereas in other schools, collaboration may be fluid across the social space. Though teachers in each scenario may have the same general inclinations to collaborate and the two types of schools may not be differentiated in terms of the general culture of collaboration, whether collaboration is confined to strong social relations or transcends them can have important implications for the flow of resources and school performance. Thus, I now turn to theories of the provision of help: How does an actor choose which members of the social system to help?

### **Actors' Allocations to a Collective**

The most direct framework for characterizing how actors allocate resources to members of their collectives is generalized exchange (Ekeh, 1974; Emerson, 1972; Yamagishi & Cook, 1993). Within generalized exchange, Ekeh (1974) contrasts pooled or group generalized exchange with network generalized exchange, as shown in Figures 1a and 1b (based on Figure 1 in Yamagishi & Cook, 1993[permissions issue]). In network generalized exchange, actors allocate resources only to specific others, whereas in pooled generalized exchange actors allocate resources to the pool as a whole. This distinction has important implications for the stability of the network and the ability of the network to expand. For example, Yamagishi and Cook (1993) find that network generalized exchange elicits greater participation or cooperation from a social dilemmas perspective. On the other hand, network generalized exchange is only as strong as its weakest link and therefore can be extremely fragile in large networks.

Though Yamagishi and Cook (1993) find differences in the effects of network versus pooled generalized exchange, they do not describe the mechanism that governs the

**Figure 1**  
**Forms of Generalized Exchange**



Source: Yamagishi & Cook (1993).

transition from one type of exchange to another. But Markovsky and colleagues (Markovsky & Chaffee, 1995; Markovsky & Lawler, 1994) do address the transition from differentiated social structure to a pooled social structure. Theorizing social solidarity in network terms, Markovsky and colleagues hypothesize that individuals link themselves to all the members of a group when they identify with the members of the group. As a result, the identity link can override relationships with specific others and thus give a basis for solidarity, as actors share a common emotional bond to the group through their self-identification with the group (Markovsky & Chaffee, 1995, p. 262).

Although Markovsky and colleagues (Markovsky & Chaffee, 1995; Markovsky & Lawler, 1994) address the transition from differentiated to pooled social structures, they do not address resource allocations. Their effects are in terms of psychological perceptions and emotional attachment. In response, the theory below integrates Markovsky and colleagues' understandings of the transition from varied to pooled social structure with the attention to resource allocations in the generalized exchange and collective action literature. In particular, I introduce the concept of a quasi-tie to integrate Markovsky and colleagues' observations regarding solidarity into a theory of generalized exchange.

### **Identification With the Collective as a Quasi-Tie**

The identity effect described by Markovsky and colleagues (Markovsky & Chaffee, 1995; Markovsky & Lawler, 1994) can be more than merely a psychological

construct because it can affect actors' allocations of resources. This locates identity within the realm of generalized exchange. Markovsky and colleagues note that when individuals identify with members of a social system as a collective, they may develop an emotional attachment to the members of the social system. Following Lawler and Thye (1999), actors may then engage in behaviors to preserve their membership in the social system. In particular, they may allocate resources generally to members of the collective to preserve standing in the collective.

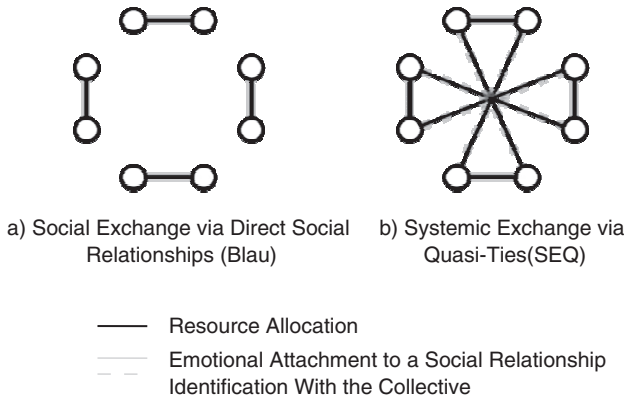
From the rational actor perspective, identifying with the collective may be a form of "relaxed accounting" (Lawler & Thye, 1999, p. 232) or resilient trust that can survive the occasional transaction in which benefits are not immediately reciprocated (Leana & Van Buren, 1999, p. 6; see Ring & Van de Ven, 1992). Thus, an actor who identifies with a collective may not expect immediate reciprocity but instead may wait for future compensation, in unexpected resources, from a member of the collective, if not from the specific other to whom the actor initially allocated resources. In this sense, identification with the collective can guide resource allocations to a collective the same way social relationships (e.g., friendship, kin, close colleagues) can guide resource allocations in social exchange (Lawler & Yoon, 1999).

When identity does direct the allocation of resources, identity takes on the function of a tie. Here, *tie* is defined as a social relationship that affects resource allocations. Though Granovetter (1973, pp. 1363-1369) does not explicitly define a tie, his discussion of diffusion and flows implies that ties are more than just social relationships because resources flow through ties. But identity does not function as a tie in the usual sense, because it does not necessarily derive from a direct social relation (e.g., friend, kin). Thus, when identification directs the allocation of resources, it serves as a quasi-tie between an actor and one or more members of a social system.

Like regular ties, quasi-ties direct resource allocations but do not necessarily affect overall levels of allocations. In particular, quasi-ties should theoretically reduce actors' tendencies to favor those with whom an actor shares direct social relations in their allocations of resources; an actor who identifies with the members of a social system *as a collective* should be equally likely to allocate resources to any member of the collective. For example, a teacher who identifies with her school as a collective should be equally likely to help all members of her school, regardless of whether she considers another teacher a particularly close colleague.

Without the effect of identity, resources might be allocated via restricted social exchange only with specific colleagues. This can result in uneven concentrations of resources within the social space of a system, making the system inefficient in using resources to respond to external disturbances or opportunities. For example, if teachers help only close colleagues, there may be pockets of expertise specific to particular reforms or innovations. Thus, not all teachers will be able to draw on others' expertise to implement innovations, contributing to uneven, uncoordinated implementation (K. A. Frank & Fahrback, 1999). As a result, teachers who have less access to others' expertise may resist implementation and compete for resources

**Figure 2**  
**Transition from Social Exchange to Systemic Exchange via Quasi-Ties**



that support the implementation (McLaughlin & Marsh, 1979). This can make schools less efficient in distributing resources for maximum educational value (Bryk & Schneider, 2002).

The transition from social exchange (Blau, 1967) to systemic exchange via quasi-ties (SEQ) in Figures 2a and 2b has some similarities with the movement from network generalized exchange to group generalized exchange in Figures 1a and 1b. Both are transitions from exchanges with specific others (in the cases of network generalized exchange and social exchange) to indiscriminate exchanges with the group (as in group generalized exchange and SEQ). But the fundamental difference between Figures 1 and 2 is in the importance of an emotional attachment to social relationships and of the embeddedness of resource allocations in those social relationships. In generalized exchange, the interpreted network is the pattern of allocations, with implications for social dilemmas and participation in social systems (see especially Emerson's [1979, pp. 357-358] description of generalized exchange in terms of resource allocations; Yamagishi & Cook, 1993). In contrast, in social exchange and SEQ, the relevant network is defined by the underlying social relationships and actors' emotional attachments to that network. These relationships can be either between pairs of actors (in social exchange, Blau, 1967; Emerson, 1979; Lawler & Yoon, 1999) or between a person and the collective with which the person identifies (Markovsky & Chaffee, 1995; Markovsky & Lawler, 1994). These emotional attachments are shown via the grey shading in Figures 2a and 2b.

Attention to the emotional attachment to social relations allows formulation of the quasi-tie hypothesis: that identification with the collective will redirect resource

allocations away from specific others with whom an actor interacts or has an objective social relation and toward the general collective. Thus, in Figure 2b, quasi-ties are manifest as resources are allocated equally to all members of the group via identification with the collective. No such hypothesis is possible for the transition from network generalized exchange to group generalized exchange because both forms of generalized exchange are expressed only in terms of the resource allocations and not in terms of existing social relationships. Thus, the transition from social exchange to SEQ is relevant to the social context in which the exchanges are embedded (Granovetter, 1985). As such, it is a theory of social capital, wherein resource allocations are guided by social structure.

## Hypotheses

The theory as represented in Figure 2 can be expressed in the following hypotheses. To begin, the hypothesis of social exchange captures the most basic rule in directing the allocation of resources:

*Ceteris paribus*, an actor is more likely to allocate resources to another with whom the actor shares a direct social relationship than to others in a social system.

The hypothesis of generalized exchange extends social exchange to chains of actors:

*Ceteris paribus*, an actor is more likely to allocate resources to another with whom the actor shares indirect, or mutual, social relationships than to others in a social system.

Taken together, the hypotheses of social exchange and generalized exchange imply a concentration of resources within cohesive subgroups that can be defined in terms of a concentration of direct and indirect relationships (K. A. Frank, 1995).

The hypotheses of the potential provider's quasi-tie then refer to how effects of social exchange and generalized exchange can be modified by identification with the collective:

*Ceteris paribus*, the more an actor identifies with members of a social system as a collective, the more likely the actor is to allocate resources uniformly throughout the social system, reducing tendencies to (a) favor those with whom the actor has a direct social relationship (modifying effects of social exchange) and (b) favor those with whom the actor has an indirect social relationship (modifying effects of generalized exchange).

Each hypothesis of the quasi-tie can be rephrased as an interaction effect: If the allocator of resources identifies with the members of a social system as a collective, then direct and indirect social relationships and chains of exchange matter less in



directing the allocation of resources. In fact, assuming that the amount of resources an actor is willing to relinquish is given, the effects of quasi-ties must be interactive—to allocate resources to some, actors must reduce the tendency to allocate resources to other actors.

Recognizing that actors will respond to others' strategies (Nash, 1950), actors may allocate resources depending on their perceptions of others' identification with the collective. Assume the quasi-tie Hypothesis 1 is true, that actors who identify with a collective are more likely to allocate resources uniformly to the collective. Therefore, it would be rational for other members of a social system to allocate resources to those who identify with the collective, because such allocations will be returned to the social system writ large. Thus, the anticipation hypothesis of the potential receiver's quasi-tie derives from actors' anticipation of others' behavior based on perceived identification with the collective:

*Ceteris paribus*, the more an actor identifies with members of a social system as a collective, the more likely the actor is to receive resources from others throughout the social system, reducing the tendency to receive resources via direct social relationships.

I will apply each of the above hypotheses directly to the empirical example of teachers in schools by replacing "actor" with "teacher," "direct social relationship" with "close colleagues," "indirect social relationship" with "close colleagues of close colleagues," and "social system" with "school." For example, quasi-tie Hypothesis 1 reads:

*Ceteris paribus*, the more a teacher identifies with members of the school as a collective, the more likely the teacher is to allocate resources uniformly throughout the school, reducing the tendency to favor those the teacher considers close colleagues.

The hypotheses of social exchange and generalized exchange have been explored and supported to varying degrees (Baker, 2000; Bendor & Swastik, 2001; Blau, 1967; Burt, 2000; Erickson, 2001; Fernandez & Castilla, 2001; Flap & DeGraaf, 1986; K. A. Frank & Yasumoto, 1998; Lin & Bian, 1991; Marsden & Gorman, 1999; Morgan & Sorensen, 1999; Uzzi, 1999; Wellman & Frank, 2001; Yamagishi & Cook, 1993). In addition, Putnam (2000) has indirectly explored effects of identification with a collective, and Lawler and Yoon (1996, 1998) have established the effect of identity on redirecting actors' allocations of resources from specific others to the collective in general.

Though the findings from the studies above are consistent with many of the quasi-tie hypotheses, most of the studies were conducted at the level of the individual and therefore did not address the effect of identification on to whom actors allocate resources. Lawler and Yoon (1996, 1998) provided an exception, but their results were from experimental studies. Thus, the initial "social ties" between pairs of actors were weakly formed at best (in contrast to kin, friends, or close colleagues),

and their collectives were defined by a small set of symbols and incentives (in contrast to the accumulation of rituals, physical architecture, and resource allocations that might define a tribe or school as a social system). Correspondingly, Lawler and Yoon's results pertain to social exchange but do not extend directly to social capital, which is embedded in enduring social relations and systems (Coleman, 1990; K. A. Frank & Yasumoto, 1998; Granovetter, 1985).

In the next section, I turn to a network study of teachers' use of computers to directly evaluate the hypotheses associated with quasi-ties. The data come from natural settings and thus feature the types of social relations and organizations that are most relevant for theory developed under the rubric of social capital. Although, in the absence of experiments, causal inferences are tenuous, the data are longitudinal and thus can be used to identify the emergence of new allocations of resources in a given year. This reduces spurious effects that could be attributed to commonality of relatively static characteristics such as teaching in the same grade, being of the same gender or level of experience, and so on.

### **Application: The Implementation of Computer Technology in Schools**

I will evaluate the hypotheses related to quasi-ties through a set of studies of the diffusion of computer technology within schools. The studies were conducted in six schools in three states. The schools were chosen because they were known, through other research, to be attempting to implement computer-related innovations.<sup>1</sup> Two of the states were in the northern Midwest, and the third was in the Southwest. Two of the schools were pure elementary schools (kindergarten through fifth grade), one had only Grades 2 and 3, one was a combined elementary and middle school, one was a middle school, and one was a high school. The student composition ranged from upper middle class (10% free lunch) to mostly lower class (95% or more free lunch), and the racial compositions included 95% or more Caucasian (White), 95% or more Latino (Hispanic), and 95% or more African American (Black).

The results for the study reported here were based on longitudinal data (Spring 2000 and Spring 2001) obtained through a questionnaire assessing teachers' use of computers,<sup>2</sup> identification with the collective, background information, and so on. The questionnaire also included sociometric questions regarding close colleagues, providers of help to use computers, and with whom teachers talked about computers. Thus, each respondent indicated others who were colleagues, were helpful, and so on (see K. A. Frank et al., 2004, for details of administration).

Using these data, K. A. Frank et al. (2004) defined access to expertise through talk and informal help as the manifestation of social capital, finding that such access was a statistically significant predictor of teachers' use of computers for core teaching tasks. The standardized regression coefficient for access to expertise (.21) was

comparable to that for adequacy of physical resources for computing (.19) and for perceived potential of computers for student use (.18).<sup>3</sup> This finding indicates that the individual advantage gained through social capital is as important as the most longstanding physical and psychological factors linked to diffusion of innovations.

Teachers who accessed expertise through talk and help increased in their implementation of computer technology, potentially benefiting individual teachers and their schools. The question then is, "Why would one teacher take the time to help or talk to another teacher?" There is a tendency, especially for populations such as teachers, to appeal to notions of altruism or community. But pure altruism is difficult to explain as a form of rational action (Coleman, 1990). Furthermore, altruism might explain why an actor may allocate resources, but it doesn't explain to whom an actor allocates resources. Thus, the focus of the analyses below is on who helped whom use computers.<sup>4</sup>

### **Cross-Nested Multilevel Models of the Provision of Help**

To estimate models of to whom actors allocate resources, provision of help was specified as the dependent variable in a multilevel cross-nested model, with pairs of teachers nested within potential providers and receivers of resources. These are  $p_2$ -like social network models, providing a new alternative to modeling social network relations with their inherent dependencies (Lazega & Van Duijn, 1997). In particular, dependencies that can be attributed to common providers or common receivers of help are accounted for with random effects. Drawing on the cross-nested multilevel framework, the models easily accommodate predictors at the level of the pair (e.g., whether two teachers are close colleagues) as well as at the level of the potential provider (e.g., the extent to which the potential provider perceives expectations to provide help) or potential receiver of help (e.g., the potential receiver's identification with the collective). I describe the measures and the model in the next subsection, with a more formal description of the measures and model in the appendix.

The hierarchical generalized linear model (HGLM) software with cross-nested effects was used to estimate the model (Bryk, Raudenbush, & Congdon, 2002). This software maximizes a penalized quasi-likelihood in the random effects (and so may slightly underestimate some random effects, especially the random effect associated with potential providers of help). This approach did not exactly conform to the  $p_2$  framework of Lazega and Van Duijn (1997) because it did not estimate the covariance of provider and receiver effects. Furthermore, the models accounted for reciprocity as a fixed effect, essentially modeling whether  $i$  nominated  $i'$ , conditional on whether  $i'$  nominated  $i$ , whereas the  $p_2$  model estimates the joint likelihood of each. Consequently, the estimates of these models were only approximations of maximum likelihood. Although the model estimated was not identical to  $p_2$ , the HGLM software can estimate weighted or count data at the pair level using a Poisson model,

which was critical to the operationalization of the allocation of resources in these data (see the appendix for a comparison with alternative estimation procedures).

Even with the application of multilevel models, the interpretation of standard errors is controversial. Lazega and Van Duijn (1997) reported standard errors and used them as a basis for interpretation, although they suggested *t* tests were approximate. More generally, Holland and Leinhardt (1981) and Wasserman and Pattison (1996) expressed extensive concern about standard errors and significance tests because of dependencies in social network data, and so I report results in terms of the ratio of estimated coefficients to their approximate standard errors, interpreting only those estimated coefficients that are at least 1.96 their approximate standard errors.

### Level of the Pair

*Who helps whom use computers? (Dependent variable).* The dependent variable, resource allocation, was based on teachers' reports of others who had provided help to use computers. The provision of help takes time and energy, and the corresponding information and expertise are critical resources individuals can use to gain advantage (Arrow, 1979; Sandefur & Laumann, 1998). Indeed, examples of effective schools refer to teachers' willingness to help one another informally (Lightfoot, 1983; Newmann, 1996). Teachers nominated others in response to the question, "Since the school year began, who has helped you use computers?" I prioritized the reliability of the perception of the receiver of help over that of the provider, because the person who receives help is more able to assess the value of the help for intended tasks. The measure of help was obtained at Spring 2001 (March to May) and, because the stem was "Since the school year began . . .," represents the amount of help provided roughly *between* Fall 2000 and Spring 2001. Most predictors were based on measures at Spring 2000 (March to May), supporting causal interpretations of effects of fixed states or attitudes (e.g., identification with the collective) on subsequent behaviors.

Teachers were given seven designated spaces to nominate others, with extra space provided for further nominations. Teachers also listed the frequency of the help provided at four levels that were converted into days/year (*daily* = 100, *weekly* = 35, *monthly* = 10, *yearly* = 3). These nominations were then converted into pair-level data, taking a value of days per year for each teacher *i'* nominated by teacher *i*, and taking a value of 0 for each member of the school that a teacher did not nominate. Thus, the outcome is highly skewed, which was accounted for with the Poisson model with overdispersion.

Following the multilevel, cross-nested nature of the models, the extent to which one teacher helped another was then modeled as a function of the pair-level characteristics described immediately below as well as characteristics of the potential provider of help, described subsequently.

*Direct social relationship.* The social exchange hypothesis suggests that teachers should provide more help to those with whom they share a direct social relationship. The presence of a direct social relationship was measured according to whether a teacher listed another as a close colleague. This was in response to the request, "Please list your closest colleagues at XX."<sup>5</sup> Teachers were given seven spaces to nominate others, with extra space provided for further nominations. Because this relation is expected to guide the provision of help, the measure was based on the response of the potential provider of help.

*Generalized exchange.* The theory of generalized exchange suggests an actor should help another if the other is part of a cycle of exchange. This was measured in terms of number of close colleagues shared by the potential provider and the potential receiver.

Of course, there are many alternate theories to explain to whom teachers might provide help. In the appendix, I describe measures of difference in informal social status, difference in expertise, potential reciprocity, common settings (membership in the same subgroup or grade), controls for covariates associated with  $p^*$  social network models (Wasserman & Pattison, 1996), and potential continuity (prior provision of help).

## Quasi-Ties as Cross-Level Interactions

The hypotheses of the quasi-tie depend on teachers' identification with the collective of their schools. The measure of identification with the collective was based on items described in the community literature (e.g., Gusfield, 1975), drawing from theoretical constructs such as Tonnies's *gemeinschaft* (Konig, 1968). But identification with the collective is distinct from sense of community, with its positive connotation (Almgren, 1981) and from definitions of *professional community* in educational research, which include specific pedagogical practices (e.g., Louis, Marks, & Kruse, 1996). Ultimately, the scale included seven 4-point Likert-type items (1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, 4 = *strongly agree*): "Other teachers in this school matter to me," "I belong in this school," "I matter to other teachers in this school," "I am accepted by the teachers in this school," "I identify with other teachers in this school," "This school has made me the teacher I am," and "I would not be the same teacher at another school" ( $\alpha = .83$ ). The scale is comparable to Factor 6, the "social interaction" operationalization of identification described by Deaux, Reid, Mizrahi, and Cotting (1999). The means of the items range within .5 of the *agree* response (items were listed in order of their mean values, from highest to lowest), with teachers most likely to concur that others in the school matter to them, and least likely to agree with the statement that they would not be the same teacher at another school.<sup>6</sup> The identification with the collective for

those who had not completed a survey at Time 1 was not known, and thus, they were not included in analyses.

Theoretically, the hypotheses of the quasi-tie apply to the distribution of resource allocations within a system. That is, teachers who identified with their schools should have had less tendency to favor direct colleagues (reducing the effects of social exchange) and indirect colleagues (reducing the effects of generalized exchange) in their provision of help. Thus, I estimated the effect of potential provider's identification with the collective on moderating the effect of direct and indirect collegial relations on the provision of help. This was done by including the interaction of identification with the collective and whether another teacher was a close colleague and with the number of common colleagues. The hypothesis of the quasi-tie suggests this interaction should be negative.

The anticipation hypothesis suggests that actors who identify with the collective will also be more likely to receive allocations of resources equally from all members of the social system. In our data, this implies an interaction of potential receiver's identification with the collective with whether two teachers were close colleagues. This is again a cross-level interaction, involving identification with the collective of the potential receiver and whether the pair of teachers are close colleagues. The hypothesis of the quasi-tie suggests this interaction should be negative.

### **Level of the Potential Provider**

The cross-nested multilevel models easily accommodate predictors associated with either the potential provider or potential receiver of help. First, social exchange (Blau, 1967) suggests that teachers provide help based on a history of involvement in such a relation (Lawler & Yoon, 1996, 1998). This was operationalized in terms of the extent to which the potential provider of help indicated that a history of mutual support increased the likelihood of supporting another teacher in the school. Second, if teachers exchange help for status, then those who perceive status associated with computer use should be more likely to provide help to others. Therefore, the potential provider's perceived status of technology was included in the model. Third, teachers may provide help because of the perception of a general norm for doing so (Coleman, 1990; Glidewell, Tucker, Todt, & Cox, 1983). Therefore, the potential provider's perceived norms for providing help were included in the model. Finally, differences between the six schools were accounted for with fixed effects via five dummy variables at the level of the provider, without the need, or data available, to estimate a separate random effect for schools as in a multilevel model (Bryk & Raudenbush, 1992).<sup>7</sup>

Note that there were no effects estimated exclusively at the level of the potential receiver of help, although it is possible to specify such effects in the multilevel cross-nested framework. Instead, differences in tendencies to receive help were accounted for via the random effects.

**Table 1**  
**Cross-Nested Multilevel Poisson Regression (i.e., p<sub>2</sub> Social Network Model) of Extent (Number of Days per Year) to Which *i*' Helped *i* Implement Technology**

Independent Variable	Coefficient	Cross-Level Interactions	e <sup>(coefficient)</sup>
<b>Pair Level 1</b>			
Potential provider listed potential receiver as a close colleague	.191 <sup>a</sup> (.037)		1.21
<i>Identification with the collective of potential provider (i')<sup>†</sup> close colleague</i>		-.153 <sup>b</sup> (.078)	1.00
<i>Identification with the collective of potential receiver (i)<sup>†</sup> close colleague</i>		-.306 <sup>a</sup> (.094)	1.00
Number of close colleagues common to potential provider and potential receiver	.095 <sup>a</sup> (.009)		1.10
<i>Identification with the collective of potential provider (i')<sup>†</sup> Number of close colleagues common</i>		-.131 <sup>a</sup> (.016)	1.00
Number of close colleagues of potential provider – Number of close colleagues of potential receiver (difference in status) <sup>c</sup>	-.086 (.127)		1.09
Expertise of potential provider – Expertise of potential receiver	2.144 <sup>a</sup> (.491)		8.53
Potential reciprocity: help from potential receiver to potential provider	.013 <sup>a</sup> (.002)		1.01
Potential provider and potential receiver are members of same subgroup	1.161 <sup>a</sup> (.065)		3.19
Potential provider and potential receiver teach in same grade	1.248 <sup>a</sup> (.070)		3.48
p*: degree centrality (increase in variance of tendency to provide or receive help)	-25.532 <sup>a</sup> (1.032)		0.00
Potential continuity: previous help from potential provider to potential receiver	.0006 (.0005)		1.00
<b>Individual Level 2a: Potential provider of help (i')</b>			
Support based on history of mutual support	-.546 (.389)		1.73
Perceived status of computer use	.360 (.847)		1.43
Perceived expectation to provide help (norms)	.371 (.349)		1.45
Identification with collective	-.861 (1.083)		2.37
<b>Individual Level 2b: Potential receiver of help (i)</b>			
Identification with collective	.292 (.783)		1.34
Intercept	-6.091 <sup>a</sup> (.578)		

Note: School effects estimated with dummy variables in Level 2a not reported. Data analyzed for 101 school actors, 2,844 pairs (only pairs within schools). Bold type indicates the level of analysis. Cross-level interactions in italics.

a. Magnitude of coefficient more than 3 times approximate standard error.

b. Magnitude of coefficient more than 1.96 times approximate standard error.

c. This predictor interacted significantly and negatively with potential provider's identification with the collective.

## Results

The results for the model of the provision of help to use computers are reported in Table 1. Analyses were conducted on only those 101 out of an original 131 teachers for whom data were available at both time points. This included 2,844 pairs of teachers nested within the six schools. Most of the reductions were due to teacher mobility and one school dropping out of the study.

Table 1 is organized according to the multilevel definition of the estimated model. The first column indicates the variable, with bold indicating the level of analysis—the pair of teachers at Level 1 and either the provider (a) or receiver (b) of help at Level 2. The second column then indicates the estimates (and approximate standard errors) at each level. For example, the estimated coefficient of close colleagues, a characteristic of the pair, appears under the pair level, and potential provider's citing of a history of mutual support as a reason for providing help appears under Level 2a, the provider of help. The next column of coefficients (and approximate standard errors) then includes estimates of cross-level interactions for testing the quasi-tie hypotheses. For example, the effect of the provider's identification with the collective in modifying the effect of close colleagues is associated with the first value of  $-.153$  under the cross-level interactions. The last column exponentiates effects to facilitate interpretation in terms of relative frequencies.

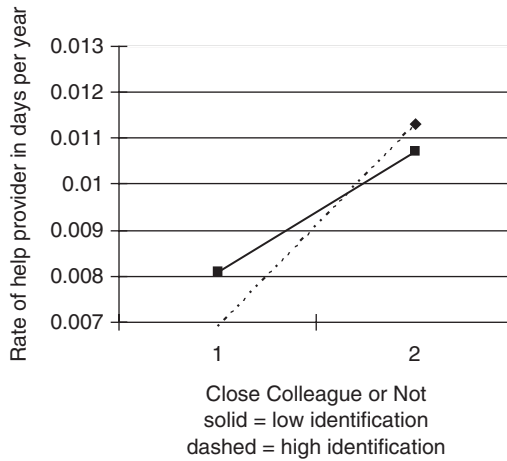
Generally, there was support for the hypothesis of social exchange. Teachers were more likely to provide help to those they listed as close colleagues, with close colleagues receiving about 20% more help than others (interpreted from the coefficient of 1.21 from the last column of the row titled "potential provider listed potential receiver as a close colleague"). But consistent with the quasi-tie hypothesis, the effect of social exchange was considerably reduced to the extent that the potential provider identified with the collective of the school (the first element in the cross-level interactions column). Approximately a one-and-one-third-unit increase in the potential provider's identification with the collective nullified the effect of a close collegial relationship ( $-.153 \times 1.33 + .191$  is approximately zero).

Figure 3 graphically demonstrates the interaction effect between the provider's identification with the collective and close colleagues on help provided. Because of complex interaction and mediating effects, the pair-level model controls for only reciprocity, previous provision of help, and school effects. Furthermore, only the effect of the provider's identification with the collective was modeled (still, the coefficients for the quasi-tie effects were significant and in the same direction as in the main model). The resulting coefficients are reported in Table 2.

The dashed line represents the relationship between being close colleagues or not and the rate of help provided for those providers who are .24 above the mean on identification with the collective. The solid line represents the relationship between being close colleagues or not and the rate of help provided for those providers who are .24 (half of one standard deviation) below the mean on identification with the



**Figure 3**  
**Interaction of Close Colleagues and Identification of the**  
**Potential Provider on the Provision of Help: Evidence of a Quasi-Tie**



collective. Note the relatively steeper slope of the dashed line, indicating the stronger effect of being close colleagues when the provider does not identify with the collective of the school. Thus, on the left, teachers with high identification with the collective are more likely to help noncolleagues than are teachers with low identification. Then, dramatically, on the right, teachers with high identification with the collective are much less likely to help close colleagues than are teachers with low identification. The crossing of the lines is consistent with the zero sum argument: Teachers with high identification are providing help to others who are not close colleagues, partly at the expense of their close colleagues. On the other hand, teachers with low identification are directing most of their help toward close colleagues.

Returning to Table 1, consistent with the anticipation hypothesis that teachers change their behaviors in recognition of others' quasi-ties, the receiver's identification with the collective also reduced the tendency for teachers to receive help from close colleagues versus others. A two-thirds-unit increase in potential receiver's identification with the collective nullified the effect of a close collegial relationship ( $-.306 \times .66 + .191$  is approximately zero). Thus, teachers who identified with the collective of their schools were more able to attract help from all other teachers, reducing effects of close collegial ties.

The potential provider's identification with the collective also reduced the effects of generalized exchange attributable to common colleagues. Though teachers provided about 10% more days of help for each common colleague (exponentiated

**Table 2**  
**Reduced Form of Cross-Nested Multilevel Poisson Regression**  
**(i.e., p<sub>2</sub> Social Network Model) of Extent (Number of Days per Year)**  
**to Which *i*' Helped *i* Implement Technology for Representing Interactions**

Independent Variable	Coefficient	Cross-Level Interactions	$e^{(\text{coefficient})}$
<b>Pair Level 1</b>			
Potential provider listed potential receiver as a close colleague	.390 <sup>a</sup> (.035)		1.48
<i>Identification with the collective of potential provider (i')<sup>†</sup> close colleague</i>		-.44 <sup>a</sup> (.078)	1.00
Number of close colleagues common to potential provider and potential receiver	.154 <sup>a</sup> (.007)		1.17
<i>Identification with the collective of potential provider (i')<sup>†</sup> Number of close colleagues common</i>		-.201 <sup>a</sup> (.013)	1.00
Potential reciprocity: help from potential receiver to potential provider	.028 <sup>a</sup> (.002)		1.03
Potential continuity: previous help from potential provider to potential receiver	.002 <sup>a</sup> (.0005)		1.00
<b>Individual Level 2a: Potential provider of help (i')</b>			
Identification with collective	.28 (.83)		1.32
Intercept	-4.85 <sup>a</sup> (.463)		

Note: School effects estimated with dummy variables in Level 2a not reported. Data analyzed for 101 school actors, 2,844 pairs (only pairs within schools). Bold type indicates the level of analysis. Cross-level interactions in italics.

a. Magnitude of coefficient more than 3 times approximate standard error.

coefficient of 1.10 associated with the number of close colleagues common to the potential provider and receiver), this effect was nullified by a two-thirds-unit increase in the potential provider's identification with the collective of the school ( $-.131 \times .66 + .095$  is approximately zero). Thus, those who identified with the collective of the school were much more likely to provide help across the whole of the school, not favoring close colleagues over others, nor close colleagues of close colleagues over others.

The evidence did not support the indirect test of social exchange, that teachers would help those of more social status (the magnitude of the coefficient was .086, which was less than its approximate standard error of .127). Perhaps teachers are less likely to seek status than employees in the private sector because of the strong emphasis on community in schools (Bryk & Driscoll, 1988; Bryk, Lee, & Holland, 1993; Darling-Hammond & McLaughlin, 1995; Fuller & Izu, 1986; Lee, Smith, & Croninger, 1997; Lieberman, 1995; Louis et al., 1996; Rosenholtz, 1989). It is interesting, though, that as reported in a note to Table 1, the effect of differences in social

status depended on the potential provider's identification with the collective. Teachers who identified with the collective were more likely to help those of less social status. Put differently, those who did not identify with the collective were more likely to help others of higher social status, consistent with an interpretation of social exchange.

There was some basic evidence for effects of the flow of expertise and of social structure, consistent with expectations. Teachers were more likely to help those of less expertise or others who had helped them (i.e., reciprocity). Teachers were also more likely to help those who were members of the same subgroup and who taught in the same grade. The negative coefficient for the  $p^*$  degree centrality indicates that, for example, teachers who were infrequent help providers were more likely to provide to those who received little help (i.e., the blind leading the blind); such an occurrence would reduce overall variation in both tendencies to provide and receive help. Finally, there was little evidence of a direct continuity effect, as teachers were only modestly (slightly more than one approximate standard error) more likely to help those whom they had previously helped (note that the strong effect of direct collegial relationships also accounts for continuity, thus reducing the coefficient for previous help).

There was little support for the indirect tests of social exchange and norms at the level of potential provider. The amount of help a teacher provided did not depend on the teacher's indication that help was part of ongoing mutual support or status associated with computers (as in social exchange), or on the teacher's perceived expectations to provide help (as in norms), or identification with the collective. Neither did overall level of help received depend on a teacher's identification with the collective. Thus, the data support the need to specify and test theoretical propositions regarding resource allocations at the pair level, as well as through interactions of individual- and pair-level characteristics, but not primarily at the individual level.

Overall, there is considerable support for multiple theories regarding the allocation of resources. At the level of the pair, teachers provided help to close colleagues (consistent with social exchange) and to others with whom they shared common colleagues (consistent with generalized exchange). But these tendencies were reduced by a potential provider's identification with the others in the school as a collective, supporting hypotheses of the quasi-tie. These effects are not just apparent upon data analysis but may also be to the teachers, as evidence consistent with the anticipation hypothesis supports the argument that the teachers themselves respond to others' identification with the collective.

## Discussion

The benefits of social capital depend on actors' allocation of resources to one another, and thus, we must understand how actors choose to whom they will allocate

resources. The theory of quasi-ties extends sociological theories of why actors allocate resources to others in a social system in general, beyond allocations embedded in specific social relations. Current theories often rely on a collective actor who receives and reallocates resources to and from members of a social system (Finkel & Muller, 1989; Gould, 1993; Laumann & Marsden, 1979; Macy & Flache, 1995; Oliver, Marwell, & Teixeira, 1985; Yamagishi & Cook, 1993).

But the theories based on a collective actor inevitably give rise to questions regarding the circumstances under which the collective actor emerges, how the collective actor responds to and perpetuates obligations and norms, whether the collective actor has the same properties as other actors in the social system, and the like. Instead, quasi-ties shift focus from the actor to the tie, using network terms to describe why people might generally allocate resources to members of their social systems. Correspondingly, the transition from small social systems in experimental or remote settings to larger social systems that are the referents for social capital theory is accomplished when actors' tendencies to favor direct and indirect social relations are modified by their identification with the members of the social system as a collective; because identity links an actor to the members of a social system writ large, quasi-ties can sustain resource flows in larger social systems than can be sustained merely through social exchange (cf., Figure 2).

By linking social structure to the allocation of resources, the theory of quasi-ties also emphasizes a new aspect of the levels at which identity operates. Typically, the construct of identity establishes either a psychological link between an individual and the members of a social system (e.g., Akerlof & Kranton, 2002; Stryker, 1980) or helps actors make social-psychological distinctions between the in- and out-group (Tajfel & Turner, 1979; Turner & Hogg, 1987). But with a focus on the allocation of resources, the baseline is not individual or group but dyadic in the form of restricted social exchange between two people as guided by an underlying social relationship. The theory of quasi-ties then shows how the psychology of identity can reduce allocations between specific pairs of actors in favor of allocations between the group. Thus, the contrast emphasized here is between the pair and the social group, instead of between the individual and the group as in identity theory (Stryker, 1980) or between two groups as in social identity theory (Tajfel & Turner, 1979).

Because the hypotheses tested here refer to one actor's allocation of resources to another, it was critical to test these theories by specifying and estimating models at the level of the pair of actors. But the theory of quasi-ties suggests that the effects at the level of the pair can be modified by the relationship an actor perceives between him- or herself and others of a social system as a collective. This perceived relationship, called identification with the collective, is a property of the individual. Correspondingly, multilevel models facilitated the expression and estimation of the theory of quasi-ties, which includes the interaction of characteristics of the individual and pair.

At the pair level, there was clear evidence of social exchange, as teachers helped close colleagues, and of generalized exchange, as teachers helped close colleagues

of close colleagues. But there was also strong evidence for the quasi-tie: The more a teacher identified with the collective of others in the school, the more the teacher tended to help any member of the school, regardless of close collegial relationships. By implication, teachers who did not identify with the collective were inclined to help only specific others in the school. Furthermore, if teachers who identify with the collective are perceived as more inclined to help others throughout the school, then it is rational to help those who identify with the collective regardless of a direct close collegial relationship. This was supported by the finding that those who identified with the collective were more likely to receive help from any other throughout the school, regardless of close collegial relationships. Thus, the function of the quasi-tie was seemingly recognized by teachers in their allocation strategies.

Combine the confirmation of the quasi-tie hypotheses with earlier findings that teachers who could access the expertise of others in the school were more likely to implement computers (K. A. Frank et al., 2004; Zhao & Frank, 2003). By implication, schools in which teachers identify more with the collective of the school should then more evenly implement technology. In other words, when teachers identify with the collective of the school, implementation should occur schoolwide instead of in isolated pockets. This is critical for the resilience of the innovation (Rogers, 1995; Tornatzky & Fleischer, 1990). Furthermore, identification with the collective can reduce longstanding factions that emerge with uneven implementation that can be detrimental to school functioning across a variety of tasks (Bryk, Lee, & Holland, 1993; Bryk & Schneider, 2002; K. A. Frank & Fahrback, 1999; McLaughlin & Marsh, 1979).

Identity can thus play a key role in coordinating the actions of teachers as members of a social system beyond that which can be sustained by direct social relationships. That is, quasi-ties facilitate the flow of help even between teachers who do not consider themselves close colleagues. Thus, when identification with the collective serves as a quasi-tie, social capital can accumulate even in large systems that cannot sustain generalized exchange, actors' rational calculations of norms, or the density of social relationships to sustain social exchange.

## Further Considerations

Focusing on resource allocations within systems is relatively unusual (Emirbayer, 1997; K. A. Frank & Yasumoto, 1998), and quasi-ties are novel. Thus, the theory and results presented here are just a beginning. First, there is the theoretical issue of the generality of the quasi-tie. Are there types of quasi-ties besides identification with the collective? In general, a quasi-tie will not be derived from direct social interaction but will affect resource allocations. As a possible second example of a quasi-tie, an actor's sense of place or attachment to a place may affect the actor's allocations to others who inhabit that space, even in the absence of direct interactions (Gieryn, 2000; Stedman, 2002, 2003). The possibility of sense of place as a quasi-tie suggests that the theory of quasi-ties may be more general than simply identity.

Second, I tested the theory of quasi-ties in only one setting. On one hand, schools offer an important testing ground because, as well-bounded social systems, schools are similar to other organizations in many respects. Furthermore, schools are currently like other organizations in their openness to external changes such as new technology and federal and state policies. On the other hand, the generality of the results is unknown, although the theoretical argument should apply in many social systems when emotion, in the form of identity, can shape the otherwise economic calculations of rational actors.

Third, the theory and results emphasize the importance of identification with the collective on the allocation of resources, raising the question of the emergence of identification with the collective. From the social psychological perspective, social identity theory (Tajfel & Turner, 1979; Turner & Hogg, 1987) asserts that actors identify more with a group when the group is contrasted with a potential rival. This accentuates in-group versus out-group distinctions, simplifying the task of differentiating between friend and foe. Following this theory, Bornstein and colleagues have found, mostly in laboratory experiments, that actors are more likely to allocate resources to members of their group when group rivalries are introduced, via rewards for intergroup competition, than when they are not (Bornstein, 2003; Bornstein, Erev, & Rosen, 1990; Erev, Bornstein, & Galili, 1993; Lawler & Yoon, 1998).<sup>8</sup> There is also evidence that identification emerges through and during participation in open, consensual decision making (Goddard, 2004; Hechter, 1987), through previous allocation of resources to members of a collective (Lawler & Yoon, 1998), or through participation in common rituals (Brint, 2001; Durkheim, 1976).<sup>9</sup> Not surprisingly, these are all collective experiences. But one wonders whether there are unique experiences within social systems that differentially affect identification with the collective—why do some members identify more with their collective than other members?

Fourth, estimating allocations of resources necessarily involves analyses of relations between people. Such data violate standard statistical assumptions of independence and thus require unique social network models and estimation procedures. I used the  $p_2$ -like models to simultaneously estimate effects of pairs and individuals. These controlled for dependencies that could be attributed to individuals' tendencies to provide or receive help. Still, there is hardly consensus regarding the optimal models to use, or regarding the validity of statistical inferences from these models (e.g., see Snijders, 2002, for concerns regarding estimation of some  $p^*$  Markov random graph models in degenerate or near-degenerate regions of the parameter space). Ultimately the estimation of complex extensions of  $p_2$  and  $p^*$  models employed here deviate from formal null hypothesis significance testing and should be considered exploratory (Gary Robbins, personal communication, [pls provide full date]). Researchers analyzing relations such as resource allocations anxiously await advancements in social network models and inference procedures.

In summary, the theory of quasi-ties helps us understand the allocation of resources in social systems beyond what is conveyed via direct social relationships. In this

sense, quasi-ties play a critical role in social transformations from micro to macro. The effects are clear for the sampled teachers in this study and are likely indicative of other social systems. Thus, change agents should be aware of, and attend to, their effect on actors' identification with members of their social systems as a collective.

## Appendix

### Measures and the Multilevel Cross-Nested Model

---

This technical appendix describes the measures and formal multilevel cross-nested model estimated in the main text of the article.

#### Secondary Pair-Level Predictors

*Difference in informal social status.* At the pair level, Blau's social exchange suggests that actors should be able to trade status to access help and advice. Difference in status in the informal organization was defined by the difference between the number of others who listed the potential provider as a colleague and the number of others who listed the potential receiver as a colleague (see also Lawler & Yoon, 1998; Montgomery, 1996).<sup>10</sup> Thus, when the potential receiver was nominated more frequently than the potential provider, the potential receiver should be able to attract more help.

*Difference in expertise.* Expertise is most likely to flow from those with more knowledge to those with less knowledge (assuming equal interests in resources and declining marginal utilities; Blau, 1967; Coleman, 1990). Expertise was measured based on a composite of a teacher's reported uses of computers for teacher functions and student functions and the amount a teacher was reported by others as having provided help at Time 1 (help provided at Time 1 being an indicator of expertise in how to use computers across a range of contexts). Components were standardized before taking the composite ( $\alpha = .67$ ). The pair-level variable was then the difference in expertise between potential provider and potential receiver.

*Potential reciprocity.* Following the  $p_2$  framework, I included a measure of the extent to which the potential receiver had helped the potential provider as reported at Time 2, thus representing the immediate reciprocity effect (Lazega & Van Duijn, 1997; Wasserman & Pattison, 1996).

*Common settings: Membership in the same subgroup or grade.* A relationship between two actors may depend on the larger social context in which the two actors are embedded (K. A. Frank & Yasumoto, 1998; Lin, 1999, 2001; Portes & Sensenbrenner, 1993). Thus, I established whether the potential provider and receiver were members of the same subgroup (subgroup membership was defined by application of K. A. Frank's [1995] algorithm to identify nonoverlapping cohesive subgroups from the sociometric data regarding close collegial relationships) and whether a pair of teachers were assigned to the same grade. These measures

*(continued)*

## Appendix (continued)

---

represent aspects of emergent and a priori social structures not directly captured by direct and indirect collegial relationships. As such, they are general “settings” (Pattison & Robbins, 2002), although the term here is not as precisely defined as in Pattison and Robbins (2002). Nonetheless, use of membership in the same subgroup or grade may well preempt the need to control for structural dependencies using multiple independent variables as in  $p^*$  models of social networks. Note that interaction effects associated with quasi-ties were much stronger if I did not control for same subgroup or same grade.

*p\* controls.* Recognizing the value of the  $p^*$  framework, I explored effects for a set of covariates representing structural dependencies. In particular, I explored homogeneous effects (those not specific to individual or pairs of actors) associated with the Markov graph triad model as described by O. Frank and Strauss (1986). These were calculated by dichotomizing the outcome (measured at Time 2) to represent the presence or absence of help, with data including all those who completed the survey at Time 2 and applying  $p^*$  software (available at <http://kentucky.psych.uiuc.edu/pstar/index.html>). Exploratory models were then estimated using ordinary logistic regression, including other covariates as a base.<sup>11</sup> Using a liberal  $\chi^2$  cutoff associated with  $p \leq .10$ , only the  $p^*$  parameter for degree centrality was retained.

*Potential continuity.* To account for continuity effects, I controlled for the extent to which the potential provider had helped the potential receiver as reported at Time 1. Thus, other coefficients can be interpreted as effects on change in the provision of help.<sup>12</sup>

### Model at the Pair Level (Level 1)

As a baseline model, at Level 1 (the pair level), the frequency with which teacher  $i'$  provided help to teacher  $i$  is a function of the tendency of  $i'$  to provide help ( $\alpha_{i'}$ ) and the tendency of  $i$  to receive help ( $\beta_i$ ):<sup>13</sup>

$$\begin{aligned} &\text{Level 1(pair)} \\ \log(\text{Frequency of help provided by } i' \text{ to } i)_{i'i} &= \alpha_{i'} + \beta_i \end{aligned} \tag{1}$$

Thus, dependencies in the network data that can be attributed to tendencies for certain teachers to provide or receive help are controlled for by including  $\alpha_{i'}$  and  $\beta_i$  in the model. Furthermore, note that because the dependent variable is frequency of help (defined in terms of days per year), a Poisson model is employed as represented by taking the log of the frequency of help provided.

Adding the pair-level predictors described above and in the main text, the final model at the pair was

$$\begin{aligned} &\text{Level 1(pair)} \\ \log(\text{Frequency of help provided by } i' \text{ to } i)_{i'i} &= \alpha_{i'} + \beta_i + \\ &\delta_1(\text{Potential provider listed potential receiver as close colleague})_{i'i} + \\ &\delta_2(\# \text{ close colleagues common to potential provider and receiver})_{i'i} + \end{aligned}$$

---

*(continued)*



## Appendix (continued)

$$\begin{aligned}
 & \delta_3(\# \text{ of close colleagues of potential provider} - \# \text{ of close} \\
 & \quad \text{colleagues of potential receiver})_{i_i} + \\
 & \delta_4(\text{Expertise of potential provider} - \text{expertise of potential receiver})_{i_i} + \\
 & \delta_5(\text{Potential reciprocity: help from potential receiver to potential provider})_{i_i} + \\
 & \delta_6(\text{Potential provider and receiver are members of same subgroup})_{i_i} + \\
 & \delta_7(\text{Potential provider and receiver teach in same grade})_{i_i} + \\
 & \quad \delta_8(p^*: \text{degree centrality})_{i_i} + \\
 & \delta_9(\text{Potential continuity: previous help from potential provider to receiver})_{i_i} \quad (2)
 \end{aligned}$$

Thus,  $\delta_1$  represents the effect of social exchange;  $\delta_2$  represents the effect of generalized exchange;  $\delta_3$  represents the effect of differences in informal status;  $\delta_4$  represents the effect of differences in expertise;  $\delta_5$  represents tendencies for actors to reciprocate;  $\delta_6$  and  $\delta_7$  represent effects of settings defined by collegial subgroups or formal grades;  $\delta_8$  represents the effect of a single  $p^*$  covariate, degree centrality; and  $\delta_9$  represents the continuity effect linked to the previous provision of help.

### Models and Measures at the Level of the Potential Provider and Receiver (Level 2)

Drawing on the multilevel aspect of the  $p_2$  framework, tendencies of teachers to provide ( $\alpha_{i'}$ ) and receive help ( $\beta_i$ ) were modeled at a separate level from the pair of actors. To begin, the tendency to provide and receive help are a function of an overall tendency,  $\gamma_0$ , and individual effects for each potential provider ( $u_{i'}$ ) and potential receiver ( $v_i$ ):

$$\begin{aligned}
 & \text{Level 2a: Potential provider of help } (i') \\
 & \quad \alpha_{i'} = \gamma_0 + u_{i'} \\
 & \text{Level 2b: Potential receiver of help } (i) \\
 & \quad \beta_i = \gamma_0 + v_i \quad (3)
 \end{aligned}$$

An important first analysis in this type of model is to compare the variance of the  $u_{i'}$  with the variance of the  $v_i$ . In these data, there were almost 3 times more variation in teachers' tendencies to provide help as to receive help (estimated variance of the  $u_{i'} = 11.4$ ; estimated variance of the  $v_i = 4.1$ ). Thus, this social system is similar to Blau's (1967, p. 178) in that there is more variance in the amount people provide help than in the amount people receive help; in both social systems, there are a few experts and a relatively large number of others who need at least some help.

As described in the main text, the model for the provider of help includes perceived history of mutual support, perceived status of computer use, and expectation to provide help. Thus, the model for potential providers ( $i'$ ) is

$$\begin{aligned}
 & \text{Level 2a: Potential provider } (i') \\
 & \alpha_{i'} = \gamma_0 + \gamma_1^{(a)} \text{ support based on history of mutual support}_{i'} + \\
 & \quad \gamma_2^{(a)} \text{ perceived status of computer use}_{i'} + \\
 & \quad \gamma_3^{(a)} \text{ perceived expectation to provide help}_{i'} + u_{i'} \quad (4)
 \end{aligned}$$

(continued)

### Appendix (continued)

Thus, in Model 4,  $\gamma_1^{(\alpha)}$  represents the effect of history of mutual support on a teacher's tendency to provide help,  $\gamma_2^{(\alpha)}$  represents the effect of perceived status of computer use, and  $\gamma_3^{(\alpha)}$  represents the effect of perceived expectation to provide help.

Within the multilevel framework, the quasi-tie hypotheses were evaluated by using identification with the collective at the provider level to model the coefficients for collegial relationships ( $\delta_1$ ) and the number of common colleagues ( $\delta_2$ ):

$$\begin{aligned}
 & \text{cross-level interaction} \\
 \delta_{1ii} &= \gamma_0^{(\delta 1)} + \gamma_1^{(\delta 1)} \text{ identification with collective of potential provider}_i, \\
 \delta_{2ii} &= \gamma_0^{(\delta 2)} + \gamma_1^{(\delta 2)} \text{ identification with collective of potential provider}_i, \tag{5}
 \end{aligned}$$

The hypothesis of the quasi-tie is that identification with the collective should reduce  $\delta_1$  and  $\delta_2$ . Thus, the hypotheses are that  $\gamma_1^{(\delta 1)}$  and  $\gamma_1^{(\delta 2)}$  are negative.

Finally, the anticipation hypothesis can be tested by including the potential receiver's identification in the model for  $\delta_1$ :

$$\delta_{1ii} = \gamma_0^{(\delta 1)} + \gamma_1^{(\delta 1)} \text{ identification with collective of potential provider}_i + \gamma_2^{(\delta 1)} \text{ identification with collective of potential receiver}_i \tag{6}$$

Thus, like the other effects of the quasi-tie,  $\gamma_2^{(\delta 1)}$  should be negative.

Note that  $\gamma_1^{(\delta 1)}$ ,  $\gamma_1^{(\delta 2)}$ , and  $\gamma_2^{(\delta 1)}$  are cross-level interactions (close colleagues at the pair-level  $\hat{p}$  identification at the individual level). This can be observed by substituting Equations 5 or 6 back into 2 (see Bryk & Raudenbush, 1992). To preserve interpretation, I added the main effects of the provider's and receiver's identification with the collective directly on the teacher's tendencies to provide and receive help, as in Models 4 and 3, respectively. Note also that all other Level 1 predictors in Model 2 are assumed to be constant across providers and senders. Thus, the term  $\delta$  can still be used to define terms at this level. Alternatively, one could assign  $\delta_p = \gamma_p$  for  $p = 3$  to 9.

Results reported in Table 1 were compared with estimates from SAS Glimmix using restricted maximum likelihood. The Glimmix estimate for the variation of the  $v_i$  was 0, and Glimmix had unstable estimates and standard errors for some of the individual-level predictors. This is not an unusual occurrence for such models (Yosef, 2001). But estimates for the cross-level terms key to the quasi-tie hypothesis using Glimmix were all within .2 of a standard error (as reported in Table 1) of the HGLM estimates. All other estimates for pair-level predictors were within 1 standard error of the HGLM estimates, with the exception of the  $p^*$  control, degree centrality, which was estimated by Glimmix as  $-27$  and by HGLM as  $-25$ , as reported in Table 1 (with an estimated standard error of 1).

Separate analyses were conducted through a single-level logistic regression exploring the full set of  $p^*$  covariates and using a liberal cutoff of .10 for inclusion in the model. Results largely confirmed those reported here, with the following differences:

1. More  $p^*$  covariates entered the model (outstars, instars, mstars, transitivity, and cycles, in addition to degree centralization). Presumably, many of these effects were absorbed by the  $u_i$  and  $v_i$  of the  $p_2$  model.

*(continued)*

## Appendix (continued)

---

2. Significance tests tended to be more liberal (perhaps because they do not address dependencies in the data as does the  $p_2$ , through its nesting structure).
3. Cross-level effects were relatively smaller when compared to their standard errors. Those associated with the potential provider of help were 1.5 to 1.8 times their approximate standard errors, and those associated with the potential receiver were smaller. This is likely resulting from the loss of power from dichotomizing the data. Single-level Poisson models confirmed the inferences made here for the cross-level terms, with three of four coefficients for cross-level terms negative and more than 7 times their standard errors in various versions of the models.

Other alternatives would have been to account for the multiple types of relations (e.g., collegiality, help, structural similarity) through the approach outlined by Pattison and Wasserman (1999), to account for valued relationships via the approach outlined by Robins, Pattison, and Wasserman (1999) instead of the Poisson model, or to account for change in the network through Snijders's (1996) method of moments. But drawing on the  $p_2$  framework facilitated parsimonious models that incorporated many of the features of the alternatives while facilitating a focus on the substantive parameters of interest.

---

## Notes

1. In four of the schools, the research was conducted in collaboration with colleagues who were evaluating the Urban Schools Initiative sponsored by the National Science Foundation. This initiative emphasized constructivist teaching practices but included a technological component.

2. The sample included administrators and support staff, but most respondents were teachers and the primary action of computer implementation occurs in the classroom, so for the remainder I refer to the set of respondents as teachers.

3. This finding was supported in Zhao and Frank (2003) using cross-sectional data on 19 schools in a single state.

4. I focused on who helped whom use computers because this is more demanding than talk about computers, the other interaction used by K. A. Frank, Zhao, and Borman (2004), and therefore the provision of help is more indicative of resource allocation.

5. Although the term *closest colleague* was not further defined, this relation has been shown to characterize the pattern of diffusion in schools (K. A. Frank & Zhao, 2005).

6. Rasch analyses (Linacre, 2001) indicated no items with mean square misfit greater than 1.5 for this measure. Substantive inferences from statistical models were unchanged using Rasch measures.

7. This approach ensures full control for school effects with minimal introduction of bias in estimates and standard errors because number of fixed effects is small relative to the degrees of freedom ( $n = 2,800$ ), as in the case of classic ANOVA.

8. The incentive to allocate resources to members of one's group also depends on the perceived efficacy of the group and on the effect that the allocation will have on the group's likelihood of winning (Lawler & Yoon, 1998; Macy, 1991; Macy & Flache, 1995).

9. From the individual level, the advantage of signifying identity is to attract resources beyond those that might be allocated based on previous exchanges. In this sense, when identity is translated into action it introduces bias (Turner & Reynolds, 2001).

10. Blau's hypothesis is consistent with Cook and Whitmeyer (1992) and Cook, Emerson, Gillmore, and Yamagishi (1983). The use of the measure is also consistent with the E-state approach of Skvoretz

and Fararo (1996) if one assumes that every teacher in these small systems is an eligible colleague. Under this assumption, the

$$\begin{aligned}
 & (\text{constraint of potential receiver over provider} - \text{the constraint of potential provider over receiver}) \\
 & = (\text{colleagues of potential receiver} - \text{common colleagues}) - (\text{colleagues of potential provider} - \text{common colleagues}) \\
 & = \text{colleagues of potential receiver} - \text{colleagues of potential provider.}
 \end{aligned}$$

11. This reverses the normal order of the  $p^*$  approach, which explores structural dependencies first and then adds variables of substantive interest. But the approach here allowed me to focus on the parameters of substantive interest while controlling for dependencies in the network data.

12. Models of a dependent variable defined as the extent of *increase* in help from Time 1 to Time 2 agreed substantially with the results reported in Table 1, but models of decrease in the provision of help could not be estimated because there were only 67 decreases out of a possible 2,844 pairs.

13. By including parameters for individual effects of potential providers and receivers of help this model is similar to the earlier  $p_1$  models and can be considered a special case of  $p^*$  (see Wasserman and Pattison, 1996, p. 410; reciprocity effects will be included below). The advantage of the  $p_2$  approach is that it treats individual effects as random, focusing on estimation of the variances across effects rather than fixed values for each individual. Thus the number of parameters does not increase with network size, and estimation is more tractable.

## References

Akerlof, G. A., & Kranton, R. E. (2002). Identity and schooling: Some lessons for the economics of education. *Journal of Economic Literature*, 40(4), 1167-1201.

Almgren. (1981). *The encyclopedia of sociology*. Guilford, CT: Dushkin publications

Arrow, K. (1979). The economics of information. In M. Dertouzos & J. Moses (Eds.), *The computer age: A twenty-year view* (pp. 306-320). Cambridge, MA: MIT Press.

Baker, W. (2000). *Achieving success through social capital: Tapping the hidden resources in your personal and business networks*. San Francisco: Jossey-Bass.

Bearman, P. (1997). Generalized exchange. *American Journal of Sociology*, 102(5), 1383-1415.

Bendor, J., & Swastik, P. (2001). The evolution of norms. *American Journal of Sociology*, 106(6), 1493-1545.

Bian, Y. (1997). Bringing strong ties back in: Indirect ties, network bridges, and job searches in China. *American Sociological Review*, 62, 366-385.

Bidwell, C. E., & Kasarda, J. D. (1987). *Structuring in organizations: Ecosystem theory evaluated*. Greenwich, CT: JAI.

Blau, P. M. (1967). *Exchange and power in social life*. New York: John Wiley.

Blau, P. M. (1977). *Inequality and heterogeneity*. New York: Macmillan.

Bolman, L. G., & Heller, R. (1995). School administrators as leaders. In S. Bacharach & B. Mundell (Eds.), *Images of schools* (pp. 315-358). Thousand Oaks, CA: Corwin Press.

Bornstein, G. (2003). Intergroup conflict: Individual, group and collective interests. *Personality and Social Psychology Review*, 7(2), 129-145.

Bornstein, G., Erev, I., & Rosen, O. (1990). Intergroup competition as a structural solution to a social dilemma. *Social Behavior*, 5, 247-260.

Brint, S. (2001). Gemeinschaft revisited: A critique and reconstruction of the community concept. *Sociological Theory*, 19(1), 1-23.

Bryk, A., & Driscoll, M. E. (1988). *The school as community: Theoretical foundations, contextual influences, and consequences for students and teachers*. Madison, WI: University of Wisconsin, National Center on Effective Secondary Schools.

- Bryk, A., & Raudenbush, S. W. (1992). *Hierarchical linear models*. Newbury Park, CA: Sage.
- Bryk, A., Raudenbush, S., & Congdon, R. (2002). *Hierarchical linear models*. Chicago: Scientific Software, Inc.
- Bryk, A., & Schneider, B. (2002). *Trust in schools*. New York: Russell Sage.
- Bryk, A. S., Lee, V. E., & Holland, P. B. (1993). *Catholic schools and the common good*. Cambridge, MA: Harvard University Press.
- Budin, H. (1999). The computer enters the classroom. *Teachers College Record*, 100(3), 656-669.
- Burt, R. S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.
- Burt, R. S. (2000). The network structure of social capital. In R. I. Sutton & B. M. Staw (Eds.), *Research in organizational behaviour* (Vol. 22). Amsterdam: Elsevier Science.
- Callahan, Raymond. 1962. Education and the Cult of Efficiency. Chicago: University of Chicago Press.
- Coleman, J. S. (1990). *Foundations of social theory*. Cambridge, MA: Harvard University Press.
- Cook, K. S., Emerson, R. M., Gillmore, M. R., & Yamagishi, T. (1983). The distribution of power in exchange networks: Theory and experimental results. *American Journal of Sociology*, 89(2), 275-305.
- Cook, K. S., & Whitmeyer, J. M. (1992). Two approaches to social structure: Exchange theory and network analysis. *Annual Review of Sociology*, 18, 109-127.
- Cuban, L. (1999, August). The technology puzzle: Why is greater access not translating into better classroom use? *Education Week*, 68, 47.
- Darling-Hammond, L., & McLaughlin, M. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, 77(7), 597-603.
- Deaux, K., Reid, A., Mizrahi, K., & Cotting, D. (1999). Connecting the person to the social: The functions of social identification. In T. R. Tyler, R. M. Kramer, & O. P. John (Eds.), *The psychology of the social self* (pp. 91-113). Mahwah, NJ: Lawrence Erlbaum.
- Durkheim, E. (1976). *The elementary forms of the religious life* (R. Nisbet & J. W. Swain, Trans.). London: Allen and Unwin.
- Ekeh, P. P. (1974). *Social exchange theory*. London: Heinemann Educational Books Ltd.
- Emerson, R. (1972). Exchange theory, Part II: Exchange relations and networks. In J. Berger (Ed.), *Sociological theories in progress* (pp. 58-87). Boston: Houghton Mifflin.
- Emirbayer, M. (1997). Manifesto for a relational sociology. *American Journal of Sociology*, 103(2), 281-317.
- Erev, I., Bornstein, G., & Galili, R. (1993). Constructive intergroup competition as a solution to the free rider problem: A field experiment. *Journal of Experimental Social Psychology*, 29, 463-478.
- Erickson, B. H. (2001). Good networks and good jobs: The value of social capital to employers and employees. In N. Lin, K. Cook, & R. S. Burt (Eds.), *Social capital: Theory and research* (pp. 127-158). New York: Walter de Gruyter.
- Fernandez, R. M., & Castilla, E. J. (2001). How much is that network worth? Social capital in employee referral networks. In N. Lin, K. Cook, & R. S. Burt (Eds.), *Social capital: Theory and research* (pp. 85-104). New York: Walter de Gruyter.
- Finkel, S. E., & Muller, E. N. (1989). Personal influence, collective rationality, and mass political action. *American Political Science Review*, 83(3), 885-903.
- Flap, H., & Boxman, E. (2001). Getting started: The influence of social capital on the start of the occupational career. In N. Lin, K. Cook, & R. S. Burt (Eds.), *Social capital: Theory and research* (pp. 159-184). New York: Walter de Gruyter.
- Flap, H., & DeGraaf, N. (1986). Social capital and attained occupational status. *Netherlands Journal of Sociology*, 22, 145-161.
- Frank, K. A. (1995). Identifying cohesive subgroups. *Social Networks*, 17, 27-56.
- Frank, K. A., & Fahrback, K. (1999). Organization culture as a complex system: Balance and information in models of influence and selection. *Organization Science*, 10(3), 253-277.
- 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. Hedges & B. Schneider (Eds.), *Social organization of schools* (pp. 279-318). New York: Russell Sage.
- Frank, K. A., Zhao, Y., & Borman, K. (2004). Social capital and the diffusion of innovations within organizations: Application to the implementation of computer technology in schools. *Sociology of Education*, 77, 148-171.
- Frank, O., & Strauss, D. (1986). Markov graphs. *Journal of the American Statistical Association*, 81(395), 832-842.
- Fuller, B., & Izu, J. (1986). Explaining school cohesion: What shapes the organizational beliefs of teachers? *American Journal of Education*, 94, 501-535.
- Gabbay, S. M., & Leenders, R. Th. A. J. (1999). CSC: The structure of advantage and disadvantage. In R. Th. A. J. Leenders & S. Gabbay (Eds.), *Corporate social capital and liability* (pp. 1-16). Amsterdam: Kluwer Academic.
- Gieryn, T. F. (2000). A space for place in sociology. *Annual Review of Sociology*, 26, 463-496.
- Gittell, R. J., & Vidal, A. (1998). *Community organizing: Building social capital as a development strategy*. Thousand Oaks, CA: Sage.
- Glidewell, J., Tucker, S., Todt, M., & Cox, S. (1983). Professional support systems: The teaching profession. In A. Nadler, J. Fisher, & B. DePaulo (Eds.), *New directions in helping* (Vol. 3, pp. 189-212). New York: Academic Press.
- Goddard, R. (2004). Collective efficacy beliefs: Theoretical developments, empirical evidence and future directions. *Educational Researcher*, 33(3), 3-13.
- Gould, R. V. (1993). Collective action and network structure. *American Sociological Review*, 58, 182-196.
- Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360-1380.
- Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, 91(3), 481-510.
- Greenfield, T. B. (1975). Theory about organization: A new perspective and its implications for schools. In R. Campbell & R. Gregg (Eds.), *Administrative behavior in education*. London: Athlone.
- Gusfield, J. R. (1975). *The community: A critical response*. New York: Harper Colophon.
- Hechter, M. (1987). *Principles of group solidarity*. Berkeley: University of California Press.
- Holland, P. W., & Leinhardt, S. (1981). An exponential family of probability distributions for directed graphs. *Journal of the American Statistical Association*, 76(373), 33-49.
- Laumann, E., & Marsden, P. (1979). The analysis of oppositional structures in political elites: Identifying collective actors. *American Sociological Review*, 44, 713-732.
- Lawler, E. J., & Thye, S. R. (1999). Bringing emotions into social exchange theory. *Annual Review of Sociology*, 25, 217-244.
- Lawler, E. J., & Yoon, J. (1996). Commitment in exchange relations: Test of a theory of relational cohesion. *American Sociological Review*, 61, 89-108.
- Lawler, E. J., & Yoon, J. (1998). Network structure and emotion in exchange relations. *American Sociological Review*, 63, 871-894.
- Lazega, E., & Van Duijn, M. (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, 375-397.
- Leana, C. R., & Buren, H. J. V. (1999). Organizational social capital and employment practices. *Academy of Management Review*, 24(3), 538-560.
- Lee, V. E., Smith, J. B., & Croninger, R. G. (1997). How high school organization influences the equitable distribution of learning in mathematics and science. *Sociology of Education*, 70, 128-150.
- Lieberman, A. (1995). Practices that support teacher development. *Phi Delta Kappan*, 76(8), 591-596.
- Lightfoot, S. L. (1983). *The good high school: Portraits of character and culture*. New York: Basic Books.

- Lin, N. (1999). Sunbelt keynote address. *Connections*, 22(1), 28-51.
- Lin, N. (2001). *Social capital: A theory of social structure and action*. New York: Cambridge University Press.
- Lin, N., & Bian, Y. (1991). Getting ahead in urban China. *American Journal of Sociology*, 97(3), 657-688.
- Linacre, J. M. (2001). *Winsteps*. Chicago: University of Chicago MESA Press.
- Little, J.W. (2003). Inside teacher community: Representations of classroom practice. *Teachers College Record* 105:913-945.
- Lortie, D. C. (1977). *Schoolteacher: A sociological study*. Chicago: University of Chicago Press.
- Louis, K. S., Marks, H. M., & Kruse, S. (1996). Teachers' professional community in restructuring schools. *American Education Research*, 33(4), 757-798.
- Loveless, T. (1996). Why aren't computers used more in schools? *Education Policy*, 10(4), 448-467.
- Macy, M. W. (1991). Chains of cooperation: Threshold effects in collective action. *American Sociological Review*, 56, 730-747.
- Macy, M. W., & Flache, A. (1995). Beyond rationality in models of choice. *Annual Review of Sociology*, 21, 73-91.
- Markovsky, B., and Mark V. Chaffee. (1995). Social identification and solidarity: a revised formulation. In B. Markovsky, J. O'Brien, & K. Heimer (Eds.) *Advances in Group Processes*, 12: 249-270. Greenwich, Conn: JAI Press.
- Marsden, P., & Gorman, E. (1999). Social capital in internal staffing practices. In R. Th. A. J. Leenders & S. Gabbay (Eds.), *Corporate social capital and liability* (pp. 180-196). Amsterdam: Kluwer Academic.
- Maslach, C. (1976). Burned out. *Human Behavior*, 5(9), 16-22.
- Maslach, C. (1978). Job burnout: How people cope. *Public Welfare*, 36, 56-58.
- McLaughlin, M., & Marsh, D. (1979). Staff development and school change. In A. Lieberman & L. Miller (Eds.), *Staff development: New demands, realities, new perspectives* (pp. 69-94). New York: Teachers College Press.
- Meyer, J., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology*, 30, 431-450.
- Montgomery, J. D. (1996). The structure of social exchange networks: A game-theoretic reformulation of Blau's model. *Sociological Methodology*, 193-225.
- Morgan, S. L., & Sorensen, A. (1999). Parental networks, social closure, and mathematics learning: A test of Coleman's social capital explanation of school effects. *American Sociological Review*, 64, 649-700.
- Nash, J. (1950). Equilibrium points in N-person games. *Proceedings of the National Academy of Sciences*, 36(1), 48-49.
- Newmann, F. (Ed.). (1996). *Authentic achievement : Restructuring schools for intellectual quality*. San Francisco: Jossey-Bass.
- Norris, C., Smolka, J., & Soloway, E. (1999, July). *Convergent analysis: A method for extracting the value from research studies on technology in education*. Paper presented at the U.S. Education Secretary's conference on education in evaluating the effectiveness of technology, Washington, DC.
- Oliver, P., Marwell, G., & Teixeira, R. (1985). A theory of the critical mass: I. Interdependence, group heterogeneity, and the production of collective action. *American Journal of Sociology*, 91(3), 522-556.
- Owen, G. (1982). *Game theory*. New York: Academic Press.
- Pattison, P., & Robbins, G. (2002). Neighborhood-based models for social networks. *Sociological Methodology*, 32, 301-337.
- Pattison, P., & Wasserman, S. (1999). Logit models and logistic regressions for social networks: II. Multivariate relations. *British Journal of Mathematical and Statistical Psychology*, 52, 169-193.
- Perrow, C. (1986). *Complex organizations: A critical essay*. New York: Random House.
- Portes, A. (1998). Social capital. *Annual Review of Sociology*, 24, 1-24.
- Portes, A. (2000). The hidden abode: Sociology as analysis of the unexpected. *American Sociological Review*, 65(1), 1-18.

- Portes, A., & Sensenbrenner, J. (1993). Embeddedness and immigration: Notes on the social determinants of economic action. *American Journal of Sociology*, 98(6), 1320-1350.
- President's Committee of Advisors on Science and Technology. (1997). *Report to the president on the use of technology to strengthen K-12 education in the United States*. Washington, DC: Author.
- Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon & Schuster.
- Ring, P., & Ven, A. V. (1992). Structuring cooperative relationships between organizations. *Strategic Management Journal*, 13, 483-498.
- Robins, G., Pattison, P., & Wasserman, S. (1999). Logit models and logistic regressions for social networks: III. Valued relations. *Psychometrika*, 64, 371-394.
- Rogers, E. M. (1995). *Diffusion of innovations*. New York: Free Press.
- Rosenholtz, S. J. (1989). *Teachers' workplace: The social organization of schools*. New York: Longman.
- Rowan, B. (1995). The organizational design of schools. In S. Bacharach & B. Mundell (Eds.), *Images of schools* (pp. 11-42). Thousand Oaks, CA: Corwin Press.
- Sandefur, R. L., & Laumann, E. O. (1998). A paradigm for social capital. *Rationality and Society*, 10(4), 481-501.
- Snijders, T. A. B. (1996). Stochastic actor-oriented dynamic network analysis. *Journal of Mathematical Sociology*, 21, 149-172.
- Snijders, T. A. B. (2002). Markov Chain Monte Carlo estimation of exponential random graph models. *Journal of Social Structure*, 3, 2.
- Skvoretz, J., & Fararo, T. J. (1996). Status and participation in task groups: A dynamic network model. *American Journal of Sociology*, 101(5), 1366-1414.
- Stainback, S., & Stainback, W. (1984). A rationale for the merger of special and regular education. *Exceptional Children*, 51, 102-111.
- Stedman, R. C. (2002). Toward a social psychology of place: Predicting behavior from place-based cognitions, attitude, and identity. *Environment and Behavior*, 24, 561-581.
- Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. *Society and Natural Resources*, 16(8), 671-685.
- Stryker, S. (1980). *Symbolic interactionism: A social structural version*. Menlo Park, CA: Benjamin Cummings.
- Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin & S. Worchel (Eds.), *The social psychology of intergroup relations* (pp. 33-47). Monterey, CA: Brooks/Cole.
- Tornatzky, L. G., & Fleischer, M. (1990). *The process of technological innovation*. Lexington, MA: Lexington Books.
- Turner, J., & Hogg, C. (1987). *Rediscovering the social group: A self-categorization theory*. Oxford, UK: Basil Blackwell.
- Turner, J. C., & Reynolds, K. J. (2001). The social identity perspective in intergroup relations: Theories, themes, and controversies. In R. Brown & S. L. Gaertner (Eds.), *Blackwell handbook of social psychology: Intergroup process* (Vol. 4, pp. 133-152). Oxford, UK: Blackwell.
- Useem, M., & Karabel, J. (1986). Pathways to top corporate management. *American Sociological Review*, 44, 184-200.
- Uzzi, B. (1999). Embeddedness in the making of financial capital: How social relations and networks benefit firms seeking financing. *American Sociological Review*, 64, 481-505.
- Wasserman, S., & Pattison, P. (1996). Logit models and logistic regressions for univariate and bivariate social networks: An introduction to Markov graphs. *Psychometrika*, 61(3), 401-426.
- Wellman, B., & Frank, K. A. (2001). Network capital in a multilevel world: Getting support from personal communities. In N. Lin, K. Cook, & R. S. Burt (Eds.), *Social capital: Theory and research* (pp. 233-274). New York: Walter de Gruyter.
- Will, M. (1986, February). Educating children with learning problems: A shared responsibility. *Exceptional Children*, 52, 411-415.
- Woolcock, M. (1998). Social capital and economic development. *Theory and Society*, 27(2), 151-208.



- Yamagishi, T., & Cook, K. (1993). Generalized exchange and social dilemmas. *Social Psychology Quarterly*, 56(4), 235-248.
- Yosef, M. (2001). *A comparison of alternative approximations to ML estimation for hierarchical generalized linear models: The logistic-normal model case*. Unpublished doctoral dissertation, Michigan State University, College of Education, East Lansing.
- Zhao, Y., & Frank, K. A. (2003). An ecological analysis of factors affecting technology use in schools. *American Educational Research Journal*, 40(4), 807-840.

**Kenneth A. Frank** is a professor in counseling, educational psychology, and special education as well as in fisheries and wildlife at Michigan State University, where he teaches general introductory courses in research methods and quantitative methods as well as advanced courses in multivariate analysis and seminars in social network analysis and causal inference. His substantive interests include the diffusion of innovations, study of schools as organizations, social structures of students and teachers, and school decision making, social capital, and resource flow. His substantive areas are linked to several methodological interests: social network analysis, causal inference, and multilevel models. His publications include quantitative methods for representing relations among actors in a social network, robustness indices for inferences, and the effects of social capital in schools and other social contexts.