

Broken bridges: a social network perspective on urban high school leadership

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Abstract

Purpose – Secondary school leadership provides multiple challenges in terms of the diversity of tasks, multiple demands on time, balancing communities and attending to instructional programming. An emerging scholarship suggests the importance of a distributed instructional leadership approach to high school leadership. However, what has been less thoroughly explored is how secondary school leadership is distributed leaders across a school district. The purpose of this paper is to investigate the social structure and positions urban high school principals occupy in the district system.

Design/methodology/approach – This study was conducted in one urban fringe public school district in southern California serving diverse students populations. The data were collected at three time points starting in Fall 2012 and ending in Fall 2014 from a district-wide leadership team including all central office and site leaders. All leaders were asked to assess their social relations and perception of innovative climate. The data were analyzed through a series of social network indices to examine the structure and positions of high school principals.

Findings – Results indicate that over time high school principals have decreasing access to social capital and are typically occupying peripheral positions in the social network. The high school principals' perception of innovative climate across the district decreases over time.

Originality/value – This longitudinal study, one of the first to examine high school principals from a network perspective, sheds new light on the social infrastructure of urban high school principals and what this might mean for efforts at improvement.

Keywords Innovation, Networks, Leadership, Involvement, Educational policy, Secondary schools

Paper type Research paper

Introduction

A growing body of research from across the globe indicates that school leadership is a key contributor that is only second to classroom instructional practices for positively influencing student learning and successful school reform efforts (Hallinger and Murphy, 1987; Leithwood *et al.*, 2004, 2008; Spillane and Louis, 2002). School leadership is of particular importance in urban secondary school settings as these principals balance a host of instructional, organizational and community demands in supporting equitable and accessible educational experiences for all students and often lack an in depth research base upon which to draw. Given the pressing accountability demands for student learning, secondary school leaders are expected to possess the capacity for leading reforms around the “technical core” of schooling, namely, improving and sustaining the quality of teaching and learning (Leithwood *et al.*, 2004).

Instructional leadership poses additional challenges for urban high school principals because unlike their elementary school counterparts, high school principals are often expected to have expertise in multiple subject areas as well as manage complex organizations that are serving large numbers of students. A growing body of work suggests that distributed instructional leadership approaches to high school leadership in



which principals support the conditions and allocate the resources necessary for improving instructional practices may ultimately impact student learning (Bredeson, 2013; Spillane *et al.*, 2004). A distributed approach emphasizes the work of formal and informal leaders within schools. However, there is a dearth of work in regard to the distribution of leadership, particularly secondary school principals within a district as a way to generate social and intellectual capital, which may be unlocked through collaboration (Nahapiet and Ghoshal, 1998).

Previous research suggests that organizational improvement is closely linked to the ties within and across units (Tenkasi and Chesmore, 2003). In the field of education, this has led to the development of professional learning communities and emphasis on collaborative structures (McLaughlin and Talbert, 1993). Most often, these types of communities are developed to increase communication and collaboration between teachers within schools; however, educational literature suggests that these communities, whether formal or informal, may be necessary throughout an entire district rather than isolated within schools to generate district-wide improvement (Spillane and Kim, 2012). Recent research has found that informal social networks (e.g. social gathering, breakfast club, as opposed to formal, structured meetings) facilitate the development of more enduring interpersonal relationships that allow for transfer and exchange of tacit knowledge and complex information necessary for organizational learning and innovation (Finnigan and Daly, 2012; Tsai and Ghoshal, 1998). In addition, educational leaders' relational ties with administrative colleagues and teachers are related to school learning climate and student outcomes (Price and Moolenaar, 2015).

While there is great value in individuals' social ties for the work of educators, we still know little about the social connectivity of high school principals in their district's larger networks. A growing number of studies explore the underlying pattern of networks within districts or between district and school leaders (see Daly and Finnigan, 2010; Spillane and Kim, 2012). However, these studies typically examine leaders' network either at the elementary school level or across a district system of K-12 schools. Findings from these studies although useful for understanding the distribution of leadership, do not highlight the relationships between and among high school principals. In this study, we respond to the gap in the literature around the relational aspect of educational leadership as a lever for change by focusing on the eco-system of relationships in which urban high school principals are situated. We aim to understand the social structure and the positions high school principals occupy in this larger system and what this might mean for efforts at improvement. In understanding these relationships, we draw on concept of social capital and social network theory and analysis as a way to both assesses the high school principals' capacity for accessing relational resources as well as visualize and analyze the set of leadership ties.

Framework

Social capital as network of relations

A number of theorists have written on social capital from different perspectives in a wide range of disciplines (e.g. sociology, economics and education, etc.). Authors such as Coleman (1988), Portes (1998), and Bourdieu (1986) took a micro-level viewpoint considering social capital as an individual asset (i.e. level of trust), while this paper proposes a meso-level perspective viewing social capital as network of relations individual actor has with others (i.e. pattern of connectivity) and such individual networks are embedded within a larger macro system (e.g. school district). This view of social capital emphasizes the notion that resources that are shared, exchanged or developed between sets of actors are embedded in larger social networks from which one can draw and accumulate his/her social capital. In other words, individual actors' volume of social capital can be determined by the extent to

which he/she is able to access, mobilize and utilize the resources embedded in his/her network of relations (Burt, 1992; Lin, 1999).

In addition to the concept of social capital, equally important is its functionality. The functionality of social capital addresses the question why relational ties are decisive of one's capital capacity. Relational ties, also defined as resources, provide opportunity for individuals to access information, knowledge, materials and even beliefs and attitudes as he/she "wishes to increase the likelihood of success in purposive action" (Lin, 2001, p. 24). This functionality view, from an economic standpoint, considers social capital as an asset of the individual in which she/he can invest in the development and formality of social networks one uses to extract resources to form personal capital (Portes, 1998). Therefore, the individuals' social capital is related to the amount of ties and resulting networks one has through their existing relationships granting he/she access to a pool of relational resources. As such, relational ties can be a product of personal investment or social status and may be useful for the individual to achieve purposive goals, be it instrumental (work-related ties) or expressive (social and emotional support). Social capital is therefore an investment in the social relations in a system through which the resources of other individuals can be accessed, borrowed or leveraged. This characteristic differentiates social capital from human capital, which refers to investments in training, development or certifications of individuals (Bourdieu, 1986; Coleman, 1988; Lin, 2001). In this work we draw on network theorists who argue that much of social capital research must be strongly rooted in individual interactions and networks (Lin, 2001). Therefore, an understanding of the ties between individuals is foundational for our work.

Personal ties can be accessed and mobilized (Lin, 2001) and can result in various degrees of tie strength and different structures of a given network in which ties are embedded (e.g. dense or sparse network structure). It is the processes of accessibility and mobilization that define the structure of individual networks of relations (Lin, 2001). Accessibility refers to the number of actors one is connected with and can access to for purposive action (Lin, 2001). Mobilizations is concerned with the relational resources, also referred to as ties, that an individual actor can extract from the network of relations that he/she has access to for purposive action, such as for accessing useful information (Lin, 2001). Individuals that have greater and advantageous accessibility (i.e. more ties, greater amount of network) can better mobilize resources for the achievement of goals/purposes (Lin, 2001). As such, relational ties (both strong and weak) between individuals in a social system facilitates the creation of a network structure that ultimately determines opportunities for exchanges and creation of social capital (Burt, 1992; Lin, 2001).

Strong ties support the transfer of tacit, non-routine, or complex knowledge (Hansen, 1999), joint problem solving (Uzzi, 1997), and the development of coordinated solutions (Uzzi, 1997). Strong ties within and across units are also related with low-conflict organizations (Nelson, 1989) and initiating and sustaining successful large-scale change efforts (Tenkasi and Chesmore, 2003). Inattention to the strength of ties during a significant organizational change initiative of a large organization may result in a failed strategy (Tenkasi and Chesmore, 2003). Conversely, weak ties may result in less dense network structure that tend to be better suited for the transfer of simple, routine information (Hansen, 1999) and allow for brokering opportunities between actors that are otherwise disconnected (Burt, 1992; Granovetter, 1973). Interestingly, both strong and weak ties are necessary within a social structure as they facilitate access to different kinds of relational resources (Tenkasi and Chesmore, 2003). This implies that individual actors must be aware of the capital assets in their network and take action through establishing social ties to access and mobilize resources for goal attainment (Portes and Sensenbrenner, 1993). As there is a focus on the role of relational ties in the development, accumulation, and shaping of social capital as a result of network relations we will draw on social network theory and analysis as a way to focus our work.

Social network theory and network relationship

Social network theory may provide insight into how the social processes and social capital stretch across individuals and levels of the educational system. The concept of social network is concerned with the pattern of social ties that exists between actors in a social network (Scott, 2000). Central to the concept is the structure and quality of relational ties and its affordances and constraints of the larger social infrastructure (Borgatti and Foster, 2003; Cross *et al.*, 2002), meaning how individuals gain access to, are influenced by, and leverage these relational resources (Degenne and Forsé, 1999). Dense network structure (i.e. more ties between actors in a network) allows better flow of information and resources (Burt, 1992) whereas less dense network (i.e. relatively fewer ties) may yield a time lag in the transfer of resources between actors as it is likely to take more time for resources to travel from one actor to another (Burt, 1992). Individual actors occupying central positions of a network (i.e. having more incoming or outgoing ties) tend to have more connections and thus have greater access to resources that one can mobilized with (Burt, 1992) but actors are more likely to be constrained by the norms and expectations from closely connected social groups. On the contrary, actors situating at the periphery or isolated position of a network (i.e. having fewer or no ties) possess fewer or no ties with others (also less social constraints) and may have limited opportunity to access mainstream information. The network perspective does not supplant the importance of individual attributes in understanding change and improvement, but rather offers a complimentary view and set of methods for better understanding the dynamic influence of social processes.

In educational leadership, a growing number of studies have begun to apply social network concept and analysis to the work of leadership and school or district-level reform (Daly and Finnigan, 2010, 2016; Liou, 2016; Spillane and Kim, 2012). For instance, research suggests that leaders who are mostly sought for advice by their administrative colleagues tend to be inclined toward innovation and efficacious about leading educational reform (Daly *et al.*, 2015). Other scholars suggest that principals with advice ties with their teachers are more likely to influence the climate of schools (Price and Moolenaar, 2015). Advice seeking or exchange through social connections enables individuals to access and be exposed to new ideas and perspectives related to their work (Alexiev *et al.*, 2010), and thus it may be associated with better outcomes for students and school climates (Daly *et al.*, 2014). Although these studies provide a solid research foundation around educational leadership from a social network approach, they primarily privilege K-12 schools in general or focus on elementary-level schools. Our search of the literature found very little work that specifically concentrated on high school principals and their social connectivity within a district-wide leadership network. This represents a major gap in the literature given the importance and role of high schools in the developmental lives of youth.

As a large body of evidence across educational settings suggests the important role of collaboration, interpersonal relationships and networked communities of practice (Stoll and Louis, 2007), it is reasonable to suggest that these elements would be relevant to high school principals even though the structure and form of high schools may differ. We argue that accessibility to relational resources outside their immediate school may be important for high school principals to obtain, develop and maintain social capital. Absence the ability to access these resources may result in organizational isolation, a lack of innovation, and the recycling of ideas and knowledge (Fleming *et al.*, 2007).

In sum, social network theory and analysis provides a useful perspective and set of robust methods that can provide insights into improvement efforts. Networks are being more often referred to as a key feature to the urban educational reform landscape particularly at the leadership level and yet we know little about where urban high school

principals are situated in these networks and how their structural position may support or constrain access to social capital resources related to change. This study builds on earlier work on educational leadership at large-scale reform such as Common Core State Standards (CCSS) and further explores leaders' advice seeking ties with a specific focus on high school principals. Further, as this school district is in the midst of implementing CCSS, which is requiring new approaches and as such the degree to which leaders perceive a climate open to new perspectives and approaches that may come from social ties may be critical (Schwarz and Shulman, 2007). Given the role of perception and its connection to behavior we are examining the leaders' perception of innovative climate over time.

Innovative climate

The concept of innovative climate is context specific as one place's innovation may be another place's daily routine. In education settings, innovative climate of schools involves the shared perceptions of educators regarding the practices, beliefs and behaviors that facilitate risk taking and the creation of new organizational routines (Moolenaar *et al.*, 2014; Daly *et al.*, 2016). As innovative climate is key to the success of organizational change, it may be also crucial for educational leaders to perceive their workplace as a risk free, safe environment in which new ideas and trial and error are encouraged, particularly in the midst of implementing CCSS. Studies in education that examine innovative climate during reform are still limited (Daly *et al.*, 2016; Liou, 2016; Moolenaar *et al.*, 2014) and even more limited as related to high school principals.

Organizations with positive innovative climate, as perceived by organizational members, are characterized by proactivity, creativity and openness to change (Anderson *et al.*, 2014). Such organizations are more likely to outperform those with lower propensity toward innovation (Damanpour and Evan, 1984), as organizational members are more likely to perceive a sense of belonging and work commitment (Anderson *et al.*, 2014), social support and emotional arousal (Daly *et al.*, 2016), and create knowledge through accessing diverse resources (Heaphy and Dutton, 2008). Individuals open to new ideas may be more motivated and willing to explore various diverse relational ties for positive exchanges (Fredrickson, 2003), and thus are likely to be well-connected (Heaphy and Dutton, 2008) and display engaged at work (Spreitzer *et al.*, 2005). On the contrary, organizations with individuals that are less risk-tolerant may inhibit the development and breakage of new relations from which one can benefit novel experiences (Spreitzer *et al.*, 2005).

Reform efforts, such as outlined in the CCSS, expect educational leaders to work collaboratively with colleagues with differing expertise in exchanging new ideas and approaches to instructional improvement (Gwynne and Cowhy, 2017). A climate of innovation may be important in terms of leader's willingness to reach out to others for new and different strategies and improvement for leadership practice. However, work in this space in terms of the role of innovative climate in a school district leadership team over time is scarce particularly as related to the specific perceptions of high school principals. This study will address the gap in examining the perceptions of innovative climate among educational leaders over time as they go about implementing the CCSS.

Taken together, this study aims to address the gap in current literature on the role of high school principals' social connectivity in their district's network of reform-related relationship as well as their perception of district's innovative climate. In addressing the gap, we explore the following research questions:

- RQ1. What is the pattern of interpersonal connectivity of high school principals within a district-wide leadership team over time?
- RQ2. What is the level of perception of high school principals regarding innovative climate across the district and how does it change over time?

Methods

The more opportunities we have to collaborate the better. There is a wealth of knowledge within our leadership team and we don't have a way to regularly access and share with one another. I think this will be the key to ensuring the common core is implemented with fidelity. As the plan has already been developed, I think we should work on the implementation as an entire leadership team- to ensure everyone knows how they fit in AND that we should meet to collectively review and discuss this implementation as an entire management team (classified and certificated, department and site). From the Purchasing Director to the Superintendent, each one of us should know in our heads what role we play in ensuring student achievement (Principal – Fall of 2012).

The above quote was reported to us at the start of the Fall of 2012, when we began this study. It reflects the outlook and potential that was repeated to us as prepared for our three-year examination of a district that was just undertaking the implementation of the CCSS. It was this quote and others that echoed the same sentiment that drove us to take more social capital perspective on the idea of change and reform within a leadership team.

Sample and context

This study uses a case study design (Yin, 2013) that focuses on one urban fringe public school district that serves approximately 30,000 K-12 students with diverse demographic backgrounds in terms of socioeconomic status, race and ethnicity, and English language learner status. We selected the study district partly because the district represents the demographic composition of general public school districts in California and largely because over the last four years the district has been increasingly focused on implementing the CCSS through a focus on collaboration. The study sample includes the leadership team of the district, which comprises all central office administrators (i.e. superintendent, director, supervisor, and coordinator, etc.) and school site principals (6 high school principals (including 3 comprehensive high schools), and 3 middle and 15 elementary school principals).

The inclusion of both district and site leaders helps this study draw a more complete picture of district-wide reform collaboration in an era of CCSS. In 2012, the district started introducing the CCSS to all schools with an aim to implement more fully in Fall 2013 and beyond. Since the instruction phase the district has undertaken a series of reform efforts to prepare themselves for CCSS implementation. Major efforts anchor around fostering a climate of trust and respect, encouraging district-wide collaboration for leadership and innovation for instructional practice, as well as establishing more regular meetings (twice a month) with all school leaders. In this work we take a systemic perspective in district-wide reform with a particular focus on high school principals as we think it is important to investigate the pattern of larger district social system in which the high school leaders are embedded.

Although the total sample of district and site leaders is 51, in this study we report on data from a sample of 44 educational administrators across the district who participated in the study for each of the three years and reflect a 93 percent response rate over time. We created a longitudinal data set to ensure we are comparing the same groups of individuals over time in an effort to see what is happening between and among a consistent group of leaders. We acknowledge there is a small number of churn among these leadership positions during the study period. However, the churn rate of approximately 10 percent does not significantly affect the pattern of overall structure for these network relations, which allows us to explore the ebb and flow of network connectivity among the study leaders over the three time periods. Of the sample, 45.5 percent worked at the district office, 13.6 percent worked as a high school principal, and 61.4 percent were female. On average, these administrators have been in education for about 22 years ($SD \approx 7.33$), worked in administration for approximate

8–9 years ($SD \approx 5.98$), and worked in their current position for approximately 12 years ($SD \approx 10.11$). What becomes clear from the sample is that the high school principals have been in their positions and in education for longer than other comparison groups, suggesting this is an experienced group of leaders (see Table I for sample demographic).

Data collection and instrumentation

We invited the district’s leadership team to participate in this longitudinal network-wide innovative climate study over three time points covering each academic year. The data were collected each Fall starting in 2012 and ending in the Fall of 2014 providing three data points. The data include social network relations and survey perceptions.

Social networks: CCSS advice (CCA). Based on earlier work (Daly *et al.*, 2014; Spillane and Kim, 2012), our research team developed a series of network questions that captured the social relationships of leaders. For CCSS advice network relation, we asked the leaders to assess the frequency of interaction of other leaders “Who do you turn to for advice about implementing the Common Core State Standards” on a four-point frequency scale with one indicating “few times a year” and four indicating “daily” interaction. We extracted ties that are of the more frequent interaction scales (i.e. a few times per month to daily) at each of the three time points as a way to reflect the durable nature of such ties. We administered a bounded approach to network data (Scott, 2000) because this study focuses on a group of leadership team members within a finite district network. This approach, coupled with high response rate, provides a more complete picture of the leader networks and yields more valid outcomes (Scott, 2000).

Perception of innovative climate. We invited participants to assess their perceptions of innovative climate on a six-point Likert scale from 1 (strongly disagree) to 6 (strongly agree). The innovative climate scale is based on a modified version of a well-validated scale (Bryk *et al.*, 1999) and was validated in previous work (see Daly *et al.*, 2016). The scale consists of seven items that reflect the extent to which the education administrators perceive their fellow

	Frequency (%)	Mean (SD)
<i>Gender</i>		
Female	27 (61.4)	–
Male	17 (38.6)	–
<i>Work level</i>		
High school	6 (13.6)	–
Middle school and other	3 (6.8)	–
Elementary school	15 (34.1)	–
District office	20 (45.5)	–
Years of being an educator	–	22.58 (7.33)
High school	–	25.00 (5.72)
Middle/elementary school	–	19.59 (6.76)
Central office	–	24.84 (7.64)
Years in administration	–	8.41 (5.98)
High school	–	12.17 (3.31)
Middle/elementary school	–	7.35 (6.87)
Central office	–	8.18 (5.53)
Years in current position	–	2.82 (3.25)
High school	–	3.67 (4.18)
Middle/elementary school	–	2.38 (3.56)
Central office	–	2.96 (2.72)

Table I.
Sample demographics
of district and
site leaders

Notes: $n = 44$ district and site leaders. Values reflect the 2012–2013 data

administrators to be open to innovation and are willing to take risks to improve the district and schools. Sample items include “Administrators in the district are continuously learning and seeking new ideas” and “Administrators in the district are generally willing to try new ideas.”

Analysis

As this study aims to explore the role of high school leaders in a larger district network, we examine network properties at whole network, group network and individual actor level for each of the three time points. In addition, we also examine individual leaders’ perception of innovative climate as well as individual leaders’ ego network neighborhood by assessing the peers with whom individual ego is directly connected at each time point. We use social network analysis to describe the network properties and descriptive and comparative analyses to indicate the difference in perception and network properties between time points.

Social network analysis. We use the Netdraw software (Borgatti, 2002) to generate network sociograms to provide visualization of the network structure at each time point. We then use the UCINET 6.0 software package (Borgatti *et al.*, 2002) to calculate a series of network measures at whole network, group, and ego/actor levels. The whole network-level indices assess the overall pattern of connectivity. The group-level analysis is to identify degrees of homophily (core–periphery) for each group within a larger district network. The group category is based on the work level of leaders (i.e. central office, high school, middle school, and elementary school). The ego network analysis is to characterize individual leaders’ own ego network neighborhood over time. The actor-level network analysis is to quantify the degree of individual leaders’ connectedness in the study social networks.

Whole network level. Whole network-level indices include network density, network reciprocity and network fragmentation. Network density refers to the percentage of ties that are present over all possible ties in a given network (Wasserman and Faust, 1994). Network reciprocity refers to the proportion of mutual ties over all possible ties (Wasserman and Faust, 1994). The network fragmentation refers to the percentage of the number of disconnected dyads between two actors to all possible number of connected dyads in a network (Wasserman and Faust, 1994).

Group network level. We use core–periphery analysis as the group-level network analysis. The core–periphery analysis seeks to identify two sets of actors based on the degree of homophily and cohesion within each set of actors (Wasserman and Faust, 1994): the core of the network is well-connected and dense, whereas the periphery consists of actors that are loosely connected to one another. The core actors are at a structural advantage to exchange information, whereas the periphery actors are less able to coordinate communication and information sharing as it takes more time and steps to transmit/disseminate information from one actor to another due to a lack of connected ties (Borgatti and Everett, 2000). The C/P analysis generates in-group correlation coefficient to indicate the strength of homophily within each group. It uses the fit function that determines the positive correlation between the observed data and the theorized core–periphery structure. A fitness value of 0 indicates that there was no core, whereas a fitness of 1 means that the observed data were a perfect fit to the theorized model. Network research suggests that fitness values greater than 0.50 indicate a developed core–periphery structure (Hanneman and Riddle, 2005) which merits further analytical examination.

Ego network level. Ego refers to the focal node of its ego neighborhood that contain the ego and all other nodes to which the ego is directly adjacent. This type of ego network is defined as the one-step ego neighborhood (Hanneman and Riddle, 2005). We use ego network size and its over time change to profile the composition of resources individual leaders have for each group. It is a common and useful way of closely looking at the network behaviors of

individual leaders within their own ego neighborhood, as each ego is embedded in the larger social structure of district network. The size of ego network refers to the number of nodes/ alters the ego is one-step directly connected to (Borgatti *et al.*, 2002). Similar to whole network measure, we further look at ego network density, reciprocity, fragmentation, and average degree to characterize the high school principals' ego network properties.

Actor-level analysis. We calculate actor outdegree, indegree and ego-reciprocity to measure the degree of individual leaders' connectedness. The outdegree of a leader refers to the number of outgoing ties a leader has, and can be interpreted as an indication of the leader's "activity." The indegree of a leader is the number of incoming ties the leader receives from others, and thus can be regarded as an indication of a leader's degree of popularity. The ego-reciprocity is the proportion of mutual ties an actor has over all possible ties that actor can have.

Results

Comparison and change of perception over time

Table II presents the descriptive and comparisons of innovative climate. On average, educational leaders perceive medium to high levels of perception around innovative climate with mean ranging from 4.49 to 4.68 and their perception increase at a slow rate over time and is not statistically significant. This suggests that educational leaders perceive the innovative climate of the district as "somewhat" innovative during the study period. However, the high school principals' perception of innovative climate decreases from Time 1 to Time 3 with an increase in standard deviation, meaning that the high school principals tend to have a wide diversity of opinion about the innovative climate of the district. In addition, of all groups, high school principals perceive the lowest levels of innovative climate, compared to elementary and middle school principals and central office leaders. These findings indicate that high school principals, as compared to their administrative peers, perceive the lowest innovative climate over time and such perceptions even decrease over time.

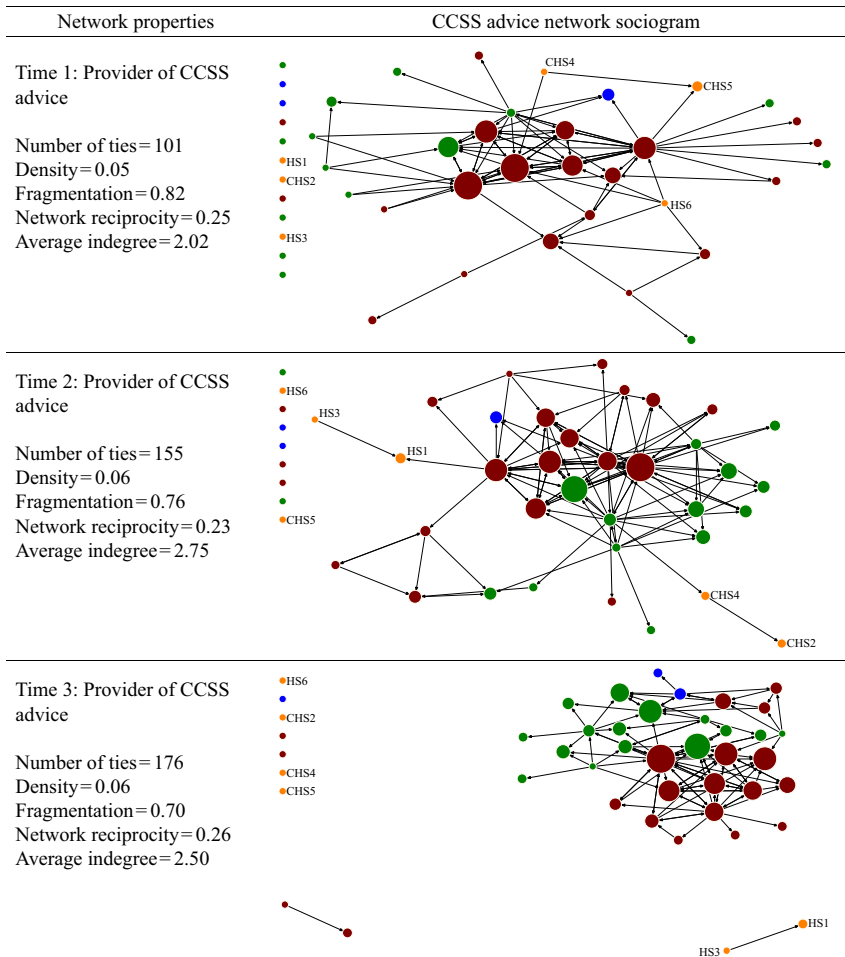
Matched network over time with HS principals embedded: overall structure and actor connectivity

Figure 1 present the CCSS advice network sociograms and actor-level network indices from a number of 44 leaders who joined the study at each time point. Nodes in all sociograms represent individual leaders that are colored with their work level with orange representing high school principals, green elementary school principals, blue middle school principals,

	T1 Mean (SD)	T2 Mean (SD)	T3 Mean (SD)
Innovative climate at district	4.49 (1.06)	4.68 (1.03)	4.54 (0.97)
HS perception	4.31 (0.90)	3.60 (0.80)	3.63 (1.17)
ES/MS perception	4.19 (1.39)	4.61 (1.26)	4.43 (1.01)
Central office perception	4.84 (0.58)	5.03 (0.63)	4.87 (0.70)
<i>F</i>	2.061	10.550	7.061
<i>df</i>	2	2	2
<i>p</i>	0.138	0.000* **	0.002* **

Table II.
Descriptive and comparative statistics of innovative climate

Notes: $n = 44$ district and site leaders. HS, high school; ES, elementary school; MS, middle school; CO, central office. p -value superscript notation: *significance between HS and MS/ES; **significance between HS and central office. No statistically significant difference in perception of innovative climate is found for each leader group between time point



	Time 1		Time 2		Time 3		Degree average	Ego-reciprocity average
	Out-/in-degree	Ego-reciprocity	Out-/in-degree	Ego-reciprocity	Out-/in-degree	Ego-reciprocity		
HS principals	1.17/0.33	0.0%	0.33/0.67	0.0%	0.17/0.17	0.0%	0.47	0.0%
ES principals	1.47/0.93	2.2%	2.53/2.87	5.3%	2.33/2.67	11.3%	2.13	6.3%
MS principals	0.00/1.00	0.0%	0.00/1.00	0.0%	1.67/1.00	13.3%	0.78	4.4%
Central office leaders	3.00/3.50	16.2%	4.05/3.55	21.6%	3.45/3.30	21.4%	3.48	19.8%

Notes: Network size = 44. Node color: orange/HS principals, blue/MS principals, green/ES principals, and dark red central office leaders. Nodes are sized by indegree. Actor label indicates each high school principal. No statistically significant difference in network density between time points

Figure 1. Network sociograms of CCSS advice over time

and dark red central office leaders. Lines represent the network relationships between leaders, in this study the CCSS advice and/or social support relations. Node size is based on the degree of incoming ties (indegree) of leaders. The larger the node, the more the leader is nominated by others as one to whom others would turn for CCSS advice and social support.

The high school principals are labeled by “HS_j,” where *j* indicates the number of high school at the district. Among these six high school principals, three of them lead large comprehensive high schools, and thus their node label is described as “CHS_j,” where C represents “comprehensive.”

A number of overall structures can be noted in the CCSS Advice network sociograms. First, the CCSS advice networks become slightly more dense (not significant between time points) with more ties, less fragmented, and slightly more reciprocated (not significant between time points). Second, the high school principals tend to be at the periphery of, or isolated from, the mainstream network over time, as evidenced by fewer numbers of CCSS advice ties and more isolated positions. This suggests that they are less involved in the sharing or exchanging of CCSS-related advice and information. For those high school principals who are weakly connected with the mainstream network around CCSS advice, they tend to represent different actors over time points. For instance, at Time 1, CHS5 and CHS6 were part of the central network, but they became the isolated actors at Time 2 and Time 3. This suggests that information and resources regarding CCSS have not been consistently distributed across all high school principals. Third, the high school principals tend to be less connected even to one another in terms of sharing, providing, or exchanging CCSS advice, whereas the majority of elementary school principals and central office leaders are connected to one another for the most part.

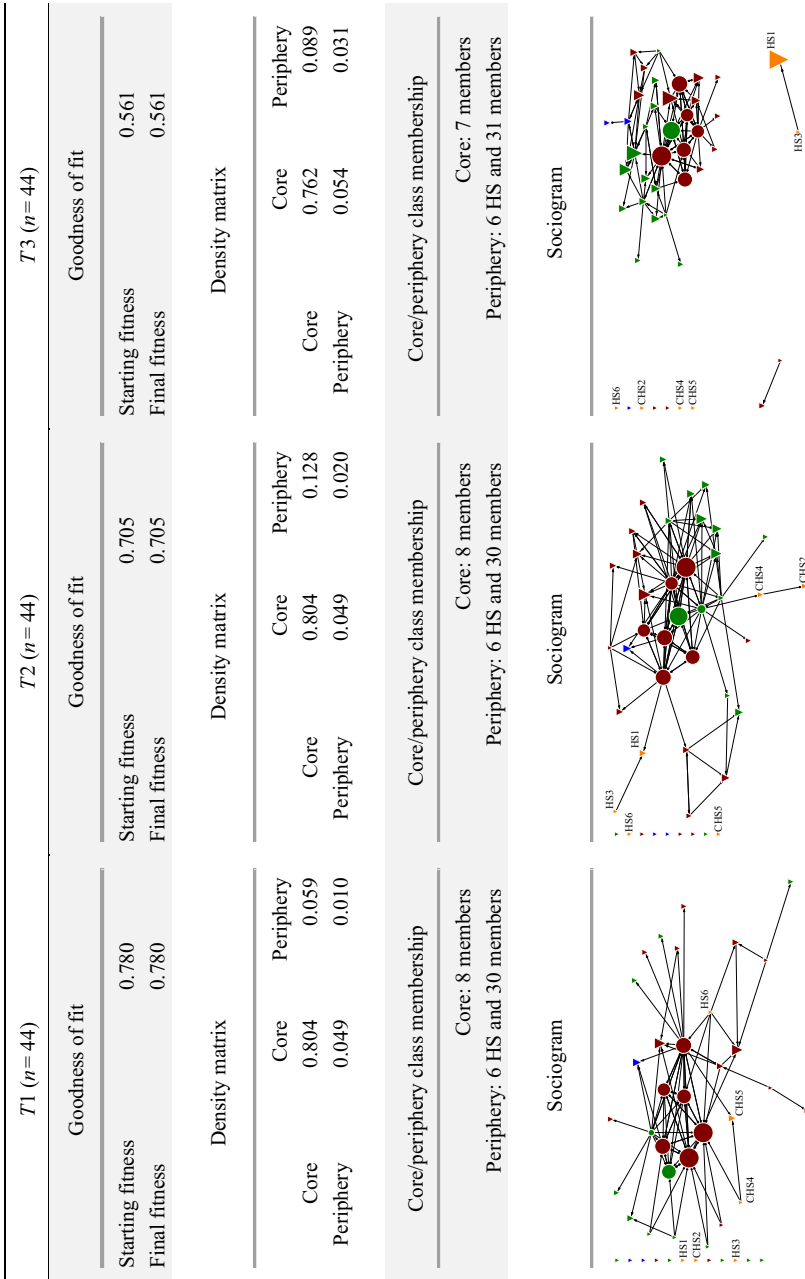
As for actor connectivity, on average, the high school principals have the lowest number of connections to and from others for CCSS advice than other leader groups and the number of their CCSS advice ties decrease from Time 1 to Time 3, whereas the other leader groups have developed or maintain ties with others over time. As for ego-reciprocity, of all the ties that high school principals have across time points, 0 percent are reciprocated, whereas the other leader groups have established increased proportion of ties that are mutual, even among the middle school principals whose mean ego-reciprocity increases from 0 to 13 percent. This suggests that over time the high school principals, in comparison to their administrative colleagues, report less engagement in terms of seeking, providing or exchanging advice around CCSS.

Network position of HS principals over time: core or periphery

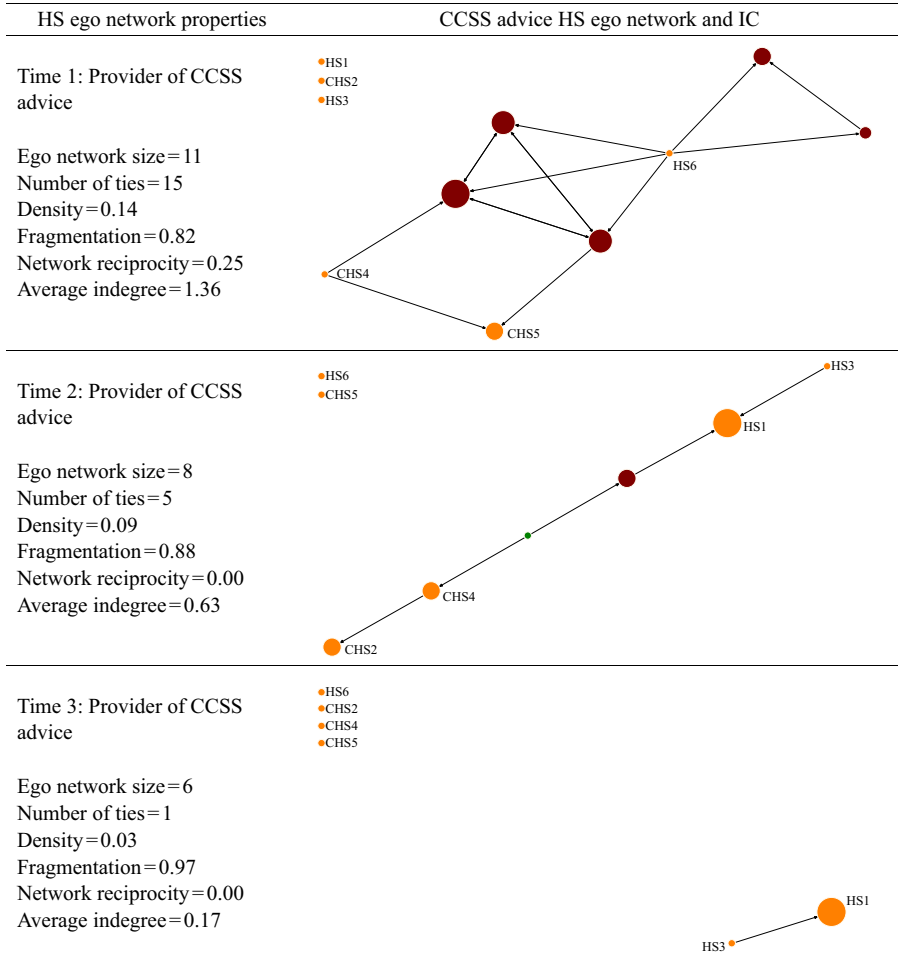
The results of the core/periphery analysis are reported in Figure 2 at each time point using the matched data set. At 50 iterations, the final fitness measures for CCSS advice networks across time points exhibit a moderate to strong core formation with final fitness ranging from 0.561 to 0.780, indicating the underlying network structure exhibits significant core/periphery pattern. This pattern is further confirmed by the density matrix where the core-core partition across time point has a higher density level of 0.762–0.804, whereas the density level of the periphery–periphery partition is only slightly above zero. In other words, the leaders in the core group are very well-connected with each other, while on the other hand the peripheral leaders are much less connected with each other. In addition, the central core consists of seven to eight leaders. Interestingly, the majority of these core leaders are from central office and none of the high school principals are in the core group. As also shown in the CCSS advice network sociogram, where circle nodes represent core members and down triangle the periphery group, all the high school principals are at the periphery structure of CCSS advice networks over time. Taken together, the abovementioned network structure confirms the peripheral network position of high school principals over time.

Ego network of HS principals over time

Figure 3 presents the high school principals’ collective ego network around CCSS advice at each time point. The HS ego networks become smaller, highly fragmented, and less dense with fewer number of ties from Time 1 through Time 3. The number of ego network size in



Notes: $n=44$ district and site leaders. The core/periphery analysis reports the results from the matched data set. The sociograms reflect the social network positions of individual leaders with circle nodes representing the core members and down triangle the periphery members



	T1 ego network size	T3 ego network size
HS principals	1.50	0.33
ES principals	2.20	4.40
MS principals	1.00	2.00
Central office leaders	4.85	5.00

Figure 3.
HS principals' ego network sociograms of CCSS advice over time

Notes: Node color: orange/HS principals, blue/MS principals, green/ES principals and red/central office leaders. Nodes are sized by indegree

terms of number of ego and alters decreases from 11 to 6 over time. On average, individual actors in the ego networks are connected with approximately 1.4 others at Time 1, with a continued decrease in Time 2 and Time 3 by 88 percent. In terms of reciprocity, while there is 25 percent of ties that are reciprocated at Time 1, none of these reciprocal ties is between any pair of the high school principals and as the number of ties drops over time, the percentage of reciprocated ties also drops to zero. As shown in the sociograms, the high school principals become less connected. At Time 1, three of the six high schools are able

to reach out to seven others within their collective ego neighborhood through at least one step away from him/her-self. However, at Time 2, the connection becomes a “line” structure in which ego and alters are connected in a line, one after the other, with little CCSS advice that may circle back to the connected members within the neighborhood. One can imagine that if any of the actors is removed from the ego neighborhood at Time 2, the ego network structure may become even more broken into disconnected pairs. This trend of continued disconnection is reflected in the ego neighborhood at Time 3 where there is only one connected pair of high school principals, with the remaining being isolated. Also note that there are no connections to middle school principals within the high school principals’ ego neighborhoods over time, which may constrain the capacity for high schools to build or maintain the relationships with their feeder schools middle schools, thus inhibiting system-wide coherence and alignment. From a social network perspective, inter-organizational relationships (e.g. school to school and school to district) need to be established and supported in order to support the flow or unique relational resources. Continued absence of work-related interactions (e.g. advice around CCSS implementation) between school principals, particularly high school principals, may inhibit the ability to create collaborative cultures and a coherent system across the district.

As for comparing ego network size between work levels, the results indicate that the high school principals’ average ego network size shrinks by 78 percent (1.50–0.33), while central office leaders and ES/MS principals’ average ego network size increases from Time 1 to Time 3. This means that the high school principals are becoming less connected for CCSS advice over time within their ego neighborhood.

In sum, our findings across three year regarding networks of advice about implementing CCSS indicate more ties and connectivity for central office and middle/elementary school leaders within the system. However, the average high school leader was not as embedded as other leaders, which was particularly dramatic in the Common Core advice network. Further, the perceptions of innovative climate while increasing over time for most leaders were less so than for the high school principals. Taken on balance this suggests that in general these high school principals were not accessing social capital resources (access to advice) that were available to them in the larger social system and as such may have not been able to bring these resources to their schools. Further, this pattern of isolation extends to feeder school patterns of middle school principals and even other high school principals potentially making district-wide coherence and alignment even more challenging.

Discussion and conclusion

This longitudinal study, one of the first to examine high school principals from a network perspective, sheds new light on the social infrastructure of urban high school principals. Overall results indicate that over time high school principals tend to become even more isolated and move to the periphery of the network. Moreover, these leaders are not just occupying peripheral positions they are often isolated from other leaders and secondary principals, while the remaining network becomes more cohesive. The quality of their interactions in terms of reciprocated ties and perceptions of the overall climate of innovation also differs significantly from their peers. The coupling of reduced reciprocated ties and reported perception of the climate becoming less open to risk taking may also inhibit the formation of ties. This combined set of findings suggest that high school principals are isolated from important relational ties, which have been shown to be supportive of improving outcomes. From a systems level this may also create challenges in terms of creating coherence and alignment for CCSS implementation across the district. In the remaining paragraphs we unpack some of our key findings.

High school principals occupy a peripheral position in the network

Strong connections between administrators are important to a coordinated change strategy as these ties support the transfer of tacit, non-routine and complex knowledge allowing for joint problem solving and the development of coordinated solutions (Reagans and McEvily, 2003). In effect, while improvement plans may prescribe particular ways of responding, it is ultimately the social ties between individuals that may well determine the shape, diffusion and success of any change strategy (Spillane *et al.*, 2006). Therefore, attention to the creation of meaningful strategic ties that enhance information transfer between administrators may support the generation and diffusion of knowledge potentially increasing the social capital in the district, as well as exposing knowledge gaps that could be specifically targeted. Working against the development of these ties for advice connections may be detrimental to the flow of knowledge and information and the fact that high school principals are on the periphery of the network may inhibit the cultivation of a coherent reform approach across the district.

Analysis of the informal social relations within the district revealed the presence of a core-periphery (C/P) structure for the advice networks. These networks are characterized by a significant level of centralization around a few individuals with others, particularly high school principals, inhabiting a more peripheral position. C/P structures limit the contribution and access to valuable knowledge by marginalizing individuals at the periphery and ultimately having a negative impact on intra-organizational knowledge sharing such as within the district (Tsai, 2002). A highly centralized structure is effective for the diffusion of routine non-complex knowledge and information (Cummings and Cross, 2003), such as technical material related to procedures and protocols. However, this type of structure has been found to impede the effectiveness of groups engaged in non-routine, complex tasks, such as high-level communication (Borgatti and Cross, 2003), knowledge sharing (Tsai, 2002) and organizational change (Cummings and Cross, 2003; Tenkasi and Chesmore, 2003) all of which are necessary in implementing the CCSS.

In the district, high school principals occupied peripheral positions and were disconnected from other principals and the “core” of central office administrators. The isolation of high school principals from other principals as well as other high school principals and central office staff may result from a district organizational structure that may privilege elementary schools as these are relatively much well-connected to the “core” of the leadership network. The greater the connectivity over time, in this case exchanging CCSS advice, the more likely the opportunity to cultivate shared norms and language that are necessary for development of organizational routines and coherence. Therefore, structures that support the development of more collaborative relationships between all leaders should be considered.

The district may well be suited in creating formal structures in the organization based on informal social networks to enhance existing ties and bolster those that are sparse (Cross *et al.*, 2002). However, the district will have to avoid the trap of merely providing time and directives to “work together” as this does not necessarily result in meaningful collaboration between leaders. In fact, “forced” collaboration may potentially calcify recalcitrant participants, making both present and future efforts at collaboration even more challenging (Harris and Chrispeels, 2006). A study by Coburn and Russell (2008) suggests that while districts may create specific roles (e.g. coaches) intended to increase collaboration the result is not always realized. Therefore, the development of structures must also include intentional opportunities for routines of interaction that promote productive exchange (Coburn and Russell, 2008). Building and strengthening these relationships may enhance the district’s capacity for change by further developing the social capital within the system (Lin, 2001). Through new lateral connections, the organization’s absorptive capacity for learning, development and goal attainment will be strengthened (Cohen and Levinthal, 1990).

Increased isolation and reduced reciprocated ties

Existing literature suggests that positive experiences from prior social interactions may foster trust by reducing uncertainty about the engagement and involvement of the other party (Tschannen-Moran, 2004). This predictability of relations gained through reciprocal interactions both decrease the vulnerability between individuals as well as potentially increase the depth of exchange due to a willingness to engage in risk taking (Uzzi, 1997). In support of this claim, research suggests that individuals tend to seek reciprocal as opposed to asymmetric relations, as those ties provide mutual benefit to the relationship in creating a reinforcing effect (Daly and Finnigan, 2011; Lin, 2001). Reciprocated relations are therefore important in providing opportunities to build and deepen the norms of trust necessary for the exchange of reform-related resources (Liou and Daly, 2014).

Reciprocity and trust are also implicated in research related to communities of practice (Lave and Wenger, 1991). Reciprocated relations provide opportunities for individuals to interact and learn together, and have been suggested to be important in educational systems oriented toward learning and innovation (Honig, 2008). These reciprocated relations can provide opportunity to modify and deepen patterns of interaction as well as develop increased repertoires of behaviors, which may be thought of as a process of learning and the formation of an innovative climate necessary for improving practice (Honig and Ikemoto, 2008). On balance this literature suggests that actors who have reciprocated relations also may have more trusting relationships (Liou and Daly, 2014). In this work we noted a decrease in relationships in general and reciprocated ties over time – this may well inhibit the formation of the trust necessary for improvement as well as decreased access to social capital resources.

Decrease in perception of innovative climate

We found that high school principals report a significantly lower perception of innovative climate among their colleagues during each year and over time. If high school administrators do not perceive a climate safe for risk taking and trying out of new ideas, this may potentially inhibit the testing out of novel approaches necessary for implementing reform and change as well as inhibit the formation of new ties. As central office administrators occupy both central positions in the informal social networks and are on the top of the formal hierarchy, they are in a position to both model the behaviors (risk taking and exploring new ideas) and support the conditions necessary for an innovative climate to flourish. Again, as has been shown in other work (e.g. Daly and Finnigan, 2011), the misalignment between perceptions and expectations may result in less coherence across the system. The decreasing of innovation climate perceived by high school principals may potentially lead to negative work relationships, as evidenced by previous work (Daly *et al.*, 2015). Leaders who perceive lower innovative climate across the district may look at the environment from a passive perspective and as such they might display negative attitude and regard their work environment and colleagues as difficult to work with leading to lowered job satisfaction (Daly *et al.*, 2015).

Limited access to social capital and impact on district coherence

Over time site administrators became increasingly disconnected from other principals and the “core” of central office administrators and yet these leaders were identified as resources for innovative practices. This type of disconnected system limits district coherence and the ability of central office and school leaders to develop meaningful partnerships as they had intended through this district-wide reform. Furthermore, this structure may inhibit the district’s ability to effectively develop shared theories of action (Agullard and Goughnour, 2006), learning partnerships (Copland and Knapp, 2006) and effectively broker resources (Honig, 2006).

Limited access to the core/mainstream network of resources may potentially engender network disruption due to weak connection within and outside high school group.

Recall that the number of ties among high school principals is fewer and most of these ties tend to be non-reciprocated. Should the high school principals desire to keep such weak ties, they may need to engage more effort in maintaining existing weak ties that are oftentimes uni-directional. Otherwise, if any of the high school principal deselected his/her point of connection for advice, it may well be the case that she/he would become one of the disconnected, isolated actors within these networks. It is noteworthy that the size of high school has little to do with the pattern of lower connectivity among the high school principals with the principals of smaller high schools being just as likely to be isolated and peripheral as their comprehensive high school colleagues. It may be more of the district-wide systemic issue that deserves more attention including issues having to do with not only lateral ties, but vertical connections across the district.

Study limitations

As with other empirical works, there are also limitations in this study, allowing the researchers to provide suggestions for future work. First, the study sample is confined to the district-wide leadership team in one district. The study results may not be generalized to all other educational settings. Future work may consider investigating the network position of high school principals in a variety of school district settings in order to capture differences and similarities in the role of high school principals as related to reform effort. Further, we acknowledge that placing the focus on high school principals may limit our understanding of the influence of feeder middle and elementary schools. Future study may explore the nuanced relationships among feeder patterns to better understand the systemic nature of the educative process over levels. Second, as we only examine the positive relationship a leader has with others regarding high propensity in risk-taking activities, we acknowledge the consequential influence of negative relationships on organizational change (Daly *et al.*, 2015; Uzzi and Dunlap, 2012). Finally, as the phenomenon of network churn (Daly *et al.*, 2017; Sasovova *et al.*, 2010) is typical in a given school district, in a longitudinal study it would also yield valuable input into our knowledge base to study the impact of churn on the performance of a leadership team in terms of collaboration around improvement. Future studies may explore the churn of educational leaders and its association with the change in district governance.

Broken bridges

Our data suggest that high school principals over time have reduced access to social capital resources, particularly those related to implementation of CCSS. This reduction in access may inhibit the movement of resources into the school itself. However, what perhaps is even more critical is the culture of risk taking for innovation and change to occur is significantly lessened. For novel ideas to enter these high school principals must not only have the opportunity to access others, but also be willing to try to new things and acquire new ideas and practices from other leaders. In the end the district will require system-wide attention to improvement rather than allowing each high school to survive or fail, thereby creating its own destiny. However, any formal support mechanisms that are developed in the district will be pointless without strong informal relationships that bridge district-wide leaders and access to critical social capital resources.

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Further reading

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