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Community Costs? Analyzing the contingent association between internal cohesion and external knowledge transfer relationships*

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Abstract
Current theoretical arguments highlight the negative implications of cohesion in a network neighborhood for relationships with outsiders. We present argument and evidence illustrating the importance of knowledge overlap inside a neighborhood in moderating the negative internal cohesion effect. We analyzed the tendency for individuals to initiate and sustain knowledge transfer relationships in an online technical forum. Empirical results indicated that as cohesion in a neighborhood increased each member was less likely to initiate and sustain external knowledge transfer relationships. However, the magnitude of negative effect that cohesion had on external knowledge transfer relationships declined as knowledge overlap in the neighborhood increased. Our research findings clarify one condition under which increasing cohesion in a network neighborhood can be expected to undermine external knowledge transfer relationships, and therefore the extent to which the benefits created by cohesion in a neighborhood will come at the expense of relationships that provide access to resources outside the neighborhood.
1. Introduction

Successful knowledge transfer is essential for a host of organizational processes and performance outcomes. These include improvements in learning rates and overall organizational efficiency (Argote et al. 1990; Darr et al. 1995), new product development (Carlile 2002; Hansen 1999) and technological innovation (Ahuja 2000; Tortoriello and Krackhardt 2010). As market competition has increased, sharing knowledge has become even more important because knowledge transfer influences a firm’s ability to improve and develop products and work routines (Rosenkopf and Almeida 2003; Sørensen and Stuart 2000). Indeed, in a dynamic market context, the ability to share knowledge is viewed as a distinct source of competitive advantage (Kogut and Zander 1996).

As successful knowledge transfer has become more important, the number of knowledge management systems that support the successful transfer of knowledge across employees, business units and business partners has grown (Alavi and Leidner 2001; Arrow 1974; Kogut and Zander 1992). A survey of high performance organizations revealed that knowledge sharing initiatives are increasingly being intertwined and targeted at employees that are critical for firm performance (Davenport 2008). Advances in information technology have provided firms such as IBM, Proctor & Gamble, Commerce Bank, and Siemens with an opportunity to leverage available knowledge and expertise across a variety of platforms, including expertise sharing forum, Blogs, and Wikis. These so-called Enterprise 2.0 systems can facilitate the broad transfer of know-how, know-what and know-who among firm employees, which in turn can enhance individual performance (Sasidharan et al. 2011).

Given the benefits successful knowledge transfer can create, management scholars have attempted to document factors that either promote or inhibit knowledge sharing activities. A number of factors, including physical proximity (Hansen and Løvås, 2004; Salomon and Martin, 2008), social similarity (Loyd et al., 2010), knowledge overlap (Simon, 1991), the strength of the relationship between the source and a recipient (Aral and Van Alstyne, 2011)
and even properties of the knowledge being shared (Szulanski, 1996), can influence the knowledge transfer process (Argote et al. 2003; Phelps et al. 2012). While fully recognizing the importance of these factors, we consider how the presence of strong ties inside a community or network neighborhood ("internal cohesion") influences the transfer of knowledge from a source to a potential recipient. We focus on internal cohesion because a number of studies have documented the positive effect that strong third party ties can have on knowledge sharing activities (Reagans and McEvily 2003, 2008; Gargiulo et al. 2009; Tortoriello et al. 2011).

Cohesion is thought to be important because while sharing knowledge can be beneficial for the recipient and the broader organizational unit, it can be costly for the source. At a minimum the source must spend time sharing his or her knowledge and expertise. And any knowledge source who shares his or her knowledge and expertise limits his or her control of potentially valuable knowledge and expertise. When the knowledge source and recipient are embedded in a dense web of third party ties, the potential costs associated with sharing knowledge are mitigated.

While cohesion can promote knowledge transfer, it is generally understood, however, that cohesion-based benefits can be costly. In particular, received wisdom indicates that an increase in cohesion inside a community or neighborhood can undermine external knowledge transfer relationships (i.e., relationships with colleagues outside of the focal network neighborhood). This basic idea was articulated by Granovetter (1973) in his strength of weak tie argument when he described why weak ties and not strong ties could be bridges between network neighborhoods. Granovetter described cognitive and social dynamics which increased the odds that an open ("forbidden") triad composed of strong ties would close. When, for example, an individual has two friends who are not friends, the triad is imbalanced and feelings of cognitive dissonance will make it difficult for an individual to maintain both relationships.
Balance is restored if the two friends become friends or if the individual terminates one of the friendships. In either case, increasing internal cohesion undermines external relationships.\textsuperscript{1}

While it is often assumed that internal cohesion will create a tradeoff between the formation of internal and external ties, the available empirical evidence for Granovetter's proposed tradeoff is mixed and inclusive. On the one hand, research findings indicate that individuals can maintain strong ties with two contacts, even when those contacts are not connected to each other (Burt 1992). Moreover, cohesion among team members does not limit their ability to maintain strong ties with people from outside the team (Reagans et al. 2004). But on the other hand, prior research has also shown that cohesion in a neighborhood can make it difficult for a community member to develop and sustain a trusting relationship with an outsider (Burt and Knez 1995; Labianca et al. 1998). Given the mixed empirical results, we see value in considering factors that could moderate any negative effect that cohesion can have on external knowledge transfer relationships. We maintain a key contingency in the current context is the extent to which members of a network neighborhood overlap in what their know-how and expertise know. Indeed, existing theoretical arguments suggest that knowledge overlap in a network neighborhood could either amplify or offset any negative association between internal cohesion and external relationships. Our objective is to examine this potential contingency and consider its implications for management and prevailing theoretical arguments.

The context of this study is a Fortune 1000 IT services firm. Global Business magazine, Fortune, reported that this firm is one of the fastest growing firms in the United States. Market success allowed the firm to expand rapidly to different cities, countries and continents. Knowledge transfer was critical for firm success but during the expansion little attention was

\textsuperscript{1}Granovetter's tradeoff seems less relevant when network neighborhoods can operate in isolation (i.e., when resources within each neighborhood, such as required knowledge and expertise, are necessary and sufficient). But even when this is true, events can transpire that require coordination between neighborhoods, and the absence of external relationships can be problematic (Granovetter, 1973). Indeed, bridges between neighborhoods provide larger collectives with the potential to achieve global outcomes that wouldn't be possible otherwise (Centola and Macy, 2007).
paid to members of the firm would continue to share knowledge with each other. As a result, different pockets of knowledge emerged between locations over the years. Senior members of the firm recognized that the absence of knowledge transfer was undermining the firm’s performance. The firm took several Enterprise 2.0 initiatives to encourage knowledge sharing among employees across locations, including the knowledge sharing forum analyzed in this study.

The firm launched the online forum in 2006 and it was adopted across different locations. The forum is technical in nature and employees primarily posted technical queries. Once a query was posted, anyone in the firm could post an answer to the forum. The forum provided knowledge seekers with greater access to a much larger knowledge pool that what would have been possible in the absence of such forum. The firm did not provide any direct incentive to participate in the technical forum. However, over approximately a year, approximately 17,000 questions were posted to the forum which received more than 20,000 responses. The forum kept track of individuals who sought assistance and the names of individuals who responded to their requests. As a result, we can measure the pattern of knowledge sharing relationships surrounding any two individuals and we can estimate how internal cohesion affected the likelihood of external knowledge sharing relationship developing and the persistence of external knowledge transfer relationships once they have been established.

2. Theoretical Development

The positive effect that internal cohesion can have on the network formation process in general and knowledge transfer in particular has been documented across a large number of studies (Phelps et al. 2012), including the online context. For example, Kumar et al. (2009) established that in an online knowledge sharing forum that an individual was more likely to receive a response to a question from a colleague when cohesion in their network neighborhood was
high. Explanations for the positive effect that internal cohesion can have on network formation processes either emphasize the importance of similarity or reputation. If, for example, two individuals are interested in developing a relationship, they will consider how cognitively and socially similar they are (Heider 1946). If the two individuals are affiliated with the same groups, hold similar political opinions, and buy the same products, they will become more attractive to each other as potential network partners, and will take advantage of any opportunity to develop a strong connection. Internal cohesion can signal cognitive and social similarity, which in turn promotes the kinds of relationships that can support knowledge transfer.

Reputation-based explanations emphasize the potential downsides associated with uncooperative behavior when cohesion in a neighborhood is high. When a network neighborhood is characterized by cohesion, information travels quickly across multiple channels and members of the neighborhood have a greater capacity for collective action, including sanctioning uncooperative members (Coleman 1988; Granovetter 1983; Ullmann-Margalit 1977). Thus, when cohesion is high in a neighborhood, individuals engage in more civic minded behaviors to protect their status and reputation. In general, internal cohesion helps to align individual behavior with collective goals and objectives and therefore helps neighborhoods to overcome collective action problems (Ingram and Roberts 2000). In any group or larger collective, conflicts of interest can develop between what is best for the collective and what is best for each individual member of the collective. For example, the successful transfer of knowledge can be beneficial for the recipient and the broader organization but is costly for the source. At a minimum, sharing knowledge requires time and effort. Moreover, anyone who shares what they know with their colleagues reduces the extent to which he or she can monopolize and therefore benefit from controlling valuable knowledge and information. When internal cohesion is high, these kinds of concerns can be mitigated because is costly for a
source to not share what he or she knows and it is costly for a recipient to misappropriate whatever knowledge and expertise the knowledge source has shared.  

While cohesion can promote network formation among individuals inside a neighborhood, it can undermine relationships with outsiders. This idea was articulated by Granovetter (1973) in his strength of weak tie argument when he argued that weak ties and not strong ties could be bridges between network neighborhoods. Using a variant of the similarity-based argument described above, Granovetter described dynamics which increased the odds that an open triad composed of strong ties would close. If for example, an individual has two friends who are not connected to each other, the triad is imbalanced and cognitive and social processes operate to correct the imbalance. Balance is restored if the two friends become friends or if the individual ends one of the friendships. In either case, the “external” relationship disappears.

Empirical evidence for the proposed tradeoff between internal cohesion and external relationships is mixed. For example, empirical results indicate an individual can maintain strong ties with colleagues who are not connected to each other (Burt 1992). Internal cohesion on a team can be high and team members can maintain strong relationships with people outside the team (Reagans et al. 2004). And yet empirical results also indicate that increases in internal cohesion can undermine the quality of relationships and interactions with outsiders (Burt and Knez 1995; Labianca et al. 1998). Given the mixed empirical results, we see value in considering factors that could moderate any association between internal cohesion and external knowledge transfer relationships. We emphasize the importance of knowledge overlap inside a network neighborhood. Existing theoretical arguments suggest that knowledge overlap within a network neighborhood could either exacerbate or offset any negative association between internal cohesion and external relationships. On the one hand, knowledge overlap can be the

---

2 The origins of trust and cooperation could be grounded in rational choice but once a knowledge transfer relationship has been developed, it is more likely to be maintained, even when commitment is not “rational” (Sgourev and Zuckerman, 2011).
source of similarity and if the positive effect that internal cohesion has on network formation is
grounded in cognitive and/or social similarity, knowledge overlap inside the neighborhood would
consolidate similarity. When a neighborhood's identity is reinforced by what members know, it
would be even harder for members of the neighborhood to maintain a relationship with an
outsider. This rationale would lead to the following prediction.

H1: The magnitude of the negative effect that internal cohesion has on external knowledge
transfer relationships increases and becomes more negative as knowledge overlap in a network
neighborhood increases.

On the other hand, if the positive effect that internal cohesion has on internal
connections is grounded in reputation concerns, one would expect for the negative association
between internal cohesion and external relationships to decline as knowledge overlap in a
neighborhood increases. As cohesion in a network neighborhood increases, every individual
can demand more from every other member of the neighborhood. Reputation-based arguments
suggest that any negative effect internal cohesion has on external relationships is a byproduct
of “greedy” neighborhood-based activities that make it difficult for members to allocate network
time and energy to external activities in general and relationships in particular. So in the current
of knowledge sharing, cohesion in a neighborhood would provide every member with an
opportunity to demand more work related help and assistance from their neighbors, which would
come at the expense of sharing knowledge with external contacts. The potential tradeoff,
however, could become less salient when knowledge overlap in a neighborhood is high. When
knowledge overlap in a neighborhood is high, knowledge transfer is easier (Cohen and
Levinthal 1990; Simon 1991). So even if neighborhood members demand more help and
assistance when internal cohesion is high, the high level of knowledge overlap would make it
easier for each member to meet those demands, and also meet obligations outside the group.
This argument leads to the following prediction.
H2: The magnitude of negative effect that internal cohesion has on external knowledge transfer relationships declines and becomes less negative as knowledge overlap in a network neighborhood increases.

3. Methods and Measures

Technical workers at a Fortune 1000 IT services firm were our study population. Market success had allowed the original firm to expand geographically to multiple cities, countries and continents. With the expansion, firm performance started to suffer. Managers understood that knowledge transfer had been essential for early success and were looking for activities to encourage the transfer of knowledge between people in different geographic locations. The firm took several Enterprise 2.0 initiatives to encourage knowledge sharing among employees across locations, including the knowledge sharing forum analyzed in this study.

The online forum was launched in 2006 with the explicit intent of encouraging transfer across the different locations. The forum was technical in nature and employees primarily posted technical questions. Questions were posted to specific topics and once a question was posted, anyone in the firm could post a response. The forum provided knowledge seekers with greater access to a much larger knowledge pool that what would have been possible in the absence of such forum. We have data on all questions and responses from April 2006 until August 2007. During the 16 month period, 17,386 questions were posted and those questions received 20,421 responses. The forum kept track of individuals who sought assistance and the names of individuals who responded to their requests. As a result, we can observe a knowledge transfer network evolving on the 16 month period. A knowledge transfer relationship exists between two individuals when one had responded to a question posted by the other. Our knowledge transfer network was updated daily so knowledge transfer relationships were allowed to develop and grow stronger but could also decay over time.
**Dependent Variable – Sharing Knowledge.** The dependent variable, \( Y_{srq} \), is an indicator variable which equals 1 if a potential knowledge source \( s \) responds to the question \( q \) posted by potential knowledge recipient \( r \) and 0 otherwise. We focus on the likelihood of an individual responding. Most responses were posted within a few hours and differences in time zones made it difficult to measure the time lapse between when a potential knowledge source was exposed to a question and when he or she posted a response. While individuals could have responded to a question more than once, this was very rare. Individuals responded to the same question more than once only thirty-nine times. While the typical person only posted a single response, like most technical forums more than one person could have responded to a question. And since more than one person can respond to a question, we have more answers than questions.

**Independent Variables**

*Internal Cohesion:* We examine how an increase in cohesion in a network neighborhood will affect the likelihood an individual will share knowledge with a colleague outside the immediate network neighborhood. The workers in our study population can belong to more than one network neighborhood. A stylized network is illustrated in figure 1. Individual \( s \) and individual \( r \) both belong to network neighborhood A. Individual \( s \) also belongs to network neighborhood B. Internal cohesion is high in neighborhood A and in neighborhood B. Cohesion in neighborhood A should increase the odds that \( s \) will initiate and sustain a knowledge transfer relationship with \( r \), while increasing cohesion in neighborhood B should make it less likely that \( s \) shares knowledge with \( r \), since \( r \) is an outsider in neighborhood B. Put differently, \( s \) and \( r \) “share” the internal cohesion in neighborhood A, while the cohesion in neighborhood B is “unshared.”

To calculate internal cohesion we first calculate the strength of the direct ties in the knowledge sharing network. The individuals in our study population can act as knowledge sources and recipients in our knowledge transfer relationships. A knowledge transfer
relationship exists between s and r if either one has responded to a question posted by the other. The data are counts. We know the number of times s has responded to a question posted by r and we know the number of times that r has responded to questions posted by s. To measure the strength of the relationship s has with r, we first sum the number of times s has responded to r and the number of times r has responded to s. $N_{srt} + N_{rst}$ is the level of the relationship between s and r at time t. It is important to remove volume or level from our network measures (Burt and Carlton 1989). One approach is to express each interaction as a function of the maximum interaction involving the focal individual at time t, which for individual s is $\max (N_{sqt} + N_{qst})$ (Reagans and McEvily, 2003; Tortoriello et al., 2011). Thus, the marginal strength of the relationship from s to r at time t is calculated as $Z_{srt} = \frac{N_{srt} + N_{rst}}{\max (N_{sqt} + N_{qst})}$, where $N_{srt}$ is the number of times s has responded to a question posted by r at time t and $N_{rst}$ is the number of times r has responded to a question posted by s at time t and $\max (N_{sqt} + N_{qst})$ is the strongest relationship s has with anyone on the forum at time t. These marginal strength relationships were used to calculate our network measures. Shared internal cohesion increases to the extent there are individuals like q who have strong connections with s and r. If our network data were binary, our measure of internal cohesion would be the number of neighbors that s and r have in common (Burt 2007).

$$Shared \text{ internal cohesion} = SIC_{srt} = \sum_{q} Z_{sqt}Z_{rqt}$$

Our measure of unshared internal cohesion increases to the extent the focal individual s had strong ties to contacts q and k and those colleagues were disconnected from the focal contact r. Again with binary network data, our unshared internal cohesion variable would be the number of “Simmelian” or closed triads (Krackhardt 1999) surrounding s that do not involve the focal respondent r.³

³ Our network variables are unadjusted in the sense we do not divide our shared internal cohesion variable by the number of contacts maintained by the focal individual s and we do not divide our unshared
Knowledge Expertise: Questions on the technical forum were posted to specific topic areas or domains. There were eighty-nine topics on the forum. An individual “expressed” or signaled his or her knowledge and expertise based on where he or she posted answers. We constructed a vector of expertise, $V_s$, for each individual based on the questions he or she has answered. The value corresponding to element $V_s(e)$, represents the number of questions on topic $e$ answered by individual $s$.\(^4\) We constructed the vector $V_s$ using information on how $s$ responded to questions posted on the forum during the 16 month time period. Thus our knowledge or expertise variable was not time dependent. We can relax this assumption and assume an individual only has expertise on a topic if he or she has responded to a question on the topic prior to the day when a focal question was posted. The time dependent expertise variable and time constant variable are correlated at 0.99 and results based on either measure lead to the same substantive conclusions.

Knowledge Overlap: We calculate the level of dyadic knowledge overlap ($DKO_{sr}$) between two individuals $s$ and $r$ as the un-centered correlation of their knowledge expertise vectors (Jaffe 1986). Dyadic knowledge overlap varies from zero to one, with a value of one indicating maximum knowledge overlap.

\[
\text{Dyadic Knowledge Overlap} = DKO_{sr} = \frac{V_s V_r'}{\sqrt{(V_s V_s')(V_r V_r')}}
\]

\(^4\) Empirical results to be presented lead to the same substantive conclusions if we define an individual’s expertise as a function of where he or she has posted questions and answers.
Triadic Knowledge Overlap: Knowledge overlap in a neighborhood can vary from high to low. We expect for the association between shared and unshared internal cohesion to vary with the amount of overlap in a focal network neighborhood. We calculated knowledge overlap at the network level using triads. To calculate shared triadic knowledge overlap, we calculate the average dyadic knowledge overlap among s, r, and q for every q connected to s and r. We sum across every such q to define the level of shared triadic knowledge overlap.

\[
STKO_{sr} = \sum_q 1/3 \left[ \frac{V_s V_r'}{\sqrt{(V_s V_s')(V_r V_r')}} + \frac{V_s V_q'}{\sqrt{(V_s V_s')(V_q V_q')}} + \frac{V_r V_q'}{\sqrt{(V_r V_r')(V_q V_q')}} \right]
\]

To calculate unshared triadic knowledge overlap, we calculated the average dyadic knowledge overlap among s, q, and k for every q and k connected to s and but not connected to r and we summed across every such q and k.\(^5\)

\[
USTKO_{sr} = \sum_{q,k, q>k} 1/3 \left[ \frac{V_k V_r'}{\sqrt{(V_k V_k')(V_r V_r')}} + \frac{V_s V_q'}{\sqrt{(V_s V_s')(V_q V_q')}} + \frac{V_k V_q'}{\sqrt{(V_k V_k')(V_q V_q')}} \right]
\]

Control Variables

In addition to cohesion, prior research has also established the importance of tie strength and network centrality for knowledge transfer. Recall that tie strength was measured as the

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\(^5\) As with our network variables, our shared triadic knowledge overlap variables was not adjusted by the number of contacts maintained by the focal individual s and our unshared triadic knowledge overlap variable was not adjusted by the number of closed triads surrounding s that did not involve the focal respondent r. We have focused on the unadjusted knowledge variables for the same reason we focused on the unadjusted network variables. However, models that use the adjusted network and knowledge variables lead to the same substantive conclusions as the models that use the unadjusted network and knowledge variables.
marginal strength of the relationship from s to r at time t.

\[
Tie\ strength = Z_{srt} = \frac{N_{srt} + N_{rst}}{\max(N_{sqt} + N_{qst})}
\]

Our indicator of network centrality is the extent to which an individual was involved in relatively strong knowledge transfer relationships.

\[
\text{Recipient’s centrality} = \sum_{q} Z_{rqt}
\]

\[
\text{Source’s centrality} = \sum_{q} Z_{sqt}
\]

Prior research has also established that similarity with respect to demographic characteristics, such as age, gender, and tenure can affect knowledge sharing behavior. Our demographic data is limited. We only have demographic data for gender. To control for any effect gender-based similarity can have on the knowledge transfer process, we created two indicator variables, both female and both male. The both female indicator is set equal to one if the recipient and source were both female and remained equal to zero otherwise. The both male indicator variable was set equal to one if the source and recipient were both male and remained equal to zero otherwise. Interactions involved men and women were the excluded category in our analysis. We also controlled for similarity with respect to work roles and responsibilities. The firm formally distinguished forty-seven job classifications (e.g., data analyst, SAS programmer, director, Senior IT Security Specialist). While we know each individual’s classification, we do not know exactly the activities each job classification entails. With more detailed information on what each work activity entailed, we could construct an indicator of how much two individuals overlapped in their work roles and responsibilities and therefore, the extent to which they were potentially more relevant as knowledge exchange partners. To control for any influence that task similarity could have on knowledge sharing, we created an indicator variable for pairs of classifications (e.g., SAS programmer and data analyst). Three hundred and eighty-two of the job classification pairs had a sufficient number of
observations to be included as controls in our models. The indicators variables are estimated in our model but are not displayed in the tables.

We know where each individual worked and so could control for the extent to which two individuals worked at the same geographic location. It is important to control for geographic proximity because two individuals who are in close proximity have more opportunities to develop stronger network connections or to simply become more aware of each other. Either dynamic could increase the odds of a knowledge source responding a question posted by a potential recipient. Our same geographic location variable is set equal to one if the potential recipient and source work at the same location and remains equal to zero otherwise.

4. Empirical Results

17,386 questions were posted to the technical forum during the 16 month period we studied.\(^6\) 1,201 individuals could have responded to each question. The 17,386 X 1,201 question-source pairs are the units of analysis. We have multiple observations for each potential recipient \(r\) and we have multiple responses from each knowledge source \(s\). The observations are clustered within knowledge sources and within potential recipients. Clustering can artificially reduce the size of our standard errors and inflate our significance tests. To adjust our standard errors for clustering, we introduced a random effect for each knowledge source and for each knowledge recipient. The crossed random effects adjust our standard errors for clustering. The individual random effects also allow us to control for the influence of unobserved and unmeasured factors (e.g., age, and tenure) could have had on the knowledge transfer process. While the crossed random effects controlled for unmeasured features of an individual either as a source or a recipient, they do not control for unobserved features of a relationship between two individuals

\(^6\) Our empirical results lead to the same substantive conclusions if we ignore the first 6 months of the technical forum.
that could have affected the likelihood they would initiate and continue to share knowledge with each other. To control for unmeasured features of each relationship that could have affect knowledge transfer, we also introduced a dyadic random effect for every pair of individuals (Reagans 2011).

While we are concerned with how unshared internal cohesion affects the knowledge transfer process, the estimates for shared internal cohesion are informative. We considered two distinct kinds of interactions in our empirical analysis. We first considered how our network variables affected the likelihood an individual would initiate a knowledge transfer relationship and then we considered how the same network variables affected the likelihood a knowledge transfer relationship would be sustained over time. The individuals in column 1 had never shared knowledge with each other. The estimate for shared internal cohesion in column 1 is positive and significant. The estimate indicates that a knowledge source was more likely to respond to a request posted by a network neighbor. The results in model 2 focus on individuals who had shared knowledge with each other in the past. The results indicate that shared internal cohesion increased the likelihood a knowledge source would sustain a knowledge transfer relationship. The estimates in models 1 and 2 illustrate the positive effect shared internal cohesion can have on the knowledge transfer process. Shared internal cohesion made it more likely a knowledge source would respond to a question posted by a colleague and would continue to respond to future requests. The estimates from models 3 and 4 illustrate the negative effects cohesion can have on external relationships. The individuals in column 3 were disconnected while the individuals in column 4 had shared knowledge with one another in the past. The estimate for unshared internal cohesion is negative and significant in models 3 and 4. Unshared internal cohesion made it less likely a source would respond to a question and even if the source had responded to a previous request (perhaps when unshared internal cohesion was lower), that he or she would continue to respond to future inquiries. Overall, the results in
models 1-4 illustrate the tradeoff associated with cohesion. Cohesion facilitates knowledge transfer among insiders but undermines sharing knowledge with outsiders.

Our predictions are tested in models 5 and 6. The individuals in model 5 had never shared knowledge, while the individuals in model 6 had. Model 5 contains an interaction between unshared internal cohesion and unshared triadic knowledge overlap. Model 6 includes a three-way interaction between our tie strength variable, unshared internal cohesion and unshared triadic knowledge overlap because the source and recipient had shared knowledge previously. It can be difficult to interpret two-way and three-way interactions, so we calculated the simple slope for unshared internal cohesion when unshared triadic knowledge overlap was high (i.e., 1.5 standard deviations above its mean) and low (1.5 standard deviations below its mean) (Aiken et al. 1991). The results for the estimates in model 5 are in table 2. When we focus on individuals who have never shared knowledge, the results indicate that the negative unshared internal cohesion effect was less negative when unshared triadic knowledge overlap was high versus when unshared triadic knowledge overlap was low. We observed similar results when we focused on individuals who had shared knowledge before. In addition to calculating the simple slope for unshared internal cohesion when unshared triadic knowledge overlap was high and low, we also considered variation in tie strength and looked at the simple slope when tie strength was high and low. The results are in table 3. The negative effect that unshared internal cohesion had on continuing to share knowledge was less negative when unshared triadic knowledge overlap was high versus when it was low. The magnitude of the negative unshared internal cohesion effect doesn’t appear to vary with the strength of the relationship between the knowledge source and recipient. Overall, the results provide support for our second prediction. The observed estimates indicate that the negative effect that cohesion had on relationships with outsiders declined as the amount of knowledge overlap in the focal neighborhood increased.
5. Summary and Discussion

The managers at our firm were interested in encouraging knowledge transfer in an online context. Individuals varied in terms of the scope of their work requirements, with some individuals having more scope and therefore in a position to benefit from a wide variety of knowledge sources, but the managers believed that the technical forum would be beneficial for everyone. We shared with the managers what we knew about how different network features contributed to knowledge sharing behavior in informal offline networks. We focused in particular on the benefits associated with increasing cohesion in a network neighborhood or community. Given the rationale for creating the online technical forum, however, we were sensitive to the potential downsides associated with increasing cohesion in a network neighborhood. If we were going to encourage the managers to build cohesive network neighborhoods online, we needed to be sensitive to when the benefits associated with internal cohesion would come at the expense of external knowledge transfer relationships. Recall that the online technical forum was initiated to encourage knowledge transfer between different geographic locations. If increasing cohesion in a network neighborhood encouraged knowledge transfer among neighbors but undermined knowledge sharing with external colleagues, we would simply be replacing one kind of social segregation with another kind. Thus, the challenge was to identify factors that could moderate any negative association between internal cohesion and external knowledge transfer relationships.

When we considered the most frequent explanations for why internal cohesion promoted knowledge sharing within neighborhoods, we found somewhat parallel explanations for why knowledge overlap encouraged knowledge transfer. Similarity-based explanations for internal cohesion suggest that when coupled with knowledge overlap, any negative effect internal cohesion can have on external knowledge transfer relationships would be even more negative. When cohesion and overlap are high, similarity is consolidated and thus the boundary between insiders and outsiders is clear with the predictable effect on in-group and out-group interactions.
Reputation-based explanations for internal cohesion suggest that when coupled with knowledge overlap, any negative effect would decline. Relationships with outsiders start to decay when a network neighborhood becomes more demanding, but at least in the context of knowledge transfer, increasing knowledge overlap makes it easier for an individual to meet internal obligations, while simultaneously maintaining external knowledge transfer relationships.

Consistent with Granovetter’s original idea, we found increasing cohesion in a network neighborhood promoted knowledge transfer within the neighborhood but also made it more difficult for an individual to initiate and sustain external knowledge transfer relationships. When internal cohesion was high, external ties were less likely to develop and to be maintained over time. The negative internal cohesion effect was moderated by the amount of knowledge overlap in the focal neighborhood. The magnitude of the negative association between cohesion and external ties declined and became less negative as knowledge overlap in the focal neighborhood increased. The empirical results suggest that at least for the knowledge workers in our study population, internal cohesion had more to do with reputation and less to do with social similarity. Of course, one could say our findings aren’t surprising because the managers in our firm were watching and so it seems obvious that individuals shared knowledge out of concerns for their reputations, in particular their reputations in the eyes of management. This rationale could help to explain the volume of knowledge sharing behavior we observed but not the variation in knowledge sharing behavior we observed.

Our empirical results were more consistent with the reputation-based view of cohesion, but it would be a mistake to reject the similarity-based approach all together. Indeed, while the two approaches are conceptually distinct, they are also related. The reputation costs associated with uncooperative behavior could be higher when an individual identifies with the social or demographic characteristic that defines social similarity (Coleman 1988; Grief 1993). The threat of punishment matters more when an individual values the social relationships that are at risk, and this is more likely when individuals are similar and identify with their shared
characteristic. People who share a demographic characteristic can also compete against each other for attention (Reagans 2005). And the more socially similar people compete against each other for attention, the more willing they should be to engage in activities that put their relationships with each other at risk in the pursuit of status, including utilizing ideas and information developed outside the group (Menon and Pfeffer 2003; Menon et al. 2006). This line of thinking provides a point of integration across the two perspectives and suggests that a key moderator for the cohesion effect on external ties is the extent to which similar people identify with their shared characteristic or compete against each other for attention, which in turn should shape the extent to which cohesion in a neighborhood either curtails or encourages external relationships and activities. The reputation-based approach we discussed is between the two end points and represents the reputation-costs an individual experiences in a diverse group or community. Data limitations prevented us from testing these kinds of issues, which is a clear limitation to our approach.

Despite these limitations, our findings have important theoretical and managerial implications. Consider, for example, a manager who would like to create a work environment that encourages the transfer of knowledge between individuals with diverse or non-overlapping areas of expertise? One alternative is for the manager to create communities that were heterogeneous with respect to knowledge and encourages the members of each community to share their knowledge and expertise. Our empirical results, however, suggest that this configuration could undermine knowledge sharing behavior. Among our knowledge workers, the positive effect that shared internal cohesion had on knowledge transfer was less positive when the degree of knowledge overlap in a neighborhood was low. And moreover, when knowledge overlap in a neighborhood was low, each member was less likely to initiate and sustain relationships with outsiders, presumably because when knowledge overlap was low, sharing knowledge with community members was more demanding and time consuming. An alternative is to create homogenous communities and encourage individuals to initiate and
cultivate external knowledge transfer relationships that provide access to diverse knowledge and expertise. Our results suggest that this alternative arrangement could be more effective.

This isn’t to say that heterogeneous neighborhoods aren’t beneficial. In particular, prior research suggests that more frequent exposure to diverse knowledge and expertise can increase an individual’s capacity for sharing knowledge and can promote creativity and innovation (Burt 2010; Reagans and McEvily 2003). When network neighborhoods are heterogeneous, more individuals acquire this capacity, while only a small number of “knowledge brokers” acquire this capacity when network neighborhoods are homogenous (Levina and Vaast, 2005). Thus our findings inform management practice by helping us to understand and appreciate what kinds of network-based benefits are more likely to emerge under the different arrangements.

Finally, our research clarifies an important theoretical question. Granovetter’s strength of weak tie argument has captured our imagination for over 30 years. Granovetter developed a framework which not only explained why bridges were valuable, but also the dynamics which allowed for bridges to be maintained. While more recent research has clarified how much tie strength contributes to the benefits bridges can create, the fundamental lesson remains the same. Network connections that act as bridges between neighborhoods provide access to more diverse knowledge and information. Bridges can also be a source of power and influence (Burt 1992; Burt 2010; Reagans and Zuckerman 2008a, b). The idea that strong ties in a network neighborhood undermine bridges has also captured our imagination. The field has made less progress on the network origin question. In general, social capital researchers have made more progress when they have analyzed network effects, such as the association between bridges and performance. It has been more difficult for researchers to nail down the dynamics that shape and influence the network formation process, such as the dynamics that facilitate and undermine bridges. Therefore, it isn’t surprising that the empirical evidence on the internal cohesion tradeoff has been more mixed. Given the mixed empirical results, we
focused on a potential contingency. We were interested in knowledge transfer and so we focused in particular on knowledge overlap in a neighborhood. We found that the degree of knowledge overlap in a network neighborhood offset the negative effect that cohesion in the neighborhood had on external knowledge transfer relationships. Our findings suggest that any negative effect that internal cohesion can have on external ties was reputation-based. The results suggest that cohesion will undermine external activities when the focal neighborhood is “greedy” and more demanding, or in general the more individuals are worried about putting relationships with insiders at risk.

Finally, our results also illustrate the benefits associated with considering network content in addition to network structure. What the technical workers where sharing (i.e., the content of the connections) ultimately shaped the association between internal cohesion and external connections. Perhaps it would be worthwhile for network-based arguments to consider the content of what is being shared. At least in our case, what was being shared, allowed us to see our network effects more clearly.

References


Reagans, R.E., E.W. Zuckerman. 2008a. All in the family: reply to Burt, Podolny, and van de Rijt, Ban, and Sarkar. *Industrial and Corporate Change* 17(5) 979-999.


Figure 1: Shared and Unshared Cohesion
<table>
<thead>
<tr>
<th>Predictors</th>
<th>Disconnected Model 1</th>
<th>Disconnected Model 2</th>
<th>Disconnected Model 3</th>
<th>Disconnected Model 4</th>
<th>Connected Model 5</th>
<th>Connected Model 6</th>
<th>Connected Model 7</th>
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<tbody>
<tr>
<td>Tie Strength (TS)</td>
<td>1.311**</td>
<td>1.329**</td>
<td>1.371**</td>
<td>1.399**</td>
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<td>Knowledge Overlap</td>
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<td>Dyadic Knowledge Overlap (DKO)</td>
<td>0.712*</td>
<td>0.881**</td>
<td>0.684*</td>
<td>0.813**</td>
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<td>0.452***</td>
<td>0.427***</td>
<td>0.342***</td>
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<td>Shared Triadic Knowledge overlap (STKO)</td>
<td>0.448***</td>
<td>0.764***</td>
<td>0.714***</td>
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<tr>
<td>STKO X TS</td>
<td>0.271*</td>
<td>0.167*</td>
<td>-0.091</td>
<td>-0.254*</td>
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<td>Unshared Triadic Knowledge overlap (USTKO)</td>
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<td>-0.254*</td>
<td>-0.289**</td>
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<tr>
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<td>Shared Internal Cohesion (SIC)</td>
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<td>2.218***</td>
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<td>SIC X STKO</td>
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<td>USIC X USTKO</td>
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<td>0.314***</td>
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<td>Recipient’s Centrality</td>
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<td>Source’s Centrality</td>
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<td>Same Geographic Location</td>
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<td>0.738***</td>
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<td>20,532,866</td>
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<td>Model Fit (McFadden’s R-Squared)</td>
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<td>Log Likelihood</td>
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<td>-69436.1</td>
<td>-100081.3</td>
<td>-67192.9</td>
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</tbody>
</table>

The stars in table 1 indicate significance levels. * = p < .10, ** = p < .05, and *** = p < .001.
### Table 2: Marginal Unshared Internal Cohesion Effect for Disconnected Dyads

<table>
<thead>
<tr>
<th>Unshared Triadic Knowledge Overlap</th>
<th>High Unshared Triadic Knowledge Overlap</th>
<th>Low Unshared Triadic Knowledge Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>High unshared triadic knowledge overlap</td>
<td>$b(1) = -1.982, p &lt; .001$</td>
<td>$b(2) = -4.103, p &lt; .001$</td>
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<tr>
<td>Low unshared triadic knowledge overlap</td>
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</tr>
</tbody>
</table>

A Wald test indicates that $b(1)$ is greater than $b(2)$ ($p < .001$).

### Table 3: Marginal Unshared Internal Cohesion Effect for Connected Dyads

<table>
<thead>
<tr>
<th>Unshared Triadic Knowledge Overlap</th>
<th>High Tie Strength</th>
<th>Low Tie Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>High unshared triadic knowledge overlap</td>
<td>$b(1) = -2.175, p &lt; .001$</td>
<td>$b(2) = -2.209, p &lt; .001$</td>
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<tr>
<td>Low unshared triadic knowledge overlap</td>
<td>$b(3) = -4.558, p &lt; .001$</td>
<td>$b(4) = -4.839, p &lt; .001$</td>
</tr>
</tbody>
</table>

Wald tests indicate that $b(1)$ is greater than $b(3)$ ($p < .001$) and that $b(2)$ is greater than $b(4)$ ($p < .001$).