

Effective Linking in a Principal Advice Network:
A Conceptual Model and Exploratory Analysis¹

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Abstract

Little is known about principals' informal advice-seeking networks, although these relationships are likely to be particularly important for professional development. We therefore use highly detailed survey and administrative data to examine advice-seeking relationships within a large urban school district. We draw upon organizational learning and social network research to better conceptualize the causes and consequences of these social ties. This framework suggests some potential barriers to “effective linking” – that is, selecting advice targets who are more experienced, have more desirable leadership skills and qualities, and have school-specific knowledge for a given principal. Exploring advice-seeking ties within a district, using both descriptive and predictive models, we find a network structure in which principals seek advice in largely effective directions; however, personal qualities matter more than school-level characteristics, and ties remain less likely between socially and geographically distant principals net of other factors. Perceived competition for students does not significantly hinder effective linking, and may in fact act as a bridge for informal advice-seeking. Our study has implications for districts seeking to better capture and transfer important organizational leadership knowledge and skills.

¹ We wish to thank Mauricio Farias and Matt Kasman for their important help with some of the measures used here and for many helpful comments, Jessica Rodriguez for excellent data collection work, and Demetra Kalgorides and John Valant for their keen insights at several points in this project.

INTRODUCTION

It is now widely recognized that effective principal leadership increases positive student outcomes (Branch, Hanushek & Rivkin 2009; Waters, Marzano, & McNulty 2003; Williams, Kirst & Haertel 2005). However, the precise knowledge and skills needed to promote school success are still being uncovered (Grissom & Loeb 2009; Horng, Klasik & Loeb 2009; Lortie 2009; Rice 2010). To help transfer some of the complex knowledge involved in improving schools, successful professional development programs have used formal mentoring approaches (Darling-Hammond & Orphanos 2007; Peterson 2002). However, little is known about less formal social networks emerging among principals and the extent to which *advice-seeking* in particular connects principals in ways that facilitate learning.

Organizational learning research has shown that capturing and transferring complex knowledge is aided by such informal networks, but various barriers often prevent individuals from finding and absorbing useful knowledge from one another (Argote 1999; Cross, Borgatti & Parker 2002; Cross & Parker 2004; Hansen 1999, 2002; Reagans & McEvily 2003). In this article, we are concerned with the extent to which several of these barriers may prevent principals from establishing the kinds of informal social networks that would best serve to transfer knowledge within districts. Various policy initiatives have shifted district central offices' mandates toward more active support roles for organizational learning, suggesting that school districts would be wise to foster professional networks among leaders in order to retain valuable knowledge (Honig 2006, 2008). However, there is a lack of both conceptual clarity and empirical analysis concerning how principals form advice-seeking networks and the potential complications to forming effective advice-seeking ties.

We draw upon organizational learning and social network research to outline some general barriers to forming effective advice-seeking ties and how this applies to the specific problems faced by school principals. We then use extensive survey and fine-grained administrative data to explore advice-seeking ties among all active principals in a large urban school district. We focus on the extent to which these realized relationships reflect what we term "effective linking" – social ties linking individuals who have clear potential for transferring important organizational knowledge. We ask: *do principals seek advice from others who are likely to offer important knowledge and skills for effective leadership within their specific schools?* In addition, because our setting epitomizes districts that have moved toward greater school choice and therefore have relatively high levels of competition over students and resources, we ask: *is perceived competition a barrier or a bridge for effective advice-seeking among principals?* Our approach offers answers to these questions through an exploratory account of a single district using fine-grained data on principal and school characteristics.

In what follows, we begin by outlining the individual and school-level factors most directly relevant for effective linking among principals within a school district. We then derive a conceptual model for why advice-seeking networks in general, and principal networks in particular, are unlikely to form strictly along these effective dimensions. We then present the data, analytical methods and results prior to offering a brief discussion of future research that could address some of the limitations of this study. Our findings suggest that in general principals in our setting do seek out advice in ways that are effective; however, there are significant gaps that may be signs of barriers. We discuss the implications of these findings for future research in our concluding section.

CONCEPTUAL FRAMEWORK

A growing literature exists on principal networks, which largely focuses on professional networks among various district leaders and between principals and the teachers in their schools. The structural features of these networks, especially their overall interconnectedness (i.e. “density”) and the position of leaders within a broader web of connections (i.e. “centrality” and “boundary-spanning”), have been shown to be important factors in understanding a number of processes, especially organizational change efforts (Daly & Finnigan 2010; Friedkin & Slater 1994; Hite, Williams & Baugh 2005; Honig & Hatch 2004; Bakkenes, De Brabander, & Imants 1999; Moolenaar, Daly & Slegers 2010).

This research represents an important use of network approaches to enduring questions of educational effectiveness. However, in addition to analyzing network structures and individuals’ positions within these structures, social network approaches have long been concerned with the factors influencing how individuals form relationships with one another – that is, the multilevel influences that shape interpersonal selection processes (Burt 1992; Friedkin 1998; Krackhardt 1992; Powell, Koput & Smith-Doerr 1996; Uzzi 1996). In this article we contribute to research on principal networks by exploring an observed advice-seeking network and the extent to which this reflects an effective set of social links within a district.²

The Dimensions of Effective Linking among Principals

Our definition of effective linking is intentionally rooted in a purely *knowledge-based* understanding of what constitutes an “effective” link. Although principals may seek advice from one another for a number of reasons related to social support, our approach is concerned with how to improve principals’ ability to find and absorb the best information and skills for learning how to become more effective leaders in their specific schools. From this standpoint, an ideal-typically effective advice-seeking network would link individuals based upon their capacity for improving one another’s work performance in general and within the context of a given school.

We see effective linking as having two dimensions, which we term “vertical” and “horizontal”. The vertical dimension concerns advice-seeking that is consistent with the hierarchical transfer of knowledge, and this could manifest in terms of both individual and school-level proficiencies. At the individual principal level, we draw upon an “integrated” view of desirable leadership qualities (Marks & Printy 2003) that suggests several factors – the overall experience as a principal in the district, a desirable leadership style, and effectiveness in specific job-related skills (Bass 1998; Grissom & Loeb 2009) – together form personal characteristics that could be transferred for improved school leadership.

Apart from these individual characteristics, principals may transfer *school-based* proficiencies in a vertical manner. These school-level vertical characteristics would include overall school performance in

² This is sometimes referred to as exploring the *etiology* of networks. We are also clearly interested in understanding the consequences of who one seeks advice from whom for a given principal’s subsequent leadership skills; although this is for practical reasons much more difficult to assess.

promoting learning outcomes, which are most commonly measured through standardized tests. In short, if principals seek advice from more experienced leaders with more desirable qualities and skills who are in schools that perform better in teaching kids, we would see this as vertically effective linking.

A more horizontal dimension would ideally join with this vertical dimension in shaping principal advice-seeking. We term this dimension horizontal because it is less concerned with overall leadership proficiency and more concerned with promoting knowledge sharing specific to a type of school. Clearly, much of the tacit knowledge involved in effective school leadership is specific to the students and communities being served. Factors such as school type (elementary, middle, or high) and the socio-demographic composition of the student body are especially likely to be important here. How to get professional development for teachers and how to address student needs will vary widely depending upon these factors. To the extent that principals seek advice from those principals who are in similar schools, we would see this horizontally effective linking.

The Barriers to Effective Linking

Various barriers to effective linking can be derived from an organizational learning perspective and studies of social networks in complex organizations (see Brass, Galaskiewicz, Greve & Tsai 2004; McGrath, Vance & Gray 2003). In this section we focus on three distinct but potentially cumulative barriers to finding and sharing useful knowledge: (1) barriers in the *search* for useful knowledge, (2) barriers in the *transfer* of useful knowledge, and (3) barriers to the *incentives* for searching and transferring useful knowledge. Each of these barriers is likely involved in shaping principal advice-seeking.

Barriers to Effective Searches. In seeking job-related resources in organizations, co-workers have relational understandings of one another's knowledge and skills – that is, they interpret others' capacities in relation to their own potential needs (Borgatti & Cross 2003). However, a tenant of organizational research holds that individuals operate under less than perfect information (see Simon 1991), and information gaps often create difficulties for *search* processes involved in identifying proper sources of useful knowledge – i.e. who to tap as the best source for information to improve a given task (Hansen 1999).

The difficulties involved in successful search processes are compounded by two factors: (1) increased organizational *complexity*, and (2) a lack of *clarity* in the knowledge needed for effective task performance. First, informational barriers to learning-based searches increase as organizations become more complex in terms of size and multi-divisional structure. Co-workers may have useful knowledge and skills to offer one another, but organizational complexity compounds the lack of awareness or social contact needed to convey this information (Tsai 2001). Second, in settings where organizational outcomes are more ambiguous – where it is less clear precisely what knowledge or skill is best for improving a task or product – individuals will also have added barriers in determining an optimal advice target.

These barriers to search processes are likely to be especially acute in the effective linking for principals. School districts are clearly complex organizations – they have a large number of employees with a complex division-of-labor, and are divided into multiple “loosely-coupled” and geographically dispersed units (Weick 1976). Having an awareness of all the possible sources of useful knowledge would demand an inefficient cognitive load in many settings, so principals are likely to “satisfice” by operating with only a partial sense of “who knows what” in the district. While some district offices may actively help with linking principals to others in seeking advice, this will not necessarily resolve the second main barrier arising from a lack of clarity concerning the problem or solution to be solved in education.

Education is often seen as exemplifying a highly institutionalized field where evaluating the quality of the “product” (educated students) is clearly difficult to ascertain and the criteria often contested (Meyer & Rowan 1977). While other professionals, such as engineers, can objectively evaluate products on quality dimensions and search for expertise in certain areas that fall short, educational systems are highly uncertain in this regard. This situation may be changing somewhat with a growing focus on skills-based testing and the use of value-added measures and other attempts to bring clarity to evaluating student gains – however, these are incomplete and presently controversial shifts in both academic circles and the public in general (Ladd 2002; see also Winerip 2011). Our point is, if researchers who have access to vast amounts of information grapple to understand the skills involved in being an effective principal, we cannot expect principals themselves to “objectively” know who the most effective leaders are in their school district. Some of the outcomes most indicative of effective leadership in schools – for example, those associated with value-added measures of student performance – may be the most difficult for principals to observe.

Barriers to Effective Transfers. Even if individuals within complex organizations can agree upon and identify the most useful knowledge, additional barriers arise in the knowledge transfer process. A common barrier to transfer arises because of the tacit nature of much useful knowledge – that is, many useful elements of knowledge don’t have documented solutions. While more explicit types of knowledge transfer easily, tacit knowledge has been described as “sticky knowledge” because it may require strong interpersonal relationships often outside the formal organizational flow chart of job titles to be successfully transferred (Hansen 1999; Krackhardt 1992; Szulanski 1996, 2000; von Hippel 1994). Someone may be able to identify a colleague who has the proper “know-how” for improving a given outcome; but may not be able to form a necessarily strong enough relationship with that person to actually transfer the knowledge.

Even members of professional communities with a strong ethos of knowledge-sharing may find it difficult to form relationships strong enough to transfer tacit knowledge. Strong ties come with costs of greater commitment and for various structural reasons generally are formed within cliques – i.e. individuals are more likely to form strong ties with others with whom they already have an “indirect” strong tie (Granovetter 1973). The time and commitment involved in establishing and maintaining strong ties may limit them to those who are already members of one’s clique – even though the most objectively novel or relevant solution to a problem may be unknown by members of one’s inner circle (Burt 1992). If a given leader is highly experienced, he or she may need to be selective with the number of less

experienced colleagues with whom they form a strong relationship. Having too few experienced leaders may lead to knowledge bottlenecks because of the demand for transfer.

Because a principal's job involves high levels of tacit knowledge – such as how to retain good teachers and counsel out problematic ones (Harris, Rutledge, Ingle, and Thompson 2006; Jacob and Lefgren 2005; Lortie 2009) – the nature of advice sought is likely to be a significant barrier in the transfer process. Many professional development programs employ direct coaching and mentoring experiences to address this knowledge complexity (Peterson 2002). However, informal networks among principals lack a centralized mechanism for linking advice-seekers to the most likely best advice-givers. Because principals may need stronger network ties to actually learn the tacit knowledge involved in effective leadership, principals may draw upon members within existing cliques – even though there is no guarantee they are objectively the best targets for knowledge transfer within a district. In addition, many school districts have relatively few experienced principals, and this may exacerbate the problem as more experienced principals will be unable to take on the number of strong ties necessary for successfully transferring tacit knowledge to the number of recipients.

Barriers to the Incentives for Effective Linking. Advice-seeking occurs within organizational and institutional contexts that effect how ties form among individuals (Brass, Galaskiewicz, Greve & Tsai 2004). We have already touched upon some of the organizational factors, such as organizational complexity, which can exacerbate the barriers to effective knowledge searches by adding more informational blind-spots within organizations. Here, we discuss how broader institutional environments (e.g. policies) can incentivize or dis-incentivize effective linking through the mechanism of trust.

All social ties require some level of trust before they can successfully act as conduits for important knowledge (Levin & Cross 2004; Von Hippel 1987). Those seeking useful professional knowledge must trust that the target for advice is truly competent and is someone who can keep confidences if necessary (Chua, Ingram & Morris 2008). The act of offering advice may also entail trust concerning future reciprocity – the understanding that one may eventually return the advice-seeking favor – as well as trust that proprietary or sensitive knowledge will not be used in a harmful way. Policy environments that erode trust will diminish professional networks in general, and be especially consequential for the strong ties needed to transfer tacit knowledge. It is not always clear *a priori* what the consequences are for certain policy shifts will be in terms of fostering or eroding trust. For example, policies increasing competition among leaders or threatening sanctions for poorer performances may in some contexts discourage knowledge transfer by narrowing networks to only focus on highly trusted others; while, in other contexts, competition further incentivize effective linking.

Recent shifts in education policy aimed at creating greater school accountability (No Child Left Behind [NCLB]) and school choice (charters, vouchers, etc.) have created more competition among principals for students and district resources. On one hand, seeking advice within this more competitive environment may involve greater levels of risk and therefore magnify the need for trust, and giving advice may have fewer benefits for those more experienced leaders to reveal the “tricks of the trade”. On the other hand, competition may give an added incentive for leaders to do a more comprehensive search for useful knowledge – to cut through some of the institutional ambiguity discussed above and to cultivate relationships with perceived direct competitors.

Barriers and Homophily. Both organizational and network approaches suggest that stronger barriers increase the likelihood that individuals will seek advice in less effective ways, because rather than successfully locating and learning from the most truly effective advisors, individuals will tend to link based upon “homophily”. The term homophily refers to a known social dynamic of individuals preferring to associate with those who are more similar to themselves, and in the process becoming even more similar because they reinforce one another’s beliefs, tastes and opinions (Lazarsfeld & Merton 1954; McPherson, Smith-Lovin & Cook 2001). In addition, homophily often concerns structural factors, such as the amount of population-level segregation, that increase the likelihood of encountering and establishing relationships with individuals who are similar along salient socio-demographic dimensions (Blau 1977; Moody 2001).

Network approaches have found that the “default” for establishing relationships is through the process of “triadic closure” – that is, individuals establishing new ties through the logic of “a friend of a friend is a friend” (Granovetter 1973). Without clear reasons for reaching outside such cliques, individuals will tend to expand and prune their ties based upon this logic of “social balance”. A similar proposition has been studied from the standpoint of decision-making in complex organizations. Truly “bureaucratic” decision-making is based upon universalistic criteria relevant for an organization – e.g. a person is hired because they have the best skills for the job regardless as to their race, class, or gender. However, where the criteria used to evaluate a decision are less certain, organizational research has found individuals make decision based upon more particularistic criteria such as social familiarity (March & Olsen 1976; Pfeffer, Salancik & Leblebici 1976).

There are several reasons to believe that principal advice networks may be particularly influenced by homophily. The need for trust and sometimes confidentiality in principal advice-seeking may make face-to-face interactions an important component for creating strong ties, and this would limit opportunities to develop ties to those individuals within a certain geographic area. The enduring importance of gender and ethnicity for structuring social interactions each has clear implications for principal advice-seeking. The ways principals are commonly brought into the profession may also encourage homophily as teachers are often “tapped” by principals in their school (Myung, Loeb, & Horng 2009) – and this initial tapping could be at the root of future advice-seeking ties. In short, principals have many reasons to draw upon homophilous ties in seeking advice – and these reasons may be further strengthened by the various organizational and institutional barriers discussed above.

Summary Model. Figure 1 summarizes our overall conceptual model of the factors shaping the likelihood that one principal (who we term “principal *i*”) will seek advice from another principal (who we term “principal *j*”). The probability of an *i* to *j* advice-seeking tie is shaped directly by (a) the likelihood that *i* will find useful knowledge from *j*, and (b) the degree of *ij* homophily that exists (i.e. shared sociodemographic characteristics). The strength of both effects (a) and (b) interact with various barriers to successful knowledge search and transfer processes outlined above. Greater barriers weaken the connection between useful knowledge and strengthen the connection between homophily and advice-seeking.

--Insert Figure 1 Here--

EMPIRICAL APPROACH

An Exploratory Analysis

Due to the intense data requirements required to test this model fully and causally, and because our analysis is to our knowledge a first assessment using in-depth data on a closed principal advice-seeking network in a large school district, we use an exploratory approach. We draw upon extensive survey and administrative data to explore the contours of this model in a given district. While the generalizability of findings is limited to our setting, this setting has implications for a number of similarly large, urban districts with high levels of school choice.³

Survey and Administrative Data Sources

Data come from two sources. The first is a 2010 survey conducted by the Center for Education Policy Analysis (CEPA) at Stanford University of all active principals and teachers in the Milwaukie Public Schools (MPS) – the 33rd largest school district in the U.S. – comprised of 133 school principals, and more than 6,000 teachers and 87,000 students. The survey had a very high response rate (100% for principals and >80% for teachers). This survey provides an in-depth view of the principal’s leadership capacities as assessed by the principals themselves, as well as more objective assessments by the teachers in their schools. The survey also provides the bases for our network measure of advice seeking.

These survey data were then merged with a second data source coming from extensive administrative records on principal background characteristics, school demographics, and student scores on standardized tests over time. Together, these provide a uniquely rich view of the factors associated with principals’ advice-seeking behavior in MPS and the extent to which it reflects effective linking.

Variables

Table 1 summarizes the variables used in our analyses. In this section we discuss these variables in more detail, while referring the reader to Appendix A where we provide additional tables and figures for some procedures.

Advice-Seeking Choice. Our main “outcome” variable concerns a principal’s primary target for professional advice among all other district principals. Each MPS principal was asked, “*If you could turn to one other principal in your district for advice or assistance in how to handle an on-the-job problem or challenge, who would that principal be?*” The “seekers” and “targets” of advice were linked to one

³ In the discussion section, we will touch upon future research strategies aimed at more thoroughly testing the model. In particular, we are missing variation in many of the barriers to effective linking because we examine a single district at a given point in time. However, our setting does allow us to analyze variation in perceived competition in order to better understand if this is a barrier or bridge for incentives behind effective linking in our context.

another in their responses to create an “adjacency matrix” of primary advice seeking where each principal is both a row and column in the dataset and a “1” indicates that the row principal *i* nominated the column principal *j* as the primary target for professional advice. The survey also asked principals to supply a reason for choosing a given principal. These qualitative responses were coded based upon an inductive schema in order to give a clearer sense of variation in the content of advice-seeking ties.

--Insert Table 1 Here--

Effective Linking. Our main concern is to explore the extent to which these choices of advice targets are associated with effective linking both vertically and horizontally. Consistent with our conceptual framework, we measure effective vertical linking at both the individual and school levels; while horizontal measures use shared school-level characteristics and are therefore inherently *relational* measures.

Vertically effective linking at the individual level is operationalized with the years of experience (*tenure*) as an MPS principal, as well as a number of variables concerning principal leadership characteristics and effectiveness at various job-related skills. To gauge leadership qualities, we use the battery of questions used in the Multifactor Leadership Questionnaire (MLQ), because by now a large body of work shows “Transformative” and “Transactional” leadership styles are associated with a number of positive organizational outcomes as compared to more “Passive” styles (e.g. Bass, Avolio, Jung & Berson 2003). We assess a principal’s overall leadership style along these three dimensions based upon both principal self-ratings as well as the average ratings from teachers in that principal’s current school using the same 36 MLQ questions.⁴ To measure a principal’s effectiveness at various job-related skills we use each principal’s responses to a set of questions on their ability to perform specific tasks. We performed factor analyses of these questions, using varimax rotation, which resulted in two factors based upon principals’ self-responses (see Appendix A for details).

We include several measures to operationalize *vertically* effective linking at the *school-level*. We measure the overall student performance on standardized tests (Math, Reading, and English/Language Arts [ELA]). From these average scores, we create a scale for *School Test Proficiency* based upon all three scores, which are understandably highly correlated ($\alpha = .9$). From this, we can see if principals turn for advice to leaders at schools with higher achieving students (or *relatively* higher achieving schools). Also using these test scores, we are also able to construct value-added measures at the school level. These measures gauge the overall school-level effect on improvements in the average student’s test performance, and thereby provide a general assessment of the school quality based upon demonstrated improvements in student learning on standardized tests (see equation 1A in Appendix A) (for similar approaches, see Hanushek & Taylor 1990; Ladd & Walsh 2002).

When operationalizing *horizontally* effective linking, we focus on shared characteristics at the school level. While much learning may be vertical in nature – transferring from more experienced and effective leaders in higher achieving schools to those lower on these dimensions – there is considerable learning to be gained by linking leaders in similar organizations and thereby facilitating the horizontal sharing of

⁴ In separate analyses we found little agreement between principal self-assessments and average teacher ratings along these dimensions. Apart from being analytically interesting, this allows us to include both measures in more predictive models. We consider teacher ratings to be more accurate indicators of leadership style.

know-how specific to a kind of school. For this reason, horizontal characteristics can only be measured as *dyadic characteristics* – that is, variables that are specific to an *ij* principal relationship. We include binary indicators for whether or not both principals in the *ij* dyad are leaders at the elementary, middle, or high school level. We also include absolute differences for various characteristics of school enrollments: student achievement of standardized tests, proportion free lunch, proportion minority, proportion English language learners (ELL).

School Competition. Principals were asked two questions concerning competition for students: (1) *To what extent does your school compete for students with other schools in the area?*, and (2) *Name which school does your school competes with most intensely for students?* The first question gauges the overall perception of competition within the principal’s environment, while the second affords a dyadic indication of the school most responsible for this competition. We use these as the basis for exploring whether or not competition increases or decreases the likelihood of effective advice-seeking behaviors – that is, if competition is a barrier or bridge in the process of seeking useful knowledge. We dichotomize the first variable into those who perceived “high levels” of competition and those who perceived lower levels; while the second variable is an indicator only in dyadic models that principal *i* perceived principal *j*’s school as a primary competitor.

Homophily. Survey data provided individual principal characteristics in terms of gender and ethnicity, which we use as the bases for gauging interpersonal homophily. Administrative data provided geographic locations for each school, which we used to create the dyadic distance between schools *i* and *j* in miles as the crow flies (which for Milwaukie is a fairly accurate indication of actual distance).

Models

We analyze these data both qualitatively and quantitatively. We begin by using a number of network analytic techniques to describe principal advice-seeking and its structural properties – including visually inspecting networks and the reasons given by principals for establishing these links. However, we are most interested in the factors associated with these links and how strongly effectiveness measures are associated with advice-seeking choices *net of other factors*. For this reason, we also employ a statistical framework that, although not causal in nature, gives a better sense of the strength of various factors involved in these observed professional networks.

We can think of a principal’s choice of a primary advice target as akin to the choice of a “best friend” network from a closed list (say, students at the same school). We can ask several types of questions of such data concerning general factors associated with overall popularity as well as the interpersonal factors associated *i* choosing *j*. We use two types of models to better understand the determinants and implications of such choices: (1) count models, and (2) conditional logit models.

First, we use count models to understand the overall “centrality” of individual principals in this network. We predict the number of times each principal was nominated as a primary target for advice-seeking by his or her colleagues. Because the dependent variable is the number of nominations, we use a Poisson model. These models have individual principals as the unit-of-observation and can be written:

$$\ln \lambda_i = \alpha + \chi_i \beta + \varepsilon , \quad (1)$$

where \ln denotes the natural log, λ_i is the Poisson mean rate for principal i (i.e. the expected number of times he or she is sought for advice by other district principals), χ_i is the i th row of the predictor matrix for variables in Table 1, β is a column vector of coefficients, and ε is an error term.

Second, we are particularly interested in better understanding the *relational* characteristics that lead a given principal i to pick a specific principal j for advice. In these dyadic models, we are able to test in detail the relative strength of effective learning, school competition and homophily in shaping the average principal’s choice of advice target. This framework is analogous to other discrete-choice models (see Maddala 1983) in which respondents are asked to choose a preference from a mutually exclusive list – also called a “choice-set”. For MPS principals the choice set is bounded in our question to the other principals in MPSD, and so each principal is faced with the same number of alters from which to choose.

Because our focal variables in these models are nearly all alternative-specific, meaning they vary for each ij principal dyad, the Conditional Logit model is used to estimate the factors associated with the average principal’s choice of advice target. The Conditional Logit model predicts a binary outcome (in this case, the choice made by principal i of principal j as the source of advice), and is a type of “fixed effect” model in that it controls for the nonindependence of including multiple observations for principal i (one for each principal j who could be selected as the advice target) (Long and Freese 2003). The model can be written as:

$$\ln \left(\frac{\Pr(y_{ij}=1)}{1-\Pr(y_{ij}=1)} \right) = \chi_{ij} \beta + \mu_i + \varepsilon_i , \quad (1)$$

where the log-odds of principal i choosing principal j as a primary source for advice is a function of relational ij characteristics in predictor matrix χ , a fixed-effect μ for each principal i , and an individual-specific error term.

RESULTS

Descriptive Results

The Principal Advice Network. We begin by exploring some basic properties in order to give a sense of the overall advice network structure. Figure 2 shows the principals as nodes (blue squares), arrayed in space using an algorithm that simply tries to make the best use given the number of nodes and ties. Nodes are larger according to their “in-degree” centrality – in this case, the number of j principals who seek advice from a focal principal i . Each of the ties connecting these nodes represents a primary advice-seeking relationship where the arrow points in the direction of the advice target.

This figure summarizes several interesting structural properties. The first concerns the relatively large number of “components” in the network – that is, the 23 distinct subgroups that are unconnected to one another through an advice-seeking tie. This fragmentation is sensible given that these relationships represent strong ties (a *primary* advice-seeking relationship), rather than a complete network of *all*

advice-seeking ties within a given time-frame (e.g. in the last month). It is almost certain that this strong network structure is held together as a single component through many weaker advice-seeking ties. Because of this overall network fragmentation, there is not much in the way of a general hierarchy to advice-seeking. Instead, we see smaller advice-seeking clusters anchored by one or two primary targets.

A second property to note is the few reciprocated advice-seeking relationships. These are indicated with double-headed arrows and thicker red lines connecting principals. Only six primary advice-seeking relationships were reciprocated – a finding that is encouraging from the standpoint of knowledge flows, because such strong and reciprocal ties are likely to lead to more insular thinking and knowledge “sinks” – areas with little out-flowing knowledge. As if to illustrate this point, half of these reciprocal ties are within isolated dyads in the overall network – that is, these two principals seek advice from one another and are not sought for advice by others. The other reciprocated ties are between individuals who are relatively equally central principals (same size nodes).

A final property that is noteworthy concerns the complete lack of “triadic closure” – i.e. there are no triangles in the network. In the case of primary advice-seeking this is logical, because a closed triad in this case would mean that a principal seeks advice from someone who goes for advice to someone who, in turn, seeks advice from that focal principal. In other words, advice-seeking would be “circular”. The absence of such circular advice flows is yet another encouraging property if the goal is to have effective flows of useful knowledge and reduce the likelihood of “groupthink”.

--Insert Figure 2 Here--

We can further explore this network by examining various characteristics of principals and schools, rather than structural characteristics alone. Figure 3 shows two network images for the MPS principal advice network. Each node’s position roughly corresponds to the geographic coding of a school’s latitude and longitude, and the node size again corresponds to principal centrality in the network.

In Figure 3a, the node’s shape reflects the principal’s gender (circle = male; square = female); colors indicate the principal’s ethnicity (red = African-American; blue = Caucasian; purple = Hispanic; green = Asian). The image suggests several properties of the network. First, principals clearly cluster geographically according to their ethnicity, and this clustering is consistent with known segregation patterns in Milwaukee. Second, principals appear to be more likely to seek advice from others who are geographically-proximate (and same ethnicity). Third, African-American women appear to be more sought for advice. Finally, advice “isolates” appear to be more geographically peripheral in the district (a finding that could result from seeking advice from principals in neighboring districts who are not included in our measure).

--Insert Figure 3 Here--

Figure 3b holds constant the positions of nodes and advice seeking ties as in Figure 3a, but alters their shape and size in order to reflect aspects of the *school* rather than the individual principal. Here, the shape reflects school type (squares are high schools and circles are elementary and/or middle schools). The node color now reflects the dominant ethnic group of the student body (red = African-American; blue = Caucasian; purple = Hispanic; green = Asian). This image suggests a preference for advice-seeking within broad school types. It also further supports the correlation between student enrollments and

principal ethnicity, and show that non-High School principals are most central (perhaps because of the relatively larger number of these schools). Finally, principals who are network isolates are more likely at elementary or middle schools.

Although many other informative images are possible, these figures provide a broad understanding of some key factors underpinning the formation of advice-seeking networks. However, these images alone do not provide a way to determine the relative strengths of different factors in shaping principals' choices of advice targets. Are intra-ethnic preferences solely a function of physical distance? How does experience affect choices net of other factors? Are non-High School principals more central net of other factors? We revisit such questions in the results for predictive models below.

Reasons for Advice-Seeking. Unlike many network studies, our data provide an assessment of the *perceived content* of the tie, not simply its presence or absence. Principals were asked *why* they sought out a specific individual for advice. These reasons were coded inductively based upon the presence of specific concepts, which were mainly indicated by exact word usages. Table 2 shows the proportion of principals mentioning each of the 8 reasons we coded (because these were not mutually exclusive, row proportions do not sum to 1). The most common reasons concern the perceived “knowledge” and “experience” or the advice target; however, there were a variety of other reasons provided within principals' accounts. The prevalence of knowledge-based reasons is encouraging from an organizational learning perspective, because principals are engaging in search processes based upon what they perceive as the most useful know-how for a job-related problem.

The raw proportion of times a reason was mentioned does not reveal much in terms of the ways various reasons may co-occur to create a broader reason for advice-seeking. To explore a bit more of the underlying ways that these 8 reasons tend to “go together” we employ a scaling procedure using Multi-Dimensional Scaling (MDS). This procedure arrays each of the 8 reasons in a 2-dimensional space based upon their tendency to co-occur. We employ a pair-wise Jaccard similarity measure of these 8 reasons so that pairs of reasons that tend to co-occur in principals' explanations are closer to one another, and those that do not tend to co-occur are more distant. The MDS procedure then attempts to array these pair-wise distances in a best-fitting set of 2-dimensional coordinates (higher dimensionality provides better fit, but more difficult visualization). Our image contains some error, but not an amount that is problematic for our descriptive purposes (badness-of-fit [sometimes called “stress”] = .2).

--Insert Figure 2 Here--

Figure 2 shows the results of the MDS procedure. The plot suggests a division between principals who explained their advice-seeking choice based upon a cluster of what we see as more effective reasons (knowledge, trust, same school type) and less clearly effective reasons (values, interesting ideas, emotions). Having stated an established relationship (a prior tie) and desirable leadership qualities are positioned in the middle of these two clusters of reasons, suggesting they are not particularly divisive in their usage. The broken diagonal line through the plot shows what we see as a general division between more and less effective reasons for advice seeking choices. Again, the majority of principals explained their choice using the elements of an effective-linking explanation, and the plot shows that these go together in a broader logic of effective linking that contrasts with a less effective set of reasons.

Predictive Models

Having explored some aspects of the structure and content of advice-seeking ties, we now turn to models that predict principals' advice-seeking choices at the group level (i.e. which principals are most sought for advice by others in the district), as well as at the dyad-level of one principal's selection of another (i.e. what *relational* characteristics matter in the average principal's advice-seeking choice). These multivariate models allow us to examine the directions and relative strengths of certain characteristics associated with collective and relational advice-seeking choices.

Predicting Group-level Principal "Popularity" (Centrality). We begin by examining what characteristics are associated with each principal's overall popularity in the network – also called his or her centrality within the network (i.e. "in-degree"). Because the principal survey gauges only primary advice targets, rather than a full list of all advisors, the network is relatively sparse and the most central actor was nominated 6 times as a primary source for advice. We use this count variable ranging 0-6 to examine the general pattern of which principals are most sought for advice. We pay particular attention to the vertical characteristics of individuals and schools that would promote organizational learning at the district level.

--Insert Table 3 Here--

Results from Poisson models predicting the number of advice-seeking nominations are shown in Table 3. Our "baseline" model here is based upon school-level characteristics. We then incorporate additional measures in subsequent models.

These models suggest that in general advice-targets are likely to have effective knowledge and skills. Popular advice targets tend to be more experienced in the district. More "transactional leaders" – especially based upon teacher ratings of principals – are *more* likely to be sought for advice; while principals who see themselves as having "transformational" qualities are in fact less popular. School-level effectiveness measures are significant in an effective direction, but these effects are weak after including individual-level factors. Principals at schools with higher overall test scores may be slightly more likely to be sought for advice. African-American women in schools with larger enrollments and higher proportions of African-American students are more likely to be sought for advice.

These results suggest that in general experience and other personal characteristics play the overall strongest role in determining the "popularity" of principals in the advice-seeking network. Principals who think of themselves as acting in "transformational" ways may in fact be poor mentors for other district principals, while those who are seen as "transactional" by their teachers have clearly more attractive qualities. Largely unobservable factors such as school-level value-added measures on standardized tests that could indicate important aspects of school performance are not central in which principal are most sought for advice.

Overall principal centrality is one way to approach effective linking at the level of the entire school district. However, it may be more accurate to think about effective linking as taking place at the dyad level – that is, in *relational* terms. Principals are likely to have an understanding of who is *relatively* more effective and who shares *similar* school conditions.

Predicting Relational (Dyadic) Advice-Seeking Choices. Our analysis culminates by examining the relational factors associated with the average principal’s choice of advice target. These models allow us to examine dyadic characteristics associated with principals’ advice-seeking, including share individual- and school-level characteristics. We also incorporate measures of competition in order to explore the extent to which perceiving competition is a barrier or bridge for more effective advice-seeking strategies.

We estimate conditional logit models examining the likelihood that each focal principal i will seek advice from a specific principal j from all possible advice targets in the district. Each principal in MPS therefore has a closed list (a “choice set”) comprised of all other active principals in the district and a “1” indicates their choice of advice target (principals cannot “self” select and are therefore not included in their own choice set). This specification necessarily omits from analysis any principal not reporting an advice-seeking tie.⁵ All predictors in these models are “alternate-specific” – that is, they vary with each possible choice of primary advice (principal j). For all vertical predictors of effectiveness, we subtract principal i ’s score from principal j ’s score, so that positive coefficients indicate that the average principal seeks advice from another who is relatively higher along these dimensions. For horizontal predictors of effectiveness, we create absolute differences for continuous variables and dummies for various ij characteristics that are “1” when there is a match on categorical variables.

--Insert Table 4 Here--

Tables 4-7 present results from conditional logit models. We begin with a baseline model of shared school-level characteristics. Subsequent models include this baseline model while incorporating other focal characteristics. Results are consistent with models predicting a principal’s overall network centrality, but offer a more in-depth view of the factors associated with principals’ choices.

Table 4 predicts selection of advice target based upon school-level characteristics. These models indicate a strong preference for seeking advice from principals at similar schools based upon shared school type (especially high school principals) and student socio-demographics. Vertical school characteristics are somewhat less predictive, but suggest that principals in general seek advice from others in relatively higher performing schools based upon value-added in ELA and overall test proficiency.

--Insert Table 5 Here--

Table 5 examines the significance of individual-level predictors, net of the baseline model, in predicting the average principal’s choice of advice target. These models are consistent with results in Table 3, suggesting that principals seek out relatively more experienced leaders in the district. In addition, relatively more transactional leaders (based upon teacher evaluations) are sought out for advice, as are relatively less transformative leaders (based upon self evaluations). The table also indicates that interpersonal homophily may be a factor in advice-seeking behaviors. The odds of a non-White principal seeking advice from another non-White principal are more than 5 times the odds of seeking advice from a White principal. Less pronounced homophily effects are found for White principals, as well as for women.

⁵ In separate models not reported here, we analyzed these non-responses and found very few differences, except perhaps geographic distance from the district center.

Table 6 shows the effects of physical proximity and direct competition measures. These models suggest that direct competition increases the likelihood of advice-seeking when both principal i and principal j nominated one another as their primary competitor for students. The actual observed direct transfer of students is not significant. Controlling for these factors and baseline shared school characteristics, physical distance impedes the likelihood of advice-seeking. This also suggests a type of homophily based upon “propinquity” in the forming of such ties.

--Insert Table 6 Here--

Our second approach to examining competition is based upon the extent to which perceiving “high levels” of competition in the environment alters who the average principal’s advice seeking choice. Because the variable for perceiving high competition does not vary within principals, it cannot be included directly in the conditional logit model (which implicitly controls for all stable characteristics of focal principals). However, it is possible to enter this into the model as a series of interaction effects with our focal variables. These interaction effects allow us to examine if perceiving competition alters these coefficients in the direction toward more or less effective-linking.

--Insert Table 7 Here--

Table 7 shows results from these interaction models. For brevity’s sake, we report only the interaction effects in this table (main effects are consistent with earlier models and are omitted to conserve space). Most interaction effects are not significant, indicating that principals perceiving high levels of competition are not significantly different in whom they seek advice from than principals perceiving lower competition levels. However, the few significant effects suggest that competition is associated with more effective-linking at the individual level. Elementary school principals perceiving high levels of competition are more likely to seek advice from non-elementary school principals (who are in general more experienced in confronting such complex issues). Perceived competition also increases the likelihood of seeking advice from principals at school with similar proportions of ELL students. Principals experiencing high levels of competition are also even more likely than those perceiving less competition to seek out relatively more experienced advice targets, relatively more transactional leaders, and (most likely) those who are relatively less passive in leadership style. Finally, a perceived high level of competition vastly increases the likelihood that a principal will seek advice from the principal at the primary competitor school.

DISCUSSION

This article has sought to contribute to a growing literature on school principals’ social networks. While the thrust of prior research in this area has looked at the *structure* of these networks, and especially the *position* of principals within these structures, we have pursued another important aspect of network approaches – namely, the factors that shape how principals select one another – through an analysis of observed social ties. This is particularly important for informal professional networks among principals because of the consequences that these ties have for organizational learning and potential student gains.

Principals have complex and multifaceted jobs that take years to master – so, any mechanism that can help capture and retain this knowledge within districts should be better understood.

We began by outlining the dimensions of effective-linking among principals, as well as a conceptual model for why principals may not find the most effective link in the complex organization that is a school district. Our findings suggest that despite the difficulties inherent in principals searching and transferring useful knowledge among one another, the average MPS principal does find a largely effective primary source for advice. Personal characteristics associated with effective schools – years of experience, a transactional leadership style – are the most consistent predictors. Some “horizontal” school-level factors – similar school type and student demographics – also tend to matter; however, many aspects of “vertical” dimensions of school-level proficiency that may be attributed in part to principal leadership are non-significant. The relative strength of social similarity and geographic proximity net of other factors also suggests that principals’ advice-seeking choices may emerge from within existing cliques.

These findings suggest that as part of their increasing role in facilitating learning (Honig 2008), district central offices may want to actively promote principal knowledge searches. One way to do so would be to make available information on school performance in order to strengthen this signal for district principals. Principals appear to weigh one another’s *personal* characteristics more strongly than their school performance criteria in how they seek advice. While such individual characteristics (years of experience, in particular) are one important and in our estimation *reliable* signal of principal effectiveness, there are school level factors (e.g. value-added measures) that may provide additional information to help principals understand who in their districts are promoting student achievement gains on standardized tests. Making such information available for principals could promote more objective searches for advice-seeking based upon performance.

Although bringing greater clarity to the search process would be one step toward fostering even more effective advice-seeking networks, there is no guarantee this would increase rates of knowledge *transfer*. In order for knowledge to actually flow among principals, advice-seeking must be accompanied by stronger and trusting ties. The kind of tacit knowledge being used to improve schools (e.g. counseling out poor performing teachers) may be difficult to transfer because of its tacit nature, and may in fact be sensitive to divulge. This required trust and tie strength may in part explain the significance of homophily in the observed principal network structure. Shared personal characteristics and geographic proximity may help in the transfer process because these afford more common understandings for framing issues and solutions. While central offices may be able to facilitate bringing greater clarity to knowledge searches, it is less obvious if this would translate into the creation of strong and trusting relationships needed to transfer useful knowledge.

There are limitations to how much we can conclude from our study, because of its exploratory nature. Lacking a longitudinal design or a quasi-experimental condition, it is impossible to say with any certainty whether our observed networks are the causes or consequences of model predictors. It is also impossible to know if useful knowledge is actually being transferred through these ties, or if advice-seeking produces tangible knowledge gains. Future research will incorporate more comparative and longitudinal approaches as we collect data on other districts and over time. These expanded data will allow for more comprehensive tests of our conceptual model. In addition, we hope to find ways to examine more

precisely what principals have learned through these social ties and the extent to which these are consistent with an emerging literature on what makes principals more effective leaders.

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TABLE 1
Concepts, Variables and Data Sources

Concept	Variable(s)	Data Source
Vertical Effective Linking		
Individual Level	Years Experience as Principal in District	MPSD
	MLQ Leadership Style (Self)	Principal Survey
	MLQ Leadership Style (Avg. Teacher)	Teacher Survey
	Skill Effectiveness (self factors)	Principal Survey
	Skill Effectiveness (Avg. Teacher factor)	Teacher Survey
School Level	School Test Proficiency	MPSD
	School Value Added	MPSD
Horizontal Effective Linking		
School Level	Same school Type (Elementary, Middle, High)	MPSD
	School Test Proficient (Absolute differences)	MPSD
	Student Enrollments & Demographics (Absolute differences)	MPSD
School Competition	Overall Perception of High Competition	Principal Survey
	Direct Competition	Principal Survey
Homophily	Shared Sociodemographic Characteristics	Principal Survey
	Physical Distance between Schools	MPSD

TABLE 2

Reasons Given for Picking Principal for Advice

Name	Proportion	Text Example(s)
knowledge/experience	0.43	"knowledgeable", "experienced"
trust	0.17	"trustworthy", "open", "honest"
prior tie	0.12	"have known", "worked with"
leadership	0.10	"leader", "leadership skills"
same school type	0.08	"similar school"
ideas	0.07	"creative thinker", "has interesting ideas"
same values	0.05	"same way of thinking", "same values"
cares	0.04	"cares about children"

TABLE 3
Incident Rate Ratios from Poisson Models Predicting Principal Centrality in Advice Network

Variable	(1)	(2)	(3)	(4)
<i>School Horizontal Characteristics</i>				
Sch. Prop. Black	2.401 (1.598)	11.556* (11.518)	25.845** (26.382)	29.026** (37.267)
Sch. Prop. ELL	3.664 (5.481)	7.745 (12.398)	28.730* (46.153)	41.688+ (81.221)
Sch. Prop. FRPL	0.194 (0.262)	0.233 (0.343)	0.138 (0.215)	0.141 (0.239)
Sch. Size	1.001* (0.000)	1.001* (0.001)	1.001* (0.001)	1.001* (0.001)
Middle School	1.171 (0.350)	1.373 (0.416)	1.314 (0.455)	0.99 (0.380)
High School	0.442 (0.280)	1.139 (0.799)	1.263 (0.881)	0.936 (0.695)
<i>School Vertical Characteristics</i>				
Sch. Test Proficiency		1.434 (0.336)	1.481 (0.371)	1.675+ (0.494)
Sch. VA Math		3.215* (1.732)	3.889* (2.282)	2.508 (1.978)
Sch. VA ELA		1.207+ (0.138)	1.129 (0.131)	1.06 (0.127)
<i>Individual Demographics</i>				
Female			2.542** (0.920)	2.779* (1.202)
Black			1.730+ (0.531)	2.392* (0.862)
<i>Individual Vertical Characteristics</i>				
Tenure				1.038** (0.015)
Effective Org.				1.032 (0.171)
Effective Personnel				1.091

				(0.233)
MLQ Transformative				0.274**
				(0.132)
MLQ Transactional				1.803+
				(0.575)
MLQ Passive				0.761
				(0.314)
MLQ Transformative (Teacher Rating)				0.807
				(0.566)
MLQ Transactional (Teacher Rating)				8.353*
				(8.019)
MLQ Passive (Teacher Rating)				4.216
				(4.832)
<hr/>				
Constant	0.751	0.201	0.062*	0.000+
	(0.679)	(0.214)	(0.083)	(0.000)
Log likelihood	-122.656	-116.904	-111.415	-97.801
Number of observations	100	100	100	100
Degrees of freedom	6	9	11	20
<hr/>				
+ p<0.10, * p<0.05, ** p<0.01				

TABLE 4
Odds-Ratios from Conditional Logit Models Showing the Likelihood of Principal *i* Seeking Advice from
Principal *j* Based Upon Relation *ij* Characteristics: School-level Models

Variable	(1)	(2)	(3)
<i>School Horizontal Characteristics</i>			
Both Elementary Sch.	0.93 (0.293)	0.889 (0.290)	0.895 (0.289)
Both Middle Sch.	2.782* (1.119)	2.641* (1.063)	2.654* (1.070)
Both High Sch.	8.542** (5.716)	15.901** (12.234)	18.834** (14.949)
ABS Sch. Prop. Black	0.209** (0.114)	0.246** (0.132)	0.245** (0.132)
ABS Sch. Prop. ELL	0.041* (0.066)	0.038* (0.062)	0.037* (0.060)
ABS Sch. Prop. FRPL	0.011** (0.012)	0.008** (0.010)	0.009** (0.010)
ABS Sch. Size	1 (0.000)	1 (0.000)	1 (0.000)
<i>School Vertical Characteristics</i>			
Sch. Test Proficiency Diff.		1.349* (0.184)	1.269+ (0.182)
Sch. VA Math Diff.			0.947 (0.261)
Sch. VA ELA Diff.			1.223* (0.098)
Log likelihood	-363.328	-346.223	-343.36
Number of observations	9662	9155	9155
Degrees of freedom	7	8	10
+ p<0.10, * p<0.05, ** p<0.01			

Note: Horizontal characteristics are measured with (1) dummy variables for shared categorical characteristics with the omitted category as a cross-category dyad, and (2) the absolute difference in continuous variables.

Vertical characteristics are measured as a directed difference (principal *j* score – principal *i* score), so that coefficients greater than 1 indicate the advice target is *relatively higher* on that dimension.

Table 5
Odds-Ratios from Conditional Logit Models Showing the Likelihood of Principal *i* Seeking Advice from
Principal *j* Based Upon Relation *ij* Characteristics: Individual Models

	(4)	(5)	(6)
<i>School Horizontal Characteristics</i>			
Both Elementary Sch.	0.778 (0.258)	0.987 (0.394)	1.043 (0.449)
Both Middle Sch.	2.492* (1.072)	1.243 (0.592)	1.268 (0.597)
Both High Sch.	8.068** (6.027)	18.301** (15.753)	18.672** (16.224)
ABS Sch. Prop. Black	0.395 (0.258)	0.458 (0.319)	0.472 (0.335)
ABS Sch. Prop. ELL	0.039+ (0.066)	0.177 (0.284)	0.188 (0.288)
ABS Sch. Prop. FRPL	0.010** (0.012)	0.005** (0.007)	0.005** (0.007)
ABS Sch. Size	1 (0.000)	1 (0.000)	1 (0.001)
<i>Individual Homophily</i>			
Both White	3.513** (1.547)	2.339+ (1.136)	2.353+ (1.148)
Both Non-White	2.806* (1.186)	5.090** (2.543)	5.152** (2.522)
Both Female	1.583 (0.500)	1.950+ (0.713)	2.063+ (0.825)
Both Male	1.635 (0.708)	0.524 (0.366)	0.467 (0.325)
<i>Individual Vertical Characteristics</i>			
Tenure Diff.		1.032* (0.014)	1.039** (0.015)
Effective Org. Diff.		1.1 (0.160)	1.081 (0.169)
Effective Personnel Diff.		0.826 (0.158)	0.837 (0.185)
MLQ Transformative Diff.		0.384* (0.152)	0.405* (0.179)

MLQ Transactional Diff.	1.169	1.23	
	(0.407)	(0.443)	
MLQ Passive Diff.	0.988	1.024	
	(0.350)	(0.365)	
MLQ Transformative (Teacher Rating) Diff.		0.771	
		(0.442)	
MLQ Transactional (Teacher Rating) Diff.		6.089*	
		(5.009)	
MLQ Passive (Teacher Rating) Diff.		1.828	
		(1.329)	
<hr/>			
Loglikelihood	-352.715	-254.58	-249.687
Number of observations	9662	6466	6466
Degrees of freedom	11	17	20
+ p<0.10, * p<0.05, ** p<0.01			
<hr/>			

Note: Horizontal characteristics are measured with (1) dummy variable(s) for shared categorical characteristics with the omitted category representing a cross-category dyad, and (2) the absolute difference in continuous variables.

Vertical characteristics are measured as a directed difference (principal *j* score – principal *i* score), so that coefficients greater than 1 indicate the advice target is *relatively higher* on that dimension.

TABLE 6
Odds-Ratios from Conditional Logit Models Showing the Likelihood of Principal *i* Seeking Advice from
Principal *j* Based Upon Relation *ij* Characteristics: Competition Models

Variable	(7)	(8)	(9)
<i>School Horizontal Characteristics</i>			
Both Elementary Sch.	1.033 (0.349)	1.018 (0.345)	1.02 (0.346)
Both Middle Sch.	2.649* (1.191)	2.563* (1.146)	2.526* (1.136)
Both High Sch.	9.785** (6.593)	9.680** (6.554)	8.710** (5.795)
ABS Sch. Prop. Black	0.653 (0.366)	0.647 (0.365)	0.655 (0.369)
ABS Sch. Prop. ELL	0.061+ (0.095)	0.059+ (0.093)	0.062+ (0.096)
ABS Sch. Prop. FRPL	0.015** (0.018)	0.015** (0.019)	0.017** (0.021)
ABS Sch. Size	1 (0.000)	1 (0.000)	1 (0.000)
<i>Competition & Proximity</i>			
Sch. Direct Distance (in Miles)	0.858** (0.047)	0.864** (0.047)	0.867** (0.047)
Sch. <i>j</i> Direct Competitor		1.218 (1.322)	1.102 (1.238)
Sch. <i>i and j</i> Direct Competitors (Both Principals)		13.348* (15.775)	12.768* (15.022)
Sch. <i>ij</i> Direct Transfers			1.046 (0.040)
Loglikelihood	-301.674	-300.136	-299.853
Number of observations	7740	7740	7740
Degrees of freedom	8	10	11
+ p<0.10, * p<0.05, ** p<0.01			

Note: Horizontal characteristics are determined as (1) dummy variable(s) for shared categorical characteristics with the omitted category representing a cross-category dyad, and (2) the absolute difference in continuous variables.

TABLE 7
Conditional Logit Models Showing Interaction Effects for Perceived High Competition and Focal Predictors of Advice-Seeking Ties

Variable	(10) Table 4 Model 3 variables + interactions	(11) Table 5 Model 6 variables + interactions	(12) Table 6 Model 9 variables + interactions
Both Elementary Sch. X Comp. High	-1.729* (0.822)		
Both Middle Sch. X Comp. High	-1.151 (0.887)		
Both Sch. X Comp. High	0.104 (1.436)		
ABS Sch. Prop. Black X Comp. High	0.842 (1.136)		
ABS Sch. Prop. ELL X Comp. High	-9.019* (4.429)		
ABS Sch. FRPL X Comp. High	0.14 (2.667)		
ABS Sch. Enrollment X Comp. High	0 (0.001)		
Sch. Test Proficiency Diff. X Comp. High	-0.042 (0.301)		
Sch. VA Math Diff. X Comp. High	0.341 (0.554)		
Sch. VA ELA Diff. X Comp. High	0.022 (0.183)		
Both White X Comp. High		-0.008 (0.947)	
Both Non-White X Comp. High		-0.319 (1.006)	
Both Female X Comp. High		-0.375 (0.805)	
Both Male X Comp. High		0.109 (1.444)	
Tenure Diff. X Comp. High		0.061*	

		(0.029)	
Effectiveness Org. Diff. X Comp. High		-0.243	
		(0.333)	
Effectiveness Personnel Diff. X Comp. High		-0.548	
		(0.482)	
MLQ Transformative Diff. X Comp. High		-0.995	
		(1.004)	
MLQ Transactional Diff. X Comp. High		1.174	
		(0.880)	
MLQ Passive Diff. X Comp. High		-1.206+	
		(0.625)	
MLQ Transformative (Teacher) Diff. X Comp. High		2.233*	
		(1.090)	
MLQ Transactional (Teacher) Diff. X Comp. High		-2.914	
		(1.670)	
MLQ Passive (Teacher) Diff. X Comp. High		-0.9	
		(1.480)	
Direct Distance X Comp. High			0.035
			(0.107)
Direct Competitor X Comp. High			19.748**
			(1.428)
Both Direct Competitors X Comp. High			0
			(.)
Direct Transfers X Comp. High			0.03
			(0.088)
<hr/>			
Loglikelihood	-326.578	-237.463	-289.54
Number of observations	8929	6365	7522
Degrees of freedom	20	33	12
+ p<0.10, * p<0.05, ** p<0.01			
<hr/>			

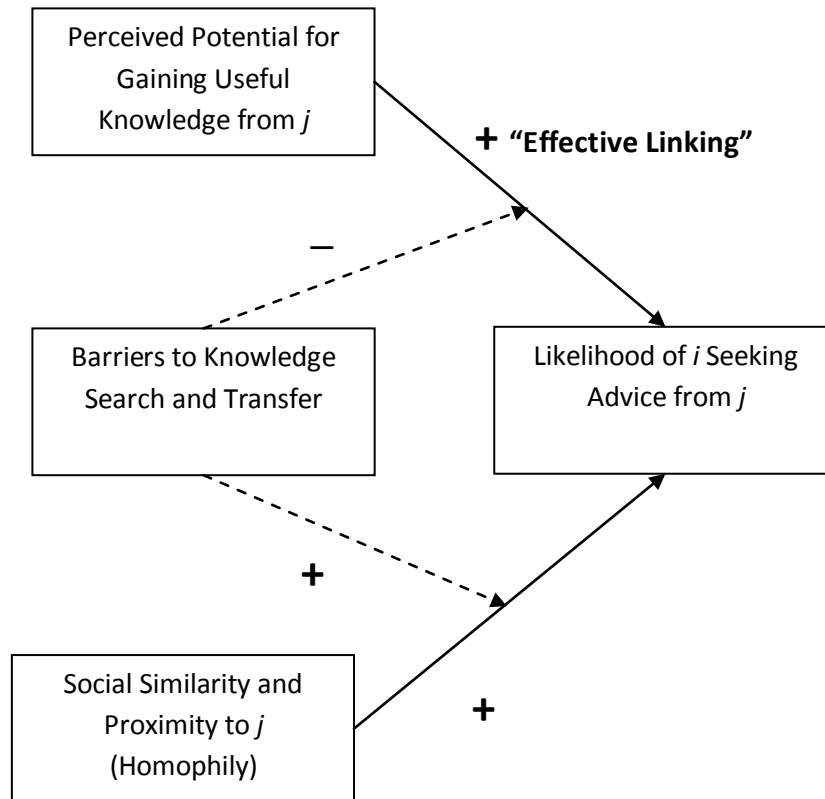


Figure 1

Conceptual Model of the Likelihood that Principal *i* Will Seek Advice from Principal *j*

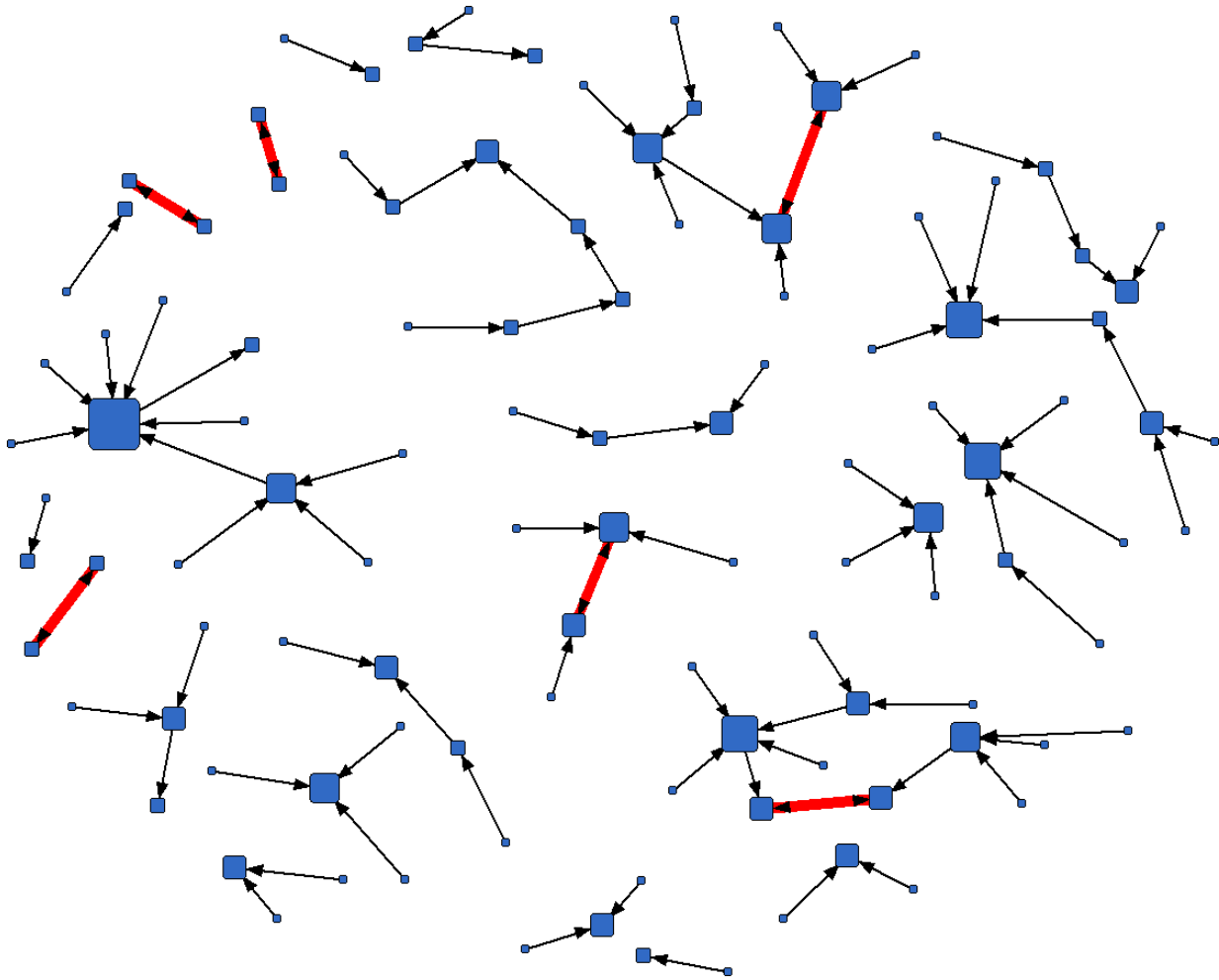


Figure 2

Structural Properties of a Principal Advice Network

FIGURE 3

MPS Principal Advice Network, 2010.

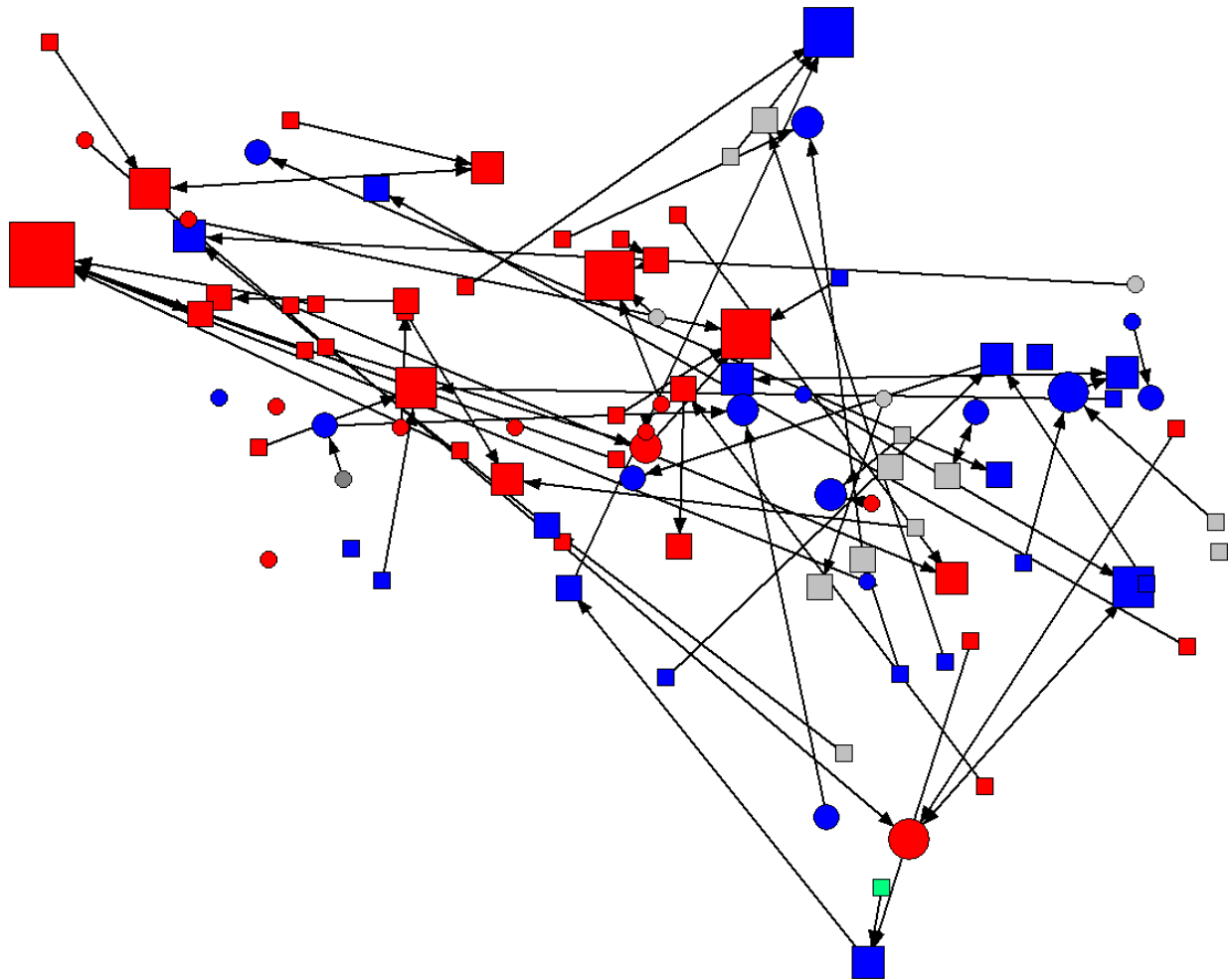


Figure 3a. Principal Gender, Ethnicity and Experience

Note: Each node is a school principal. Nodes show gender (square=female; circle = male) as well as ethnicity (red = African-American; blue = Caucasian; gray = Hispanic; green=Asian). Size corresponds to the in-degree centrality. The direction of the lines indicates the direction of advice-seeking. Principals are positioned in geographic space based upon latitude and longitude coordinates.

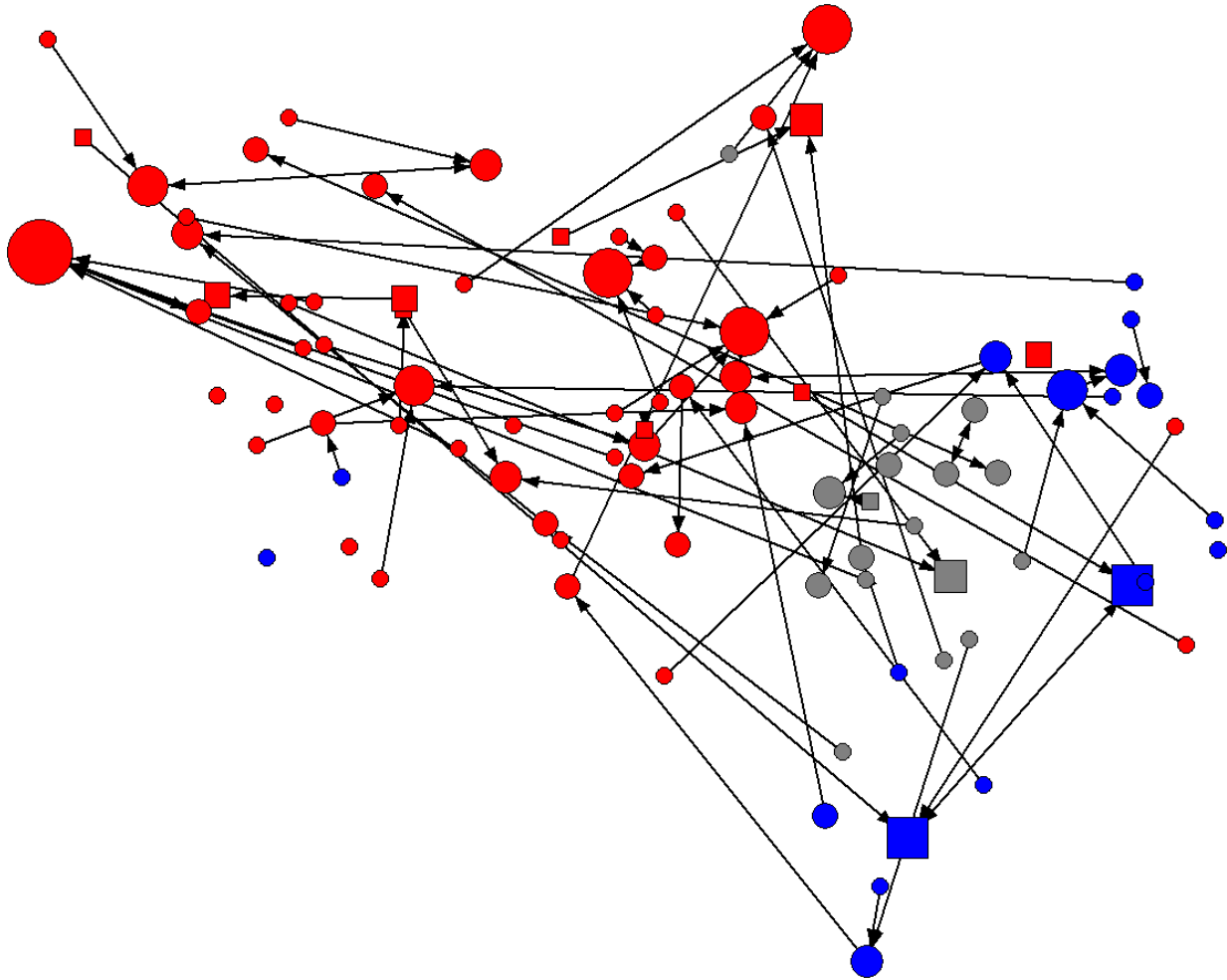
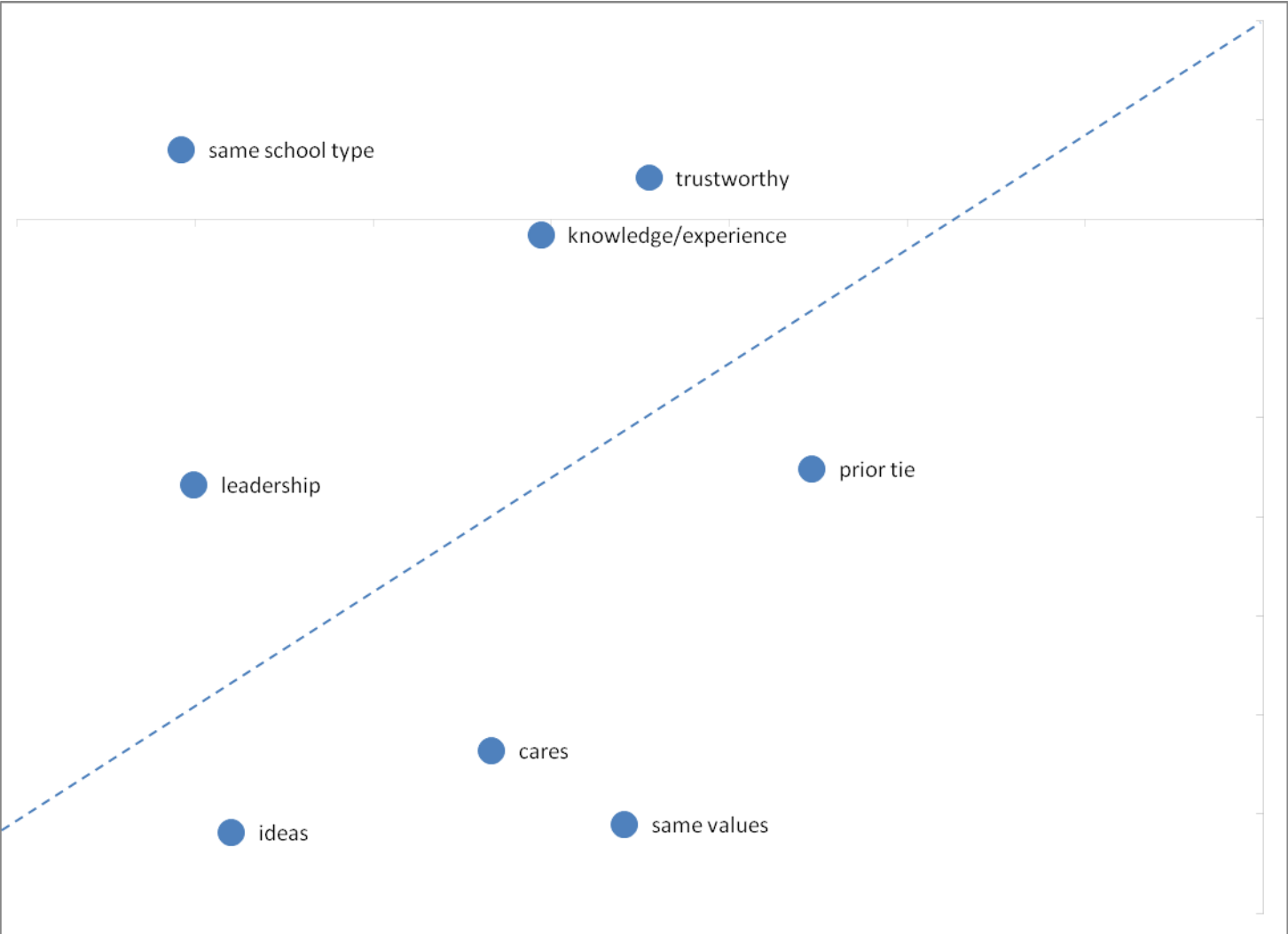


Figure 3b. School Characteristics

Note: The image is the same as Figure 3a, except nodes reflect school-level characteristics (square = high school; circle= elementary and/or middle). The majority ethnicity of the student body is reflected in the node color (red=African-American; blue=Caucasian; gray=Hispanic).

FIGURE 2

MDS Plot Showing the Co-occurrence Patterns for Explanations for Advice Seeking



APPENDIX A: SUPPLEMENTAL MATERIALS

Factor Analysis of Principals' Self-Reported Skill Effectiveness

Figure 1A

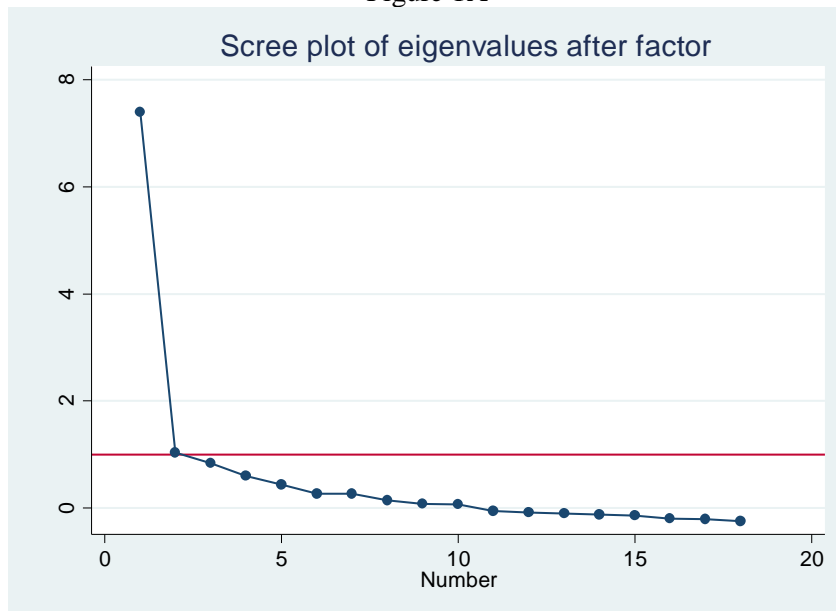


Table 1A: Derived Factors of Self-Rated Principal Effectiveness

	(Factor 1) Effectiveness w/Organization	(Factor 2) Effectiveness w/ Personnel
Filling Teaching Slots		0.7558
Finding Best Teachers		0.7826
Retaining Teachers		0.4603
Comm. w/District Admin.		
Getting Parents		
Maintaining Fac.		
Maint. Safe		
Offer High Qual. Instruction	0.5159	0.3525
Offer Student supplemental Services	0.4931	
Control over Instructional Programs	0.5967	
Control over Budget		
Getting Community		
Student Discipline		
Using data for Sch. Improvement	0.435	
Dismissing Low Perf. Teachers		0.3394
Getting Staff to Work Together	0.611	
Experiment New Instruction	0.7263	

Constructing School Value-added Scores