Chapter Seven

The Co-evolution of Friendship and Leadership Networks in Small Groups

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ABSTRACT

This study examines the dynamic interplay of friendship and leadership networks. We collected whole-network panel data-- at two intervals, four months apart-- from all 25 members of a small group of elite students at a large Midwestern university. Using the software program SIENA, we analyzed network dynamics using a stochastic actor-based approach that modeled network change as a Markov process evolving in continuous time. We found statistically significant differences in the structure and dynamics of friendship and leadership networks at the dyadic, triadic, and network level of analyses. Our findings offer new theoretical insights into how friendship and leadership relations co-evolve in an interdependent work group.

INTRODUCTION

Human groups are more than mere averages of the characteristics of their members: They are also structured patterns of interpersonal relations. Some members see one another as friends; others don't. A few individuals are seen as leaders; most are not. These different and crisscrossing interpersonal relations can influence one another over time. Group members who share one kind of relation (e.g., friendship) can come to share a different kind of relation (e.g., leadership). The idea that members of human groups are connected through structured informal relations, of course, is not new (e.g., Durkheim, 1893; Moreno, 1935). What is new is the precision and theoretical sophistication with which the structure of these relations has come to be represented and analyzed. The burgeoning research on "social network analysis" has shown that the structure of informal group relations can have consequences for a number of important outcomes, such as the satisfaction and performance of group members (for a review, see Kilduff & Tsai, 2003). Yet, despite the advances in our knowledge of the consequences of social networks in small groups, fundamental questions related to how different social networks arise and co-evolve remain unanswered.

Consider, for example, the relationship between friendship and leadership in groups. Some of the earliest work on social networks examined how popularity in friendship networks may be related to the attainment of leadership status in the eyes of group members (e.g., Jennings, 1943, 1947). A number of subsequent studies have shown that the two relations are modestly correlated (e.g., Bass, 1960; Borgatta, 1954; Schneider et. al., 2002). But does friendship lead to perceptions of leadership? Or do we come to befriend the people we see as leaders? And how do the two kinds of relations interact and influence one another over time? Do we, for example, come to see the friends of people we view as leaders as leaders, too? We understand that leadership can be influenced to emerge under specific conditions for appointed project managers but we need to understand the curious role of friendship

(Graen, Hui, & Taylor, 2006). More generally, how do friendship and leadership networks change and co-evolve in human groups?

There are at least two reasons these questions have gone unanswered despite decades of research on the structure and consequences of social networks in groups. First, answering these questions requires the adoption of longitudinal research designs, but most network research to date has tended to rely on cross-sectional designs instead. Second, traditional statistical techniques for network analysis are inadequate for persuasively teasing out patterns of co-evolution between multiple networks because of the dependence structures that underlie network genesis and development (for a detailed methodological discussion, see Snijders, 2005).

In this paper, we collected whole-network panel data-- at two intervals, four months apart-- from all 25 members of a small group of elite students at a large Midwestern university to examine the dynamic interplay of friendship and leadership networks. We analyzed network dynamics using a stochastic actor-based approach that modeled network change as a Markov process evolving in continuous time. We constructed and tested hypotheses that focus on differences in the structure and dynamics of friendship and leadership networks at the dyadic (2 person), triadic (3 person), and network (all group members) level of analyses. Finally, we examined how friendship and leadership relations influenced one another over a period of four months.

Theory and Hypotheses

Network Genesis

Where do social network ties come from? One answer that has received a clear and consistent support focuses on the readily observable characteristics of people. From this "homophily" perspective, people are drawn to similar others, where similarity is based on such readily observable features as gender and race. In organizational groups, the evidence clearly shows that individuals tend to cluster on

the basis of gender (e.g., Ibarra, 1992) and race (e.g., Mehra, Kilduff, & Brass, 1998), especially when it comes to voluntary, expressive relations like friendship.

Going beyond the well-established effects of homophily, a possible source of new network ties may be existing ties: Ties of one kind (e.g., friendship relation) could be the basis on which ties of another kind (e.g., leadership relation) are built. An existing friendship tie between two parties increases the likelihood of interaction and resource exchange among the parties (e.g., Homans, 1958). This exposure and exchange are likely to generate trust and respect over time, both of which are fundamental ingredients for the development of leadership relations (e.g., Dirks, 2006). In work groups, trust is a crucial element of effective leader behaviors (e.g., Fleishman & Harris, 1962) and effective leader-member exchange (Graen & Cashman, 1975; for a review of this evolving theory, see Miner, 2005). Not all friendship relations turn into leadership relations, of course. But the trust that results from ongoing friendly interactions should increase the likelihood of the development of a future leadership relation.

Hypothesis 1: If A sees B as a friend, then A is more likely to see B as a leader in the future.

Network Dynamics

How do friendship and network ties grow over time? Two well-known engines of network growth are those of "*reciprocity*" and "*transitivity*" (for reviews, see Wasserman & Faust, 1994; Monge & Contractor, 2003). As shown in Table 1, if A sees B as a friend, then, over time, B is likely to see A as a friend, too. We tend to reciprocate relations over time by liking the people who like us. At the triadic level of analysis, there is rich theory (e.g., Holland & Leinhardt, 1975) and evidence to suggest that social network ties tend to be transitive such that if there exists a tie between A and B and a tie between B and C, then, over time, there is likely to emerge a tie between A and C. Individuals who share mutual friends are more likely to develop future friendships than individuals who lack mutual friends.

Insert Table 1 here

However, it seems likely that although reciprocity and transitivity characterize expressive relations such as friendship, they may be less applicable to cognitive relations, such as leadership. Humans tend to experience "cognitive strain" when their friendships are not reciprocated (Festinger & Hutte, 1954; Heider, 1958). But it seems less likely that they will experience strain when their nominations of leadership are not reciprocated. This is because cognitive strain in unreciprocated relations is, at least in part, normatively derived: we are socialized to expect reciprocation in friendship relations (Heider, 1958). But the norms for leadership relations are different: we expect leadership to be hierarchical rather than mutual. This leads us to hypothesize that:

> *Hypothesis 2:* Reciprocity (if A→ B at time 1, then B→ A at time 2) and transitivity (if A→B and B→C at time 1, then A→ C at time 2) will tend to characterize the growth of friendship networks but not leadership networks.

A different engine of network growth is captured by so-called "preferential attachment" (Barabasi & Albert, 1999; cf. Merton, 1968). The idea behind this principle of network growth is that nodes that already have lots of ties are more likely to be the recipients of new ties. This principle of growth through preferential attachment has been shown to apply more generally across different kinds of physical networks (Barabasi & Albert, 1999). For example, scientific papers that have received many citations tend to be more cited in the future than those papers that have received fewer citations: articles gain citations over time in a manner that is proportional to the number of citations the article

has already received (Price, 1965). The applicability of preferential attachment models to the study of social networks in small groups, however, has received little empirical attention. Here we argue that the dynamics of both friendship and leadership networks will follow the pattern and logic of growth through preferential attachment. Individuals who receive many nominations are likely to attract proportionally higher nominations over time because individuals who are well connected are likely to be perceived as possessing high social status and as having greater access to social resources.

Hypothesis 3: The likelihood of a person attracting friendship/leadership ties in the future is proportional to the friendship/leadership ties they have in the past.

In human groups, individuals who are perceived to be connected to resourceful others are often seen as resourceful themselves. For example, research in work organizations has shown that someone perceived to be the friend of a positively valued other is also likely to be perceived positively. In particular, the performance reputations of people with prominent friends tend to benefit from the perception that they are linked to those friends (Kilduff & Krackhardt, 1994). It has been argued that this "basking-in-reflected-glory" effect involves deliberate attempts by people to garner positive evaluations by emphasizing their ties to prominent individuals (Cialdini et. al., 1976). Although previous research has examined how this effect may influence workplace performance, the basking-in-reflected glory has received little attention in the context of perceived leadership. Here we ask the question: If A views B as a leader, and B views C as a friend, does A come, over time, to see C as a leader? Colloquially, do we come to see the friends of the people we view as leaders as leaders, too? Building on homophily theory (Lazarsfeld & Merton, 1954), we believe the answer to this question is affirmative. Not only do people tend to befriend similar others, they expect that others befriend people on the basis of similarity, too. According to this logic, people who one sees as leaders are expected to associate with people who also possess leadership characteristics. Thus,

Hypothesis 4: The friends of people one views as a leader will also come to be seen, over time, as leaders (If at T1 (A sees B as a leader; and B sees C as a friend), then at T2 A sees C as a leader).

METHODS

Sample

We tested our hypotheses using "whole-network" panel data from a 25 member group of "elite" first-year, undergraduate business students at a large Midwestern University. These students were selected by the undergraduate "honors" selection committee on the basis of high standardized test scores, high-school GPA, and clear evidence of "leadership potential" (as judged by past achievements, letters of recommendation, and performance in face-to-face personal interviews). The members of this elite group were co-located in a dorm on campus. They took most classes together, and they tended to participate in many informal events (e.g., fund drives, sporting events, and other campus activities) with each other. Every member of this elite group of undergraduates received a full scholarship from the college. At the time the data were collected, the entire "honors" group was working on a "real world" project with a local company. This project required them to learn about and prescribe future business strategies for the company. Students self-organized to work on the project—there was no formally appointed leader. The final product was a poster presentation that was displayed in the lobby of the business school, two months after our final data collection. Students were graded on their contributions to the team project.

Data

Whole-network data (a design where every member of the group provided data on his/her relations with every other member of the group) for this study were collected at two time points, roughly four months apart. For each time point, questionnaires were distributed in class by the principle investigators. The questionnaires took on average about 15 minutes to complete. Data on gender and race were collected separately, in an earlier survey. All 25 honors students responded to the questionnaire. Data on SAT/ACT scores were collected directly from the college.

We collected data on two kinds of relations, friendship and leadership. Specifically, on the questionnaires, we asked respondents to look down a list of names of their fellow group members and identify (by placing a check in the appropriate box) the individuals they considered "close personal friends." Similarly, we asked respondents to look down a list of names of their fellow group members and place a check next to the name of the individual(s) whom they saw as a "leader." We did not specify what we meant by the term "leader" because we were interested in capturing respondents' implicit or naïve theories of leadership (cf. Lord & Maher, 1993:11). We conceive of attributed leadership as a phenomenological construct: A leader is someone who is perceived as such by others (Calder, 1977; Pfeffer, 1977; Meindl, 1993). Our approach to conceptualizing and assessing leadership perceptions is consistent with both early research on the linkages between social networks and leadership perceptions (for a review, see Shaw, 1964) and the more recent work that has sought to revive and reinvigorate this classic line of inquiry (e.g., Mehra, Dixon, Brass, & Robertson, 2006).

The data on friendship and leadership were used to construct two separate 25 x 25 matricies where a value in row i, column j of a matrix represented whether I perceived j as a friend (and, in the separate matrix, as a leader).

Analysis

Analysis of dynamic networks with standard statistical methods (e.g. regression) is problematic due to the interdependence of network observations over time (Burk, Steglich, & Snijders, 2007; Snijders, Steglich, & van de Bunt, 2008a). However, recent methodological innovations have made it possible to analyze network panel data through actor-based simulations (Snijders, 2005; Snijders, 2001). This modeling approach posits that choices by actors in the network are stochastic processes "driven by actors" based on inherent network structures, actor covariates (attributes), and dyadic covariates (pairs of nodes) (Snijders et al., 2008a: 1). This approach assumes that the actors in the network and all possible network behaviors of those actors (i.e. creating a tie, dissolving a tie, maintaining at tie) represent the "state space" of all possible actor choices between discreet time points (Burk et al., 2007; Snijders et al., 2008a). Network structures from one state to the next are assumed to be connected by a series of steps, or discreet stochastic actor choices, generally interpreted as a Markov process such that "the probability distribution of the future network given current and past states of the network is a function only of the current network" (Snijders et al., 2008a: 4).

Although network observations are only made at two or more time periods, the intermediate steps between these "snapshots" are presumed to reflect actor choices, modeled as independent behaviors or decisions. According to Snijders (2008a) important assumptions of the stochastic actor–oriented model are: 1) the time parameter is continuous—while the networks are single time points, the "time" between networks is continuous to allow for the decisions of actors between network states, 2) network change is due to a Markov process as described above, 3) actors can change their outgoing ties only 4) an actor is probabilistically chosen to change one tie at a time—so ties are not coordinated, but are only sequential, 5) the 'change rate' of actors is based on the actors network position and actor covariates, and 6) the probabilities of tie changes are based on actor network position and actor

covariates as well as the other actors in the network (see Snijders et al., 2008a; Steglich, Snijders, & Pearson, 2008 for more complete discussion of the technical aspects of model assumptions).

Parameters are included in the model to estimate the endogenous and exogenous effects on actor choices in the networks. Essentially, the actor-based stochastic model provides a method of probabilistically deriving actor choices, based on selected effects. Whether or not an actor changes a tie is based on the actors *objective function*, which represents the value of an actor's choice to change a tie or to do nothing (Snijders et al., 2008a). The objective function is a linear combination of effects chosen by the researchers, weighted by parameter estimates, which reflect the actor choices to be studied in the analysis. These effects, such as reciprocity or transitivity, are from the perspective of the actor, and the parameter estimates are the probabilistic tendency to act on a particular effect depending on the network, but the tendency to act can also depend on the attributes of the actor or others in the network (Snijders et al., 2008a).

Thus, for dynamic network analysis, actor-based simulation models can test probabilistic actor choices for networks over time based on theoretically derived actor effects. And it is important to note that the parameter estimate in the objective function is close to normally distributed, and can therefore be tested with a t-test (Snijders, Steglich, Schweinberger, & Huisman, 2006; Snijders et al., 2008a).

Longitudinal network data for this study were analyzed with a the actor-based model simulation using SIENA (Snijders et al., 2006; Snijders et al., 2008b) as part of a publicly available software package called StOCNET (Boer, Huisman, Snijders, Steglich, Wichers, & EPH, 2006). Additional network analysis were performed in UCINET 6.207 (Borgatti, Everett, & Freeman, 2002).

Formulas describing how transitivity and reciprocity (hypothesis 2), preferential attachment (hypothesis 3), and "network transference" (hypothesis 4) were assessed are provided in Table 1. We controlled in our analysis for the likely effects of homophily by including as covariates in the analysis

matricies that captured in cell I,j whether or not i and j were similar in terms of gender, race, and SAT/ACT scores. Our analytic technique also included a parameter that controlled for the overall tendency for networks to grow over time (see Snjiders et. al. 2006).

RESULTS

The members of the group had an average SAT/ACT score of 1274. 64 percent of the group members were male; and 90 percent were White.

Place Table 2 and Figures 1a&b & 2a&b about here

Figures 1a and 1b show the friendship network at times 1 and 2 respectively. Figures 2a and 2b show the leadership networks at time 1 and time 2 respectively. The figures show clear evidence of gender-based homophily in the friendship network, but homophily appears to play little role in the leadership network. The figures also show that the friendship network was denser than the leadership network at both time periods (density for friendship network at T1= .45, and at T2= .54; density for leadership network at T1=.20, and at T2=.18—density is a measure of the number of ties relative to the total number of possible ties in a network). The friendship network grew in size from a total of 270 ties at T1 to 325 ties at T2. Over the same time period, the leadership network shrunk from a total of 120 ties at T1 to 110 ties at T2.

In analyses not reported here, we examined the birth and death of network ties over time in the friendship and leadership networks. The rate at which new friendship ties were born (i.e., ties that existed at T2 but not at T1) was almost three times higher than the rate at which new leadership ties were formed (105 new friendship ties at T2 versus 33 new leadership ties at T2). However, the mortality rate (i.e., ties that existed at T1 but not at T2) for leadership ties was greater than it was for friendship ties (35.83% and 18.51% respectively).

Although the friendship and leadership networks were significantly correlated (QAP correlation = .51 at T1, and .34 at T2; p<.001), the results in Table 2 show that they were clearly different in terms of size, structure, and dynamics. Correlational analyses alone would provide a misleading picture of the extent of network change over time.

Our first hypothesis predicted that friendship relations can generate new leadership relations. If A sees B as a friend, then A is more likely to see B as a leader in the future. The results of the SIENA analysis, presented in Table 3, show that this prediction was supported (t = 3.192, p < .001). Interestingly, the analysis also show that leadership relations do not lead to friendship relations (t = -.390, p = ns). Friendship was not a prerequisite for leadership. Note that the results in Table 3 control for the effects of similarity on the basis of gender, SAT/ACT scores, and ethnicity. Hypothesis 1, therefore, received strong support.

Our second hypothesis predicted that symmetry and transitivity would characterize the pattern of network growth for the friendship network but not for the leadership network. In support of this hypothesis, the results in Table 3 show that whereas there was support for transitivity as an engine of growth in the friendship network (t = 6.938, p < .001) it did not explain growth in the friendship network (t = -0.352, p = ns). However, there was no evidence that reciprocity explained growth in the friendship network (t = -1.397, p = ns). Hypothesis 2 received mixed support.

Our third hypothesis predicted that the logic of preferential attachment would characterize growth in both the friendship and leadership networks. The results reported in Table 3 show that this prediction received support for the leadership network (t = 3.086, p < .01), but the results were in the *opposite* direction for the friendship network (t = -2.055, p < .05). The likelihood of a person attracting leadership ties in the future was proportional to the leadership ties they had in the past. But the

likelihood of a person attracting friendship ties in the future was inversely proportional to the friendship ties they had in the past. Hypothesis 3, therefore, was only supported for the leadership network.

Place Table 3 about here

Our fourth hypothesis predicted that the friends of people who a person views as a leader will also come to be seen as leaders. The results presented in Table 3 show that this hypothesis was supported ($t = 3.471$, $p < .001$; cf. Graen chapter three on the process of forming competence networks of leaders.)

DISCUSSION

Our study used an innovative methodological approach to examine the dynamics and co-evolution of friendship and leadership networks in a work group setting. Although there has been a great deal of research on friendship networks in groups, and some research on leadership networks in groups, these two networks have only rarely been jointly examined. When they have, the research design has tended to be cross-sectional, making it difficult to understand how friendship and leadership networks evolve and influence one another over time. Despite the small sample size, our longitudinal results offer a rare glimpse into the similarities and differences in how friendship and leadership networks emerge and influence one another over time.

At the dyadic level, we found that friendship leads to leadership but not the other way around. If a person sees another as a friend, they are more likely to come to see them as a leader than someone they had not previously seen as a friend. However, leaders do not become friends over time. We further expected that the pattern of growth in friendship network would reflect reciprocity, but we did

not find support for this prediction. It may be that the four month time frame we observed was not long enough for the full effects of reciprocity to emerge. We did, however, find support for the idea that growth in the friendship network reflected the principle transitivity. If in the first time period A saw B as a friend, and B saw C as a friend, then, in the second time period, A reported C as a friend. Growth in the leadership network, by contrast, did not reflect either reciprocity or transitivity, as we had predicted. This pattern of results suggests that the engines of network growth are different for friendship and leadership networks (for a complementary pattern of results, see Graen, Hui, & Taylor 2006).

Our study also found that friendship and leadership networks differed in terms of how the number of prior ties a person possessed influenced the number of future ties the person received. Prior work has found that the likelihood of a node in a network attracting new ties in the future is proportional to the friendship and leadership ties they had in the past. We found that this principle of growth through preferential attachment applied to the leadership network: people attracted new leadership nominations at T2 in a manner proportional to the number of ties they had at T1. But the pattern was reversed for friendship: the likelihood of attracting new ties at T2 was negatively related to the number of ties the person attracted at T1. In the leadership network, the rich got richer. In the friendship network, the rich got poorer.

A potential explanation for this pattern of results is that in small groups, there is a relatively low carrying capacity for friendship. It may be that popular individuals in the friendship network are too busy to take on additional friends. Or it is possible that individuals assume that popular individuals already have too many friends to accept any new overtures of friendship. It is also possible that the perceived rewards of leadership become more attractive over time. Whatever the precise mechanism, our results suggest boundaries for what researchers have assumed is a general pattern of network

growth (Barabasi & Albert, 1999). Whereas growth through preferential attachment may appropriately describe growth in certain networks (e.g., leadership networks; or the pattern of which web sites link to which others on the internet), it may not apply to all networks.

We found that friendship and leadership networks differ in terms of their size, structure, and patterns of growth. But we also found that these networks co-evolve over time. For example, our results show that the friends of individuals who were perceived as leaders came themselves to be seen as leaders. There is prior cross-sectional evidence for this basking-in-reflected glory effect in the context of workplace performance. Our study provides longitudinal evidence to suggest that it may also apply in the context of leadership perceptions. However, it may also be that this perceptual effect is muted over longer periods of time as differences in getting group tasks accomplished become clearer.

Our study focused on network dynamics, but did not examine the consequences of these dynamics for group performance or member satisfaction. Prior work suggests that the degree of overlap between friendship and leadership can influence group performance (e.g., Graen, Hui, & Taylor, 2006). It is possible that the pattern of co-evolution that produces overlap between these networks is as important for understanding group outcomes as the degree of overlap appears to be. Future studies should combine our SIENA based modeling approach with objective and subjective measures of group performance and member satisfaction to address this intriguing possibility.

The group we examined in this study was non-hierarchical. There was no formally appointed leader or leaders in the group. This effectively allowed us to control for the likely effects of formal status on the structuring and co-evolution of friendship and leadership networks. But this focus on a student group also limits the generalizability of our results. It is unclear how the network dynamics we have reported here would unfold in a more formal, hierarchically structured workplace (see Graen and

associates on leadership emergence in groups with formal leaders). We call for future work using our modeling approach in hierarchical settings.

The focus of our study has been structural. Although we included the individual attributes of gender, race, and SAT/ACT scores as controls in our analysis, we did not include any of the other individual difference variables (such as differences in experience, or personality). It would be interesting to see how these deeper-level individual differences influence the dynamics and co-evolution of friendship and leadership networks. Perhaps there are systematic personality differences that are related to different network growth strategies. Some types of people (e.g., extraverts) may tend to seek popular friends; and others (introverts) may seek the opposite. Network research more generally has tended to ignore individual differences in node characteristics. We believe that the selective incorporation of individual differences could enhance the power and accuracy of network theories, including theories of network dynamics and co-evolution.

Conclusion

Friendship and leadership relations are ubiquitous in human groups. Our study suggests that these relations, while related, tended to (a) follow different logics of growth, and (b) co-evolve over time. The methods used in our study are specifically designed to deal with problems of dependency and autocorrelation that have hampered work on network dynamics. Our study suggests some answers to a few perennial questions: Does friendship lead to perceptions of leadership? (Yes.) Do we come to befriend the people we see as leaders? (No.) Can we come to be seen as leaders by befriending people who are seen as leaders? (Yes.) Do the rich get richer when it comes to leadership? (Yes.) Do the rich get richer when it comes to friendship? (No: they get poorer.) Although our study is modest and our results tentative, we hope it stimulates future researchers to take up the many unanswered questions related to the co-evolution of social networks and leadership in work groups.

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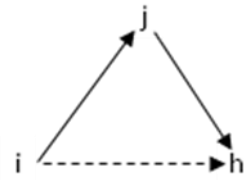
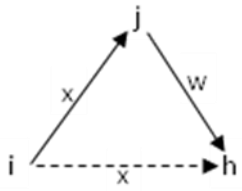
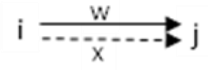
Table 1

Descriptions and formulas for network structural variables used in the analysis

Variable	Diagram	Description	Formula*
Reciprocity		The tendency for i to reciprocate ties over time.	$=\sum_j x_{ij}x_{ji}$
Transitivity		The tendency for i to create a tie to h over time, given that i has a tie to j, and j has a tie to h in the same network.	$=\sum_{j,h} x_{ij}x_{ih}x_{jh}$
Triadic Closure		The tendency for i to create a tie to h in network x over time when i has a tie to j in network x, and j had a tie to h in network w.	$=\sum_{j\neq h} x_{ij}x_{ih}w_{hi}$
Basking in reflected glory effect		The tendency overt time to nominate an individual who has been nominated by others	$=\frac{1}{n}\sum_j x_{ij}\sum_h x_{hj}$
Network Transfer		The tendency for i to nominate j in network x over time, when i has a tie with j in network w.	$=\sum_j x_{ij}(w_{ij}-\overline{w})$

Note: Dashed lines represent tie creation in time two, and solid lines represent ties at time one. In addition, i represents the focal actor, x is the dependent variable network, and w is the covariate network at time one.

TABLE 2

Network Descriptives

Network	Time 1	Time 2
Friendship		
Density	0.45	0.54
Average Ties Received	10.80	13.00
Overall Network Size	270	325
Leadership		
Density	0.20	0.18
Average Ties Received	4.80	4.40
Network Size	120	110

Table 3

Parameter estimates for Friendship and Leadership perceptions over time generated in SIENA

		Friendship Network				Leadership Network			
	Variable			*t-value*	*p-value*			*t-value*	*p-value*
1.	Gender similarity	0.560	(0.163)	3.436	< ***0.001***	-0.351	(0.267)	-1.315	*0.188*
2.	SAT/ACT Similarity	0.088	(0.536)	0.164	*0.869*	0.828	(0.837)	0.989	*0.322*
3.	Ethnic similarity	-0.409	(0.179)	-2.285	***0.022***	-0.160	(0.240)	-0.667	*0.504*
8.	Network transfer	-0.085	(0.218)	-0.390	*0.695*	0.849	(0.266)	3.192	***0.001***
4.	Reciprocity	-0.245	(0.175)	-1.397	*0.162*	0.130	(0.263)	0.494	*0.621*
5.	Transitivity	0.090	(0.013)	6.938	***0.001***	-0.019	(0.054)	-0.352	*0.724*
7.	Basking effect	-0.328	(0.160)	-2.055	***0.039***	4.613	(1.495)	3.086	***0.002***
9.	Closure	-0.005	(0.023)	-0.226	*0.821*	0.118	(0.034)	3.471	< ***0.001***

Note. The t-values refer to tests based on the t-ratio defined as parameter estimate divided by standard error. Standard errors are in parentheses. All tests are two-tailed. Although not reported here, both models controlled for growth in individual networks over time.

Figure 1 A

Friendship network at time one

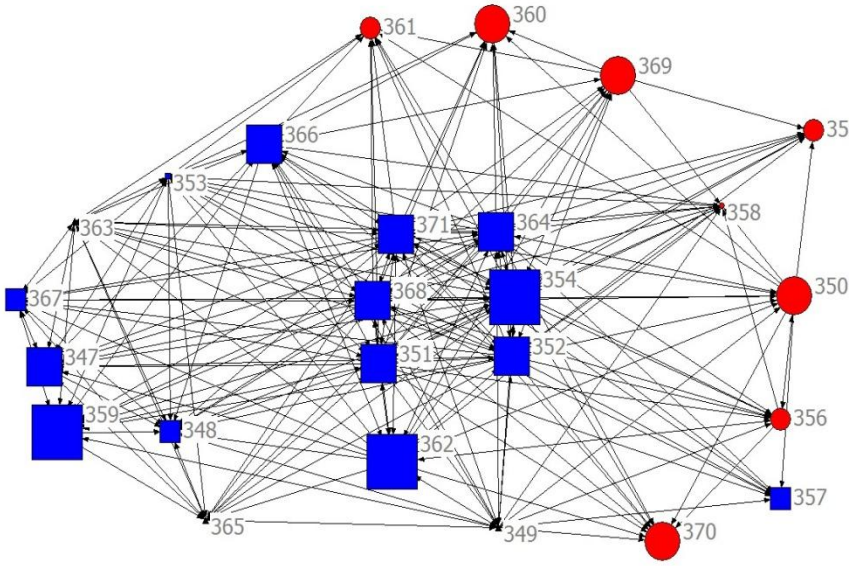
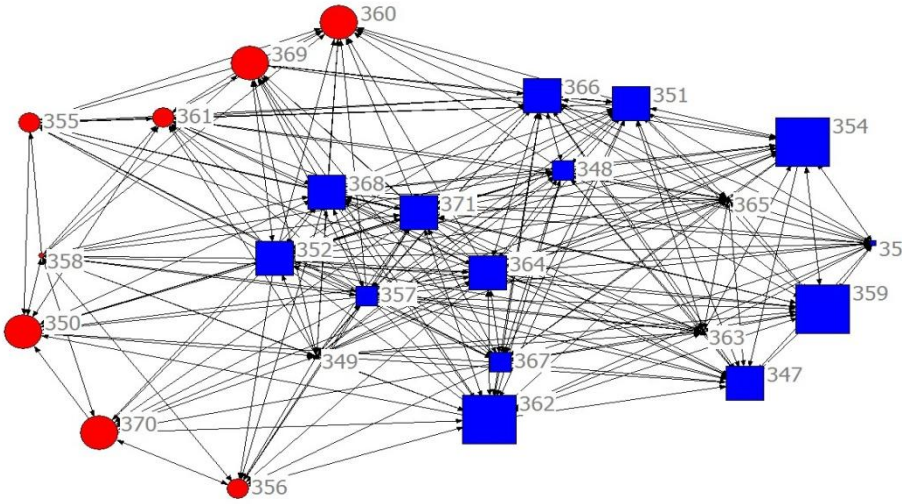


Figure 1 B

Friendship network time two



Note: Square nodes are men; round nodes are women. Size of the node reflects SAT/ACT scores: Bigger nodes had higher scores.

Figure 2 A

Leadership network time one

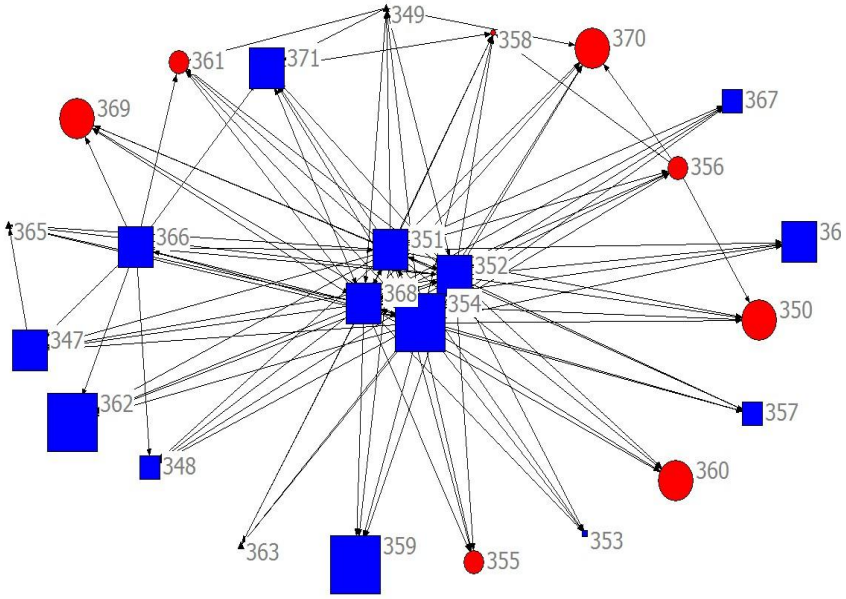
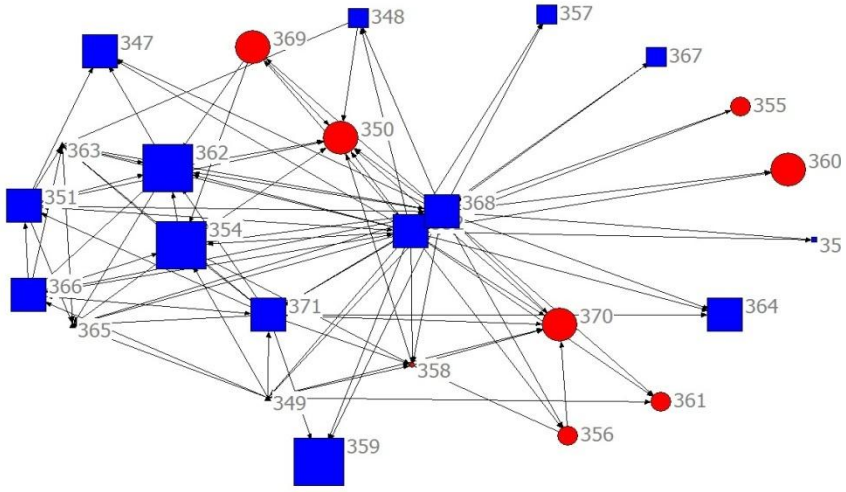


Figure 2 B

Leadership network time two



Note: Square nodes are men; round nodes are women. Size of the node reflects SAT/ACT scores: Bigger nodes had higher scores.