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Effects of Classroom Embeddedness and Density on the Social Status of Aggressive and Victimized Children

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Abstract

This study investigated the independent and interacting effects of classroom-level embeddedness (i.e., hierarchical vs. egalitarian) and classroom density on the perceived popularity and social preference of aggressive and victimized 3rd-4th grade students ($N = 881$). A cohesive blocking procedure was used to compute embeddedness. Multilevel analyses indicated that aggressive children achieved much higher perceived popularity in hierarchical classrooms with high density. While children with high victimization scores were unpopular across classrooms, they were least unpopular in egalitarian classrooms with high density. Furthermore, aggressive children were more disliked in low-density classrooms, and victimized children were more disliked in hierarchical classrooms. Implications for educational management of classroom social structures are discussed.

Keywords

network structure, social status, aggression, victimization

Psychological processes that underlie aggression and victimization are highly responsive to social context (e.g., Cairns & Cairns, 1994; Wright, Giammarino, & Parad, 1986) and in particular to the social status and social network dimensions of early adolescent peer ecologies (Mulvey &

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Cauffman, 2001; Rodkin, 2004; Salmivalli, 2001; Schäfer, Korn, Brodbeck, Wolke, & Schulz, 2005). Aggressive children are more accepted in classrooms with higher levels of aggression overall (Chang, 2004; Sentse, Scholte, Salmivalli, & Voeten, 2007; Stormshak et al., 1999) or from popular adolescents (Dijkstra, Lindenberg, & Veenstra, 2008), whereas victims are less disliked and better adjusted when victimization is more common in their classrooms (Sentse et al., 2007). Many of the studies that investigate the influence of classroom social context on aggression and victimization infer network characteristics through the aggregation of individual-level scores. Increasingly, researchers are also taking advantage of sociological social network procedures that model complex aspects of group dynamics (Burk, Steglich, & Snijders, 2007; Hanish & Rodkin, 2007; Kindermann & Gest, 2009). The integration of social network analysis into peer relationships research has great potential, and allows classroom-level phenomena to be measured in ways that are not simply derivative of aggregated individual-level characteristics.

The primary interest of social network researchers is to understand how actors (or members) of a network are linked together and how the structure of their relationships might affect them (Wasserman & Faust, 1994). The social network perspective suggests that network members are interdependent rather than independent, the relational ties between them work as paths for transferring resources or information, and the network structures facilitate or constrain their behaviors. In other words, members' attitudes or behaviors may be accounted for by the structure of the network (Choi & Kim, 2008). In the present study, we investigate how the structure of classrooms' peer networks is related to the social status of aggressive and victimized youths. In particular, two features of classroom network structure that may have implications for the popularity and social preference of aggressors and victims are (a) *embeddedness,* or the degree to which the classroom network structure is hierarchical versus egalitarian and (b) *density,* or the richness of interpersonal ties between classmates. The purpose of the present research is to determine the independent and interacting effects of classroom-level structural hierarchies and density on the social status of students perceived by their peers as aggressive or victimized.

Early experimental studies consistently suggested that social networks with an egalitarian structure have benefits in terms of the effectiveness of group performance and morale across different age groups. Studies with undergraduates showed that compared to members in a hierarchical network, members in an egalitarian network experience greater freedom of communication (Leavitt, 1951; Shaw, 1954) and have more diverse perspectives

(Haythorn, 1958). Studies with early adolescents also showed the superiority of an egalitarian structure. For example, peer groups with an egalitarian compared to a hierarchical structure have more positive social interactions (i.e., cooperation, less peer rejection) and win more intergroup competitions (Sherif, 1956). In contrast, peer groups with a hierarchical structure show more intragroup hostility and aggression (Lewin, Lippitt, & White, 1939; Lippitt, 1939).

Despite this rich historical legacy of empirical research, and the emphasis on group-level processes in studies on bullying, only one recent study has specifically examined the effects of classroom-level hierarchy. Schäfer et al. (2005) reported that elementary classrooms with a rigid, hierarchical status structure promoted victimization by establishing fixed social positions, making victimization more stable over time relative to classrooms that were fluid and egalitarian in the distribution of peer social status. However, Schäfer et al. (2005) did not explicitly identify children's social networks and their structures but instead made inferences about hierarchy by examining variable distributions of liked most and liked least nominations.

In the present research, we explicitly model classroom-level structural hierarchy by using the level of embeddedness in the classroom. Embeddedness refers to the degree of hierarchical nesting of the various subgroups that make up a social network. Embeddedness is best understood through an explanation of structural cohesion, as proposed by Moody and White (2003). The structural cohesion of a social group is identified by the minimum number of persons whose presence is necessary for the group to hold together, that is the minimum number of individuals who would break the network into two or more subgroups if they were removed from it. Thus, a group is highly cohesive if every member is directly connected to every other member (or most other members). The structure of such a group is not easily altered by the removal of one member. On the other hand, when individuals have few connections among them or if they are connected through a single individual, they form a weakly cohesive group. This group can be easily broken into two or more subgroups if certain members are removed.

Although most students in a classroom, except isolates, form one network in which all members are connected with one another through direct or indirect relational ties, individuals vary in their resistance or vulnerability to be disconnected from the network depending on the cohesion of their ties. For example, some students (i.e., A, B, C) in a classroom might form a peer group with high cohesion such as a clique, in which members are all directly connected with one another (i.e., A-B, A-C, and B-C). Also, each of the members in this type of peer group might have direct links with students with

whom other in-group members are not directly connected (i.e., A-D, but B⊬D and C⊬D). Members in this type of peer group (i.e., A, B, C) do not become disconnected from the rest of the group by the removal of a member. On the other hand, some students (i.e., D, E, F) in the same classroom may have few direct ties to the peers or their affiliates might not be directly connected with one another (i.e., D-A, D-E, and E-F, but A⊬E and D⊬F). Due to these loose ties, they (i.e., D, E, F) can be relatively easily disconnected from the classroom network. Embeddedness of classroom networks is identified by recursive removal of less cohesive subgroups, thus uncovering a hierarchically nested structure with increasingly cohesive subgroups nested within each other like a set of Russian dolls.

Classrooms with a high level of embeddedness are characterized by a highly cohesive core and a number of decreasingly cohesive peripheral subgroups. These classrooms include deeply embedded students who are difficult to disconnect from the network as well as moderately and trivially embedded students who can be disconnected from the network relatively easily. Thus, structural position among network members varies greatly in highly embedded classrooms. In low-embeddedness classrooms, however, most students are equally embedded, either equally strongly or equally poorly. We refer to high-embeddedness classrooms as *hierarchical* because their networks are characterized by a succession of nested structures which can be ordered by their level of cohesion. Although students in hierarchical, high-embeddedness classrooms occupy varying positions in the network structure, the word *hierarchy* in the present study should not be understood as a pyramidal categorization of a group of people according to status or power. Low-embeddedness classrooms are referred to as *egalitarian* as the ties among students in those classrooms are characterized by a rather uniform distribution.

The primary hypothesis of this study is that classroom embeddedness will be associated with the social status peers attribute to students who receive a high number of peer nominations for aggression and victimization. While aggressive youth may have both high and low social status depending on how status is measured (Cillessen & Mayeux, 2004; LaFontana & Cillessen, 2002; Parkhurst & Hopmeyer, 1998; Rodkin, Farmer, Pearl, & Van Acker, 2000), young adolescents who are victimized by their peers tend to have low status (Graham & Bellmore, 2007; Salmivalli & Isaacs, 2005). Students' positions in the network structure are more stratified in classrooms with a high level of embeddedness. Due to great variation in individuals' structural positions, the transmission of information and resources is not equally distributed among all members of the network. The inequality of access to information and resources is expected to promote social tensions and hostility between members (Lewin

et al., 1939; Lippitt, 1939). Thus, aggressive behaviors might be prevalent in classrooms with high embeddedness. Studies based on social context perspective (e.g., Chang, 2004; Sentse et al., 2007; Stormshak et al., 1999; Wright et al., 1986) have suggested that social status associated with certain behaviors is reinforced by the prevalence of the behavior within the peer group. Accordingly, we anticipate that the status of students with high aggression scores will be higher, and that the status of students with high victimization scores will be lower in hierarchical, highly embedded classrooms.

While embeddedness identifies a network's hierarchical structure, the index of density captures the average level of connectivity among network members. Density is generally computed as the number of observed ties in the network divided by the number of maximum possible ties (Wasserman & Faust, 1994). Whereas density refers to the mean level of connectivity, embeddedness represents how that connectivity is distributed. For example, imagine two networks of five members each. One network has an egalitarian structure (e.g., ⌂) in which each member has two direct ties; the other network has a hierarchical structure (e.g., X) in which a member in the center has four direct links to every other member—the top two members have two links, and the bottom two members have one link to the centered person. These two networks have the same density (D = .50) but differ in the distribution of connectivity.

It is possible that density itself does not yield positive or negative outcomes but instead interacts with other aspects of network structure and group norms (Haynie, 2001). Members in dense networks share common identities (Coleman, 1990) and clear group norms (Podolny & Baron, 1997). The values shared by a network—whether prosocial or antisocial—may be more easily reinforced and transmitted under conditions of dense interpersonal ties. For example, Haynie (2001) found that adolescents in dense friendship networks were more delinquent when delinquency was prevalent in the network. Conversely, when peer networks were not inclined toward delinquency, adolescents engaged less in those behaviors despite high friendship density.

We anticipate that density alone will not affect the relationships of aggression and victimization to peer status. However, density may moderate the impact of embeddedness. In a highly dense network, the effect of structural hierarchy may be stronger than in a loosely connected network because pathways of communication and influence are numerous and varied. Therefore, we anticipate that density will interact with embeddedness to moderate associations between aggression, victimization, and status. The status of students seen as aggressive is expected to be highest and the status of students seen as victimized lowest in classrooms where both embeddedness and density are high.

In our analysis, peer status is operationalized as both perceived popularity and social preference as there are important distinctions between these two status subtypes. Perceived popularity, which is also called *consensual popularity* (de Bruyn & Cillessen, 2006), captures students' assessments of their peers' social rank or reputation, regardless of how they personally feel about them. It reflects students' perceptions of the peer group's general views toward a classmate. Thus, it is a good index of group norms, values, and beliefs. In contrast, social preference refers to likeability and is a reflection of each student's personal feelings of affection toward each peer. Therefore, it is expected to be less dependent on social context. We hypothesize that the effects of classroom level of embeddedness and the interaction effects of embeddedness and density, which are group features, will be more prominent for perceived popularity than for social preference.

Summary of the Study's Hypotheses

The present study tested a total of five hypotheses for each of the two dependent variables, perceived popularity, and social preference. The first set of hypotheses concerned the effects of classroom network structure on adolescents' perceived popularity. First, aggressive students were expected to have higher perceived popularity in classrooms with higher levels of embeddedness. Second, victimized students were expected to be perceived as more unpopular in classrooms with higher levels of embeddedness. Third, we expected that classroom density would not be associated with the perceived popularity of either aggressive or victimized students. Fourth, we expected aggressive students' perceived popularity to be higher in high-embeddedness, high-density classrooms than in low-embeddedness, high-density classrooms. Fifth, we expected victimized students' perceived popularity to be lower in high-embeddedness, high-density classrooms than in low-embeddedness, high-density classrooms. Our hypotheses for social preference were identical to the hypotheses concerning perceived popularity, but we expected the effects of classroom network features to be weaker for social preference.

Method

Participants and Procedure

Participants were 679 third and fourth graders (323 boys, 356 girls; *M* age = 9.75, *SD* = 0.77) from 42 classrooms in nine elementary schools in the Midwest United States. Participants provided data on 881 classmates (448 boys,

433 girls). The sample ethnic composition was 44% African American, 37% European American, 8% Asian, 7% Hispanic, with 4% classified as "Other" (i.e., Native American, etc.). Participation rates ranged from 50% to 96% across the 42 classrooms ($M = 78\%$, $SD = 11\%$). Active parental consent and student assent were obtained from all participants.

Children were surveyed in the spring semester during regular class hours across two 30-minute sessions. During the survey, one administrator read the instructions and the questions aloud while scanning the room to check for potential problems. Additional administrators provided mobile monitoring and assisted children as needed. Children were assured that their answers would be kept confidential and that they could stop participating at any time. They were also instructed not to talk to their classmates and to cover their responses. All surveys were identified and distributed in a manner that concealed the identity of participants.

Classroom Social Network Structure Measures

The indices of classroom embeddedness and density were obtained based on within-classroom *hang around* affiliations. Children were asked to circle "yes" or "no" to the question: "Do you *hang around* together a lot with some kids in your classroom?" Participants responding affirmatively were prompted to check off boxes adjacent to the first names and last initials of peers in their classroom under the heading, "MY GROUP."

Embeddedness. Cohesive blocking (Moody & White, 2003) using NetMiner 2.5 was performed in order to identify classroom embeddedness. The first step in cohesive blocking is to determine all the links between all members of the classroom network and delineate the main classroom network by excluding isolates and segregated peer groups which do not have any tie to the main network. The second step is to identify the cutset or the collection of members who, when removed, break the main network into several subgroups. The third step is to distinguish the subgroups resulting from the removal of the cutset and then restore the cutset members to the subgroups they belong to. For example, if a member of the cutset induces two subgroups, he or she is restored to both subgroups. This process is repeated simultaneously for all subgroups induced by the procedure until the subgroups are trivial (i.e., consisting of one person other than the cutset) or all members within each subgroup have an equal number of connections to one another, thus no further cutset emerges.

In the current study, patterns of cohesive blocking varied across classrooms. In a typical pattern, cohesive blocking repeatedly generated two subgroups,

one less cohesive than the other (see Figure 1a, for example). Across our sample, 31% of classrooms (13 out of 42) showed this type of network structure. In another typical pattern, the procedure initially generated two subgroups—one less cohesive than the other—and several (mostly two) cohesive subgroups emerged in the middle of the procedure, with further iterations being performed in each cohesive subgroup (see Figure 1b, for example). Among our classrooms, 29% (12 out of 42) fell into this pattern. Finally, in 40% of the classrooms (17 out of 42), several (mostly two) cohesive subgroups emerged in the first step of the procedure and further iterations were performed in each subgroup (see Figure 1c, for example).

As shown in Figure 1b and 1c, two types of subgroups may arise when cohesive blocking is performed. Some subgroups simply "detach themselves" from the rest of the network. As a result, distinct cohesive subgroups are "side-by-side" in the network structure. These subgroups are similar to the primary peer groups which are identified by conventional group identification techniques (i.e., NEGOPY, Social Cognitive Mapping, etc.). However, some subgroups are not segregated from other groups but nested within other groups. These subgroups are organized in a Russian dolls-like fashion, with increasingly cohesive subgroups nested within each other. In the present study, only the later type of subgroups was considered. Thus, the different patterns of cohesive blocking across classrooms (i.e., (a)-(c) in Figure 1) were not the main focus of our study, and classroom-level of embeddedness was determined by the highest number of iterations for the classroom. For example, in Figure 1, the level of embeddedness is four for all three networks, (a) through (c), although the pattern of cohesive blocking is different for each network.

In the present study, level of embeddedness differed across classrooms ($1 \leq E \leq 8$, $M = 3.5$, $SD = 1.66$). Some classrooms were hierarchical (having a high level of embeddedness), whereas others were relatively egalitarian (having a low level of embeddedness). Figures 2 and 3 show the affiliative patterns of classrooms with the highest and the lowest level of embeddedness, respectively. In hierarchical classrooms, there is variation in students' positions in the classroom network structure. For example, deeply embedded students (i.e., Nos. 4, 6, 9, 15, 18, and 23 in Figure 2) have a highly cohesive linkage. The peers a student hangs out with also affiliate with one another; the network position of these students is not affected by the removal of another student. However, some students in the same classroom (i.e., Nos. 13, 14, 10, 16, and 20 in Figure 2) have weak ties to the network. They affiliate with few peers, and these peers are not strongly connected to one another (i.e., No. 16 affiliates with Nos. 6, 20, and 21, but No. 20 is not connected

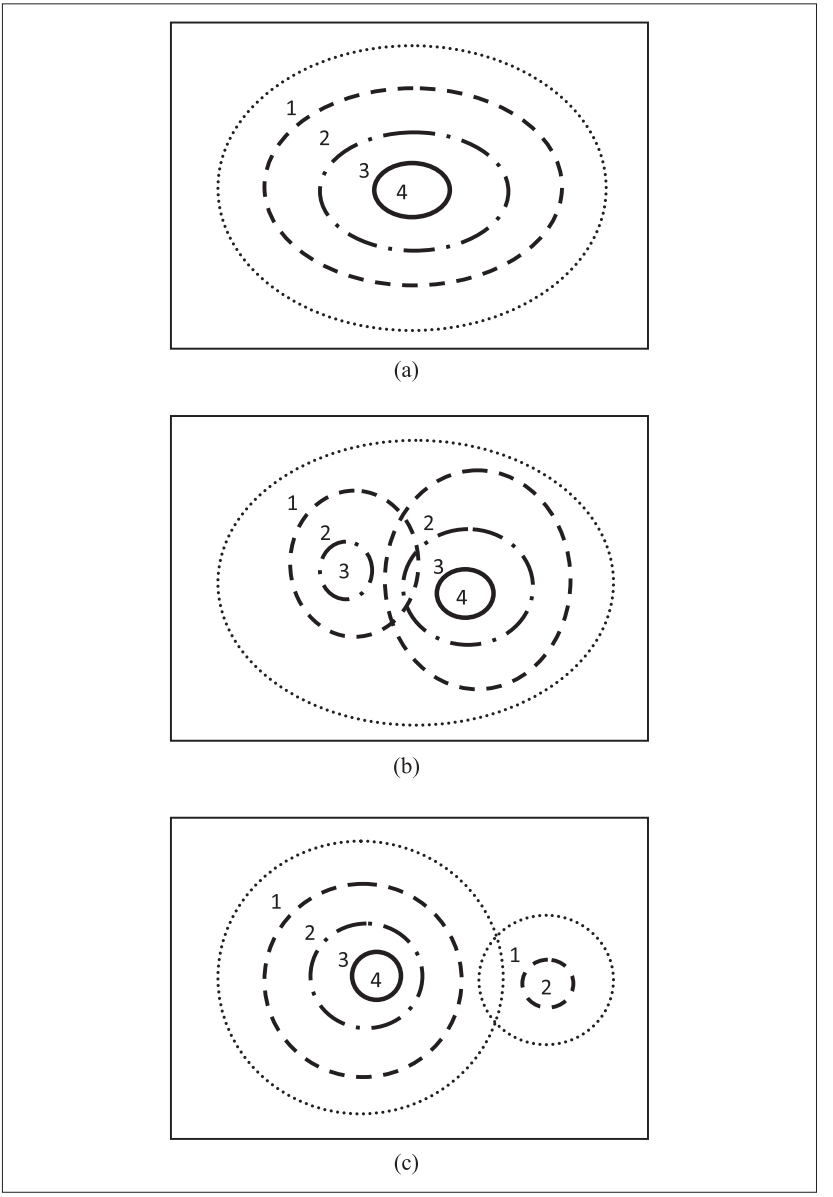

Figure 1. Typical patterns of cohesive blocking procedure across classrooms
Note: In each network, subgroups having the same style of lines are iterated simultaneously.

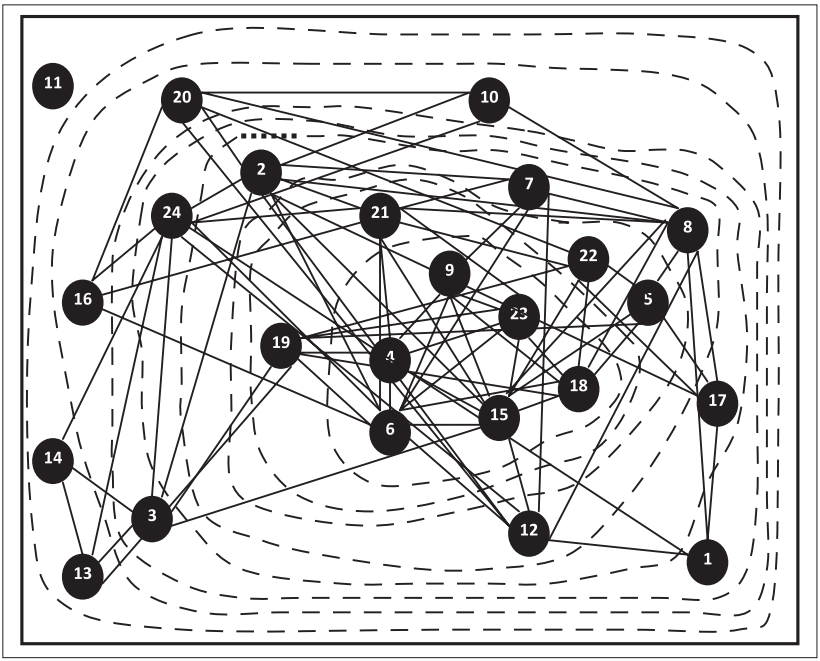

Figure 2. Affiliative network structure and ties of the classroom with highest embeddedness

Note: Solid lines are affiliation ties, and dotted lines are the boundaries of embeddedness levels. $n = 24$ (participation rate = 75%). Classroom embeddedness (E) = 8. $Z_E = 2.99$. Classroom density (D) = 0.21. $Z_D = -0.17$.

with Nos. 6 and 21). Due to this low level of cohesion, they can be easily disconnected from the network if an affiliate (i.e., cutset member) is removed. In classrooms with low embeddedness, there is little variation among students' network positions (see Figure 3) as most students are equally connected with one another. For the analysis, classroom-level embeddedness was divided by the number of participants in each class in order to control for the number of reporters and standardized ($-1.66 \leq Z_E \leq 2.99$). Standardized embeddedness was not correlated with classroom size ($r = .29$, *ns*) or number of participants ($r = .24$, *ns*).

Density. Density identifies the average level of connection among members in a network. Density is computed by the number of ties present divided by the number of possible ties in a network and ranges from 0 to 1. In the

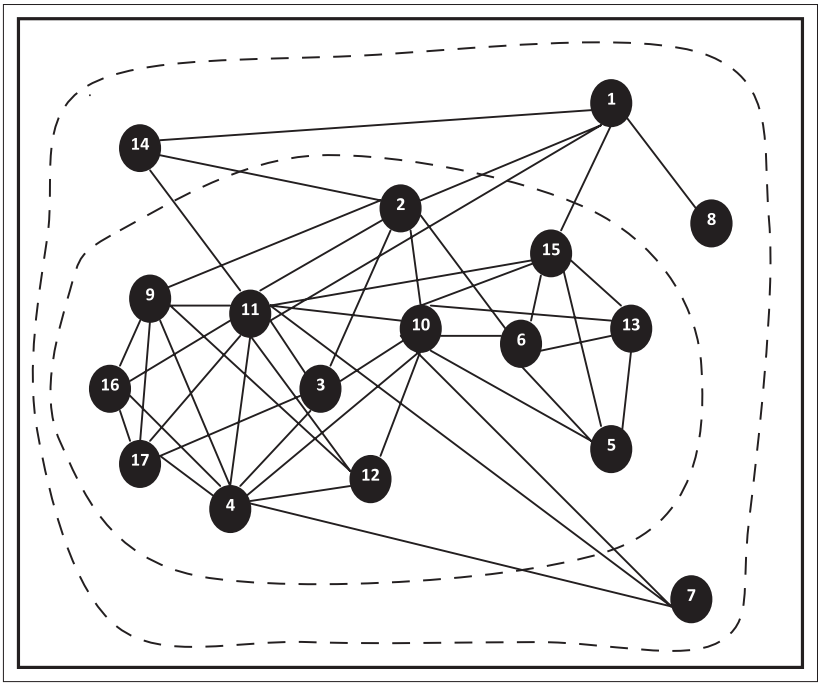

Figure 3. Affiliative network structure and ties of the classroom with lowest embeddedness

Note: Solid lines are affiliation ties, and dotted lines are the boundaries of embeddedness levels. n = 17 (participation rate = 71%), Classroom embeddedness (E) = 2. Z_E = –1.66. Classroom density (D) = 0.17. Z_D = –0.79.

present study, level of density varied across classrooms ($.09 \leq D \leq .66$, $M = .23$, $SD = .11$). In our analysis, density values were corrected for classroom size by controlling for the maximum number of ties in each classroom (see Haynie, 2001; Scott, 2000) and then standardized ($-1.70 \leq Z_D \leq 3.06$). The corrected density was not correlated with either classroom size ($r = -.21$, *ns*) or number of participants ($r = .18$, *ns*). Density was not associated with embeddedness ($r = .09$, *ns*).

Aggression, Victimization, and Social Status Measures

Children were asked to nominate peers in their classroom who best fit descriptors related to students' social behaviors. Eight items were used in the

present investigation. Participants were instructed to check off boxes adjacent to the first names and last initials of classmates. They were told that they could nominate an unlimited number of same- and other-sex peers. All self-nominations were excluded from the analysis.

Aggression. Aggression was measured with three items ($\alpha = .93$): make fun of ("These kids *make fun of* people. They like to make fun of other kids and embarrass them in front of other people"), say mean things ("These kids *say mean things* to other kids, and they spread nasty rumors about other kids"), and start fights ("These kids *start fights.* These kids push other kids around, hit them, or kick them."). For each item, a proportion score was computed by dividing the number of nominations received by the number of participants. The proportion scores were then standardized within sample and log-transformed for normalization (see Rodkin et al., 2000; Rose & Swenson, 2009 for similar procedures). A composite score for aggression was obtained by averaging the standardized and log-transformed scores for the three items and restandardizing within sample.

Victimization. Victimization was measured with a single item: picked on ("These kids are always getting *picked on,* being made fun of, called bad names, even hit or pushed"). As with aggression, proportion scores were standardized, log-transformed, and restandardized within sample.

Perceived popularity. Children were asked to nominate who is *popular* ("These are the most *popular* kids in my class") and who is *not popular* ("These are the kids in my class who are *not popular*") in their classroom. Perceived popularity scores were computed by subtracting standardized proportion scores for *not popular* from standardized proportion scores for *popular.* The resulting difference score was log-transformed and restandardized within sample.

Social preference. Children were asked to nominate peers they *like most* ("These are the kids who I would *like most* to play with.") and *like least* ("These are the kids who I would *like least* to play with."). Social preference scores were obtained by subtracting standardized *liked least* from *liked most* proportion scores. Like the perceived popularity variable, the resulting difference score was log-transformed and restandardized within sample.

Results

Student-Level Analyses

Perceived popularity and social preference were highly correlated ($r = .68$, $p < .001$). While aggression was positively correlated with perceived

popularity ($r = .12$, $p < .001$), it was negatively correlated with social preference ($r = -.26$, $p < .001$). Victimization showed negative associations with both perceived popularity ($r = -.42$, $p < .001$) and social preference ($r = -.31$, $p < .001$). There was no significant association between aggression and victimization ($r = .04$, *ns*).

Random-coefficient regression models were tested for the student-level variables only, using SAS PROC MIXED. Aggression and victimization were entered as predictors and social status variables (i.e., perceived popularity and social preference) as outcomes. Each student-level predictor had a significant relationship with the two types of social status. Aggression positively predicted perceived popularity ($\beta = .078$, $t = 2.59$, $p < .01$), but victimization was a negative predictor of perceived popularity ($\beta = -.545$, $t = -17.48$, $p < .001$). Both aggression and victimization had a negative association with social preference ($\beta = -.314$, $t = -10.43$, $p < .001$ and $\beta = -.420$, $t = -13.44$, $p < .001$, respectively).

Class-Level Analyses

Two sets of Hierarchical Linear Models (HLM) were analyzed by SAS PROC MIXED. Embeddedness, density, and the interaction between these two classroom-level variables, as well as cross-level interactions between student-level and class-level variables, were added as predictors to the previous sets of models. The results are reported in Table 1.

Perceived popularity. The associations between aggression, victimization, and perceived popularity remained statistically significant in the final HLM model. Aggression was a positive predictor of perceived popularity ($\gamma = .068$, $t = 2.25$, $p < .05$), but victimization was a negative predictor ($\gamma = -.525$, $t = -16.59$, $p < .001$). Mean perceived popularity did not vary as a function of classroom embeddedness ($\gamma = -.003$, $t = -0.05$, *ns*), density ($\gamma = .088$, $t = 1.34$, *ns*), or the interaction of these two ($\gamma = -.012$, $t = -0.13$, *ns*). Classroom embeddedness moderated the slopes between perceived popularity and aggression ($\gamma = .111$, $t = 3.51$, $p < .001$) and victimization ($\gamma = -.076$, $t = -2.03$, $p < .05$). No significant moderating effect of density was found. However, the interaction between embeddedness and density moderated the effects of aggression ($\gamma = .107$, $t = 2.52$, $p < .05$) and victimization ($\gamma = -.100$, $t = -2.26$, $p < .05$) on perceived popularity.

Figure 4 presents the effects of the interaction between embeddedness and density on the aggression-popularity (top panel) and on the victimization-popularity (bottom panel) relationships. The association between perceived popularity and aggression was moderated by an interaction between

Table 1. Effects of Both Individual- and Classroom-Level Predictors on Social Status

	Perceived popularity		Social preferences	
Variables	Coefficient	*SE*	Coefficient	*SE*
Intercept	.032	.064	.054	.070
Level 1 (Individual level)				
Aggression	.068*	.030	–.301***	.030
Victimization	–.525***	.032	–.421***	.032
Level 2 (Classroom level)				
Embeddedness	–.003	.064	–.009	.071
Density	.088	.065	.169*	.072
Embeddedness × Density	–.012	.089	–.039	.098
Cross-level interactions				
Embeddedness × Aggression	.111***	.032	.059	.031
Embeddedness × Victimization	–.076*	.037	–.102**	.037
Density × Aggression	.015	.033	.074*	.033
Density × Victimization	.028	.033	–.006	.033
Embeddedness × Density × Aggression	.107*	.043	–.029	.042
Embeddedness × Density × Victimization	–.100*	.044	–.032	.044

Note: No. of classroom = 42 (df = 39); No. of student = 881 (df = 827).
*p < .05. **p < .01. ***p < .001.

embeddedness and density. Specifically, the aggression-popularity slope across high-density classrooms differed depending on those classrooms' level of embeddedness. Aggression was a strong positive predictor of perceived popularity in classrooms with high embeddedness and high density, $b = 0.30$, $t(873) = 2.89$, $p < .01$, but a negative predictor of perceived popularity in classrooms with low embeddedness and high density, $b = –0.14$, $t(873) = –1.97$, $p < .05$. The perceived popularity of students with a high aggression score (+1 *SD*) was +0.42 in highly embedded and highly dense classrooms but only –0.01 in classrooms with low embeddedness and high density. The difference in perceived popularity scores for students with a high versus low aggression score was 0.60 in highly embedded and dense classrooms and –0.27 in classrooms with low embeddedness and high density. This result suggests that peers tended to perceive students with high aggression scores as popular in classrooms with high embeddedness and density and unpopular in classrooms with low embeddedness and density.

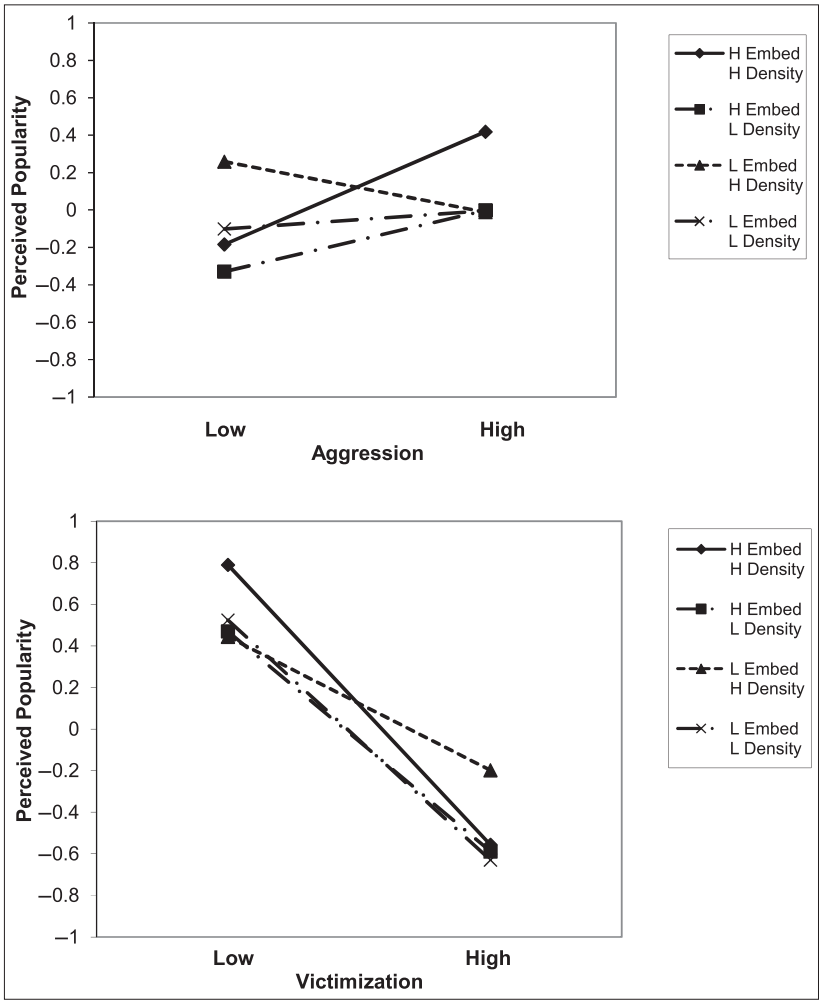

Figure 4. Interacting effects of classroom-level embeddedness and density on the popularity-aggression (top panel) and popularity-victimization (bottom panel) relationships

Note: The plots are presented following Aiken and West's (1991) guidelines (i.e., ±1 *SD* above or below the *M*).

The combination of embeddedness and density also moderated the relationship between victimization and perceived popularity (see bottom panel of Figure 4). Even though victimization was a negative predictor of perceived

popularity in all classrooms, the slope was the steepest in classrooms with high levels of both embeddedness and density, $b = –0.67$, $t(873) = –4.67$, $p < .001$, and the least steep in classrooms with low embeddedness and high density, $b = –0.32$, $t(873) = –2.67$, $p < .01$. The difference in perceived popularity for students with a high versus low victimization score was 1.35 in classrooms with high embeddedness and high density and 0.64 in classrooms with low embeddedness and high density. Students with high victimization scores were unpopular in all classrooms, but their popularity was lowest in highly embedded and dense classrooms.

Social preference. The associations between aggression, victimization, and social preference remained statistically significant in the final HLM model. Both aggression and victimization were negative predictors of social preference ($\gamma = –.301$, $t = –9.93$, $p < .001$, and $\gamma = –.421$, $t = –13.31$, $p < .001$, respectively; see Table 1). Mean social preference did not vary depending on classroom embeddedness ($\gamma = –.009$, $t = –0.12$, *ns*) or the interaction of embeddedness and density ($\gamma = –.039$, $t = –0.40$, *ns*) but tended to be greater in classrooms with high density ($\gamma = .169$, $t = 2.36$, $p < .05$). Classroom embeddedness moderated the relationship between victimization and social preference ($\gamma = –.102$, $t = –2.72$, $p < .01$) while classroom density moderated the effect of aggression on social preference ($\gamma = .074$, $t = 2.26$, $p < .05$).

Figure 5 shows the moderating role of embeddedness on the victimization-preference relationship (top panel) and the effect of density on the aggression-preference relationship (bottom panel). Classroom embeddedness moderated the association between victimization and social preference. Victimization was a negative predictor of preference in all classrooms, but the victimization-preference slope was steeper in high embeddedness, $b = –.523$, $t(877) = –2.00$, $p < .05$, than in low embeddedness classrooms, $b = –.319$, $t(877) = –1.35$, *ns*. This result suggests that students with high victimization scores experience stronger peer rejection in hierarchical classrooms compared to egalitarian classrooms. Classroom density moderated the association between aggression and social preference. Although aggression was a negative predictor of social preference in all classrooms, students with high aggression scores were significantly more disliked in classrooms with low density, $b = –.375$, $t(877) = –6.53$, $p < .001$, than in classrooms with high density, $b = –.227$, $t(877) = –1.319$, *ns*. While students generally disliked their aggressive peers, they showed stronger antipathies toward them when they were loosely connected to one another. No significant effects of the interaction between embeddedness and density on the associations between aggression, victimization, and social preference were found.

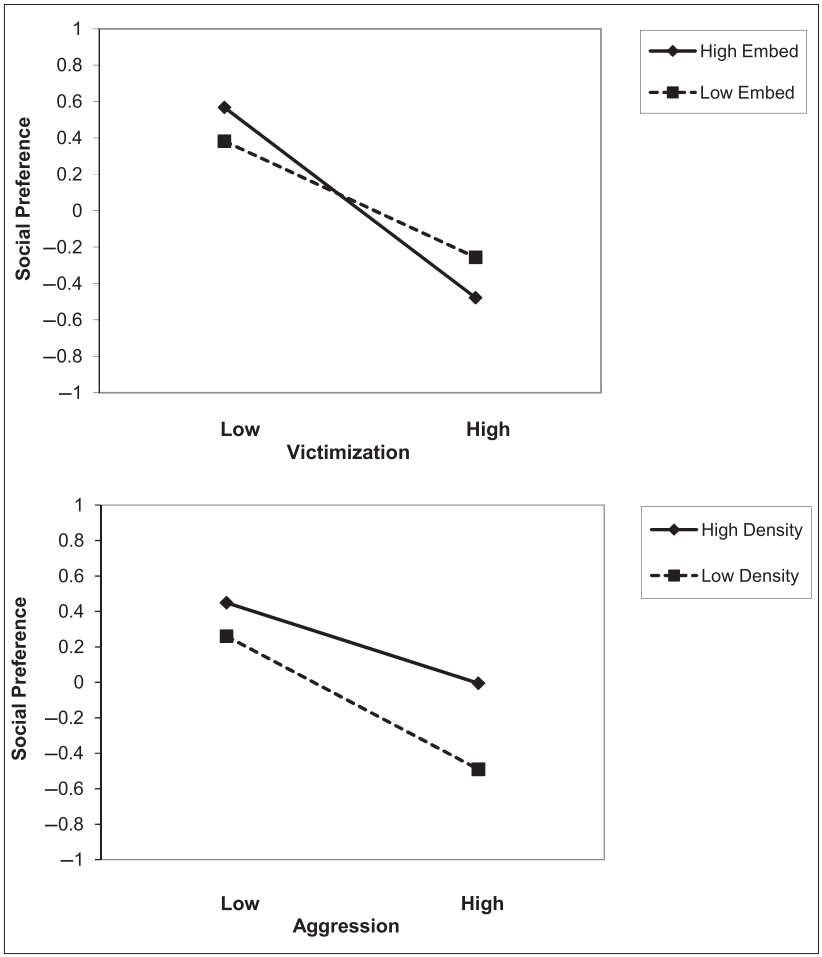

Figure 5. The effect of classroom-level embeddedness on the preference-victimization relationship (top panel) and the effect of classroom-level density on the preference-aggression relationship (bottom panel)
Note: The plots are presented following Aiken and West's (1991) guidelines (i.e., ±1 *SD* above or below the *M*).

Discussion

This study demonstrated the importance of classroom social structure to early adolescents' regard for their aggressive and victimized peers, using

classroom-level measures of structural embeddedness (Moody & White, 2003) and density derived from social network analysis. The primary study hypothesis was that the social status of aggressive youth would be higher and the social status of victimized youth would be lower in hierarchical, highly embedded classrooms. We expected that classroom density would moderate the effect of embeddedness, so that the popularity of students perceived as aggressive would be higher and the popularity of students perceived as victimized lower in classrooms with high levels of both embeddedness and density. We hypothesized that the effects of embeddedness and the interaction effects of embeddedness and density would be stronger for perceived popularity, a group reputational index of social status, than for social preference, an individual affect measure of social status. Study results generally supported these hypotheses.

As expected, there was a relationship between classrooms' level of embeddedness and the perceived popularity of aggressive and victimized students. Students with high aggression scores tended to be perceived as popular in high-embeddedness classrooms and as unpopular in low-embeddedness classrooms. Although victimized students were unpopular across all classrooms, their popularity was even lower in highly embedded classrooms. These findings are consistent with research showing that a democratic structure—where social power is relatively evenly distributed among group members—constitutes a more prosocial and less hostile environment by allowing maximum participation of all youth (Lewin et al., 1939; Schäfer et al., 2005; Sherif, 1956). Although not directly tested, the prevalence of positive social interactions in classrooms with low embeddedness might explain why aggressive students would be more stigmatized and victimized students (relatively) more popular in these peer ecologies. In hierarchical classrooms, aggression might be an efficient means for highly embedded individuals to maintain their central position in the peer ecology and for peripherally embedded members to achieve more central positions.

The main study finding was that relationships of individual-level perceived popularity with aggression and victimization were moderated by a combination of classroom-level embeddedness and density. Reported effects were most clear when classrooms were not only hierarchical (i.e., with many levels of structural embeddedness) but also dense with high levels of social connectivity between students. Students with high aggression scores tended to be perceived as popular in high-embedded and dense classrooms and as unpopular in low-embedded and dense classrooms. Students with high victimization scores were unpopular in all classrooms, but their popularity was lowest in highly embedded and dense classrooms. These findings are consistent with

the idea that the norms of a network become reinforced through a high density of social relationships (see Haynie, 2001). In low-density classrooms, social information might not be transmitted efficiently to the whole classroom as pathways of communication are more limited.

Interactive effects of embeddedness and density on the social status of children perceived to be aggressive and victimized were more closely associated with group-oriented (i.e., perceived popularity) than relationship-oriented (i.e., social preference) measures. Perceived popularity is a network-relevant construct, geared toward status and reputation in the group. Social preference refers instead to children's likeability and acceptance among peers, reflecting dyadic dynamics of attraction and repulsion (Asher & McDonald, 2009; Rubin, Bukowski, & Parker, 2006). In classrooms with high embeddedness and density, peers may dislike students with high aggression even if they perceive aggressive youth to be popular. This scenario may typify the social dynamic of some low-quality classrooms.

Primary study findings concerned the interactions of embeddedness and density on perceived popularity, but some other findings suggest the importance of social preference. For example, embeddedness moderated the relationship between social preference and victimization, such that students with high victimization scores were more disliked by peers in classrooms with high embeddedness. In addition, classroom-level density moderated the relationship between aggression and social preference, suggesting that aggressive children in low-density classrooms were more disliked by their peers than those in highly dense classrooms. On average, a student in a highly dense classroom affiliates with more peers than in a low-density classroom. Thus, children with high aggression scores might also have a higher chance to have relational ties with peers in classrooms with high density, and in turn, they are more likely to have a good number of classmates who would nominate them as someone they like. In contrast, aggressive students in low-density classrooms may have been unsuccessful at securing a high number of affiliations from peers.

Study Limitations

Four limitations of this research deserve particular attention. First, the variables used in this study were measured only by peer nominations. Although the peer nomination is probably one of the most valid and reliable methods for the study of peer relationships in terms of not having biases of self-reports (which accentuate positive relationships and underreport negative relationships), using variables measured only via peer perceptions might lead to

shared method variance problems. The use of variables (aggression and victimization) assessed by other methods (i.e., self-reports and teacher-reports) rather than exclusively by peer nominations may be an optimal way to avoid this kind of problem.

Second, in this research we analyzed the network structure of classrooms as a whole and did not differentiate the structural hierarchy of girls' and boys' groups. Maccoby (1998) and Owen Blakemore, Berenbaum, and Liben (2009) write that girls' groups are less hierarchical and have more positive group norms (i.e., a higher level of cooperation or intimacy) than groups of boys (but see Gest, Davidson, Rulison, Moody, & Welsh, 2007). As such, girls may form a more egalitarian network structure, and aggressive girls might not achieve high status as compared to aggressive boys. Thus, the hierarchical structure of overall classroom-level networks might be mainly explained by boys' highly embedded networks, and the positive aggression-status association in hierarchical and dense classrooms might be due to the high status of aggressive boys and not girls. Preliminary analyses in this study did not indicate a substantial effect of gender, but further work is needed on identifying the structure of gendered subgroups and its effects on group functioning.

Third, Moody and White (2003, p. 105) demonstrated that the "structural cohesion" of a network resulting from the cohesive blocking procedure "simultaneously defines a *group* property characterizing the collectivity, a *positional* property that situated subgroups relative to each other in a population, and *individual* membership properties." Our study focused on the level of embeddedness and interpreted it with the combination of a "group" and a "positional" property for identifying characteristics of network structure with classroom-level data. Individual membership properties have not been explored in the present study but has great potential to answer many research questions (i.e., How are students placed in the core different from students with peripheral positions in the network structure in terms of social status or social power? Are deeply embedded students in classrooms with a hierarchical structure more aggressive than those in classrooms with an egalitarian structure?). The hierarchy of classroom network structure should be meaningfully related to the hierarchy of individual status or power.

Fourth, although our study demonstrated linkages between classroom-level network structures and the social status of aggressors and victims, the cross-sectional data of the present study does not allow us to make causal inferences regarding network-status associations. Whether the presence of popular-aggressive children leads to the emergence of a hierarchical structure or whether hierarchical structures promote aggressive students' achievement of high status remains to be determined. It is conceivable that certain students,

through their attributes and behaviors, strongly contribute to the formation of classroom network structures. Once the structure is established, it is plausible that the social structure affects values shared by the network. As pointed out by Kindermann and Gest (2009), modeling procedures that allow researchers to make causal inferences about group influence is a critical issue.

Longitudinal or cross-sectional studies on peer network structure across various age groups might also provide developmental insights on how peer ecologies may influence the emergence of and changes in group norms. With a relatively young sample of 3rd and 4th graders, our study found an association between students' regard for peers with high aggression and victimization scores and the network structure of their classroom. Whether this relationship between the structure of peer networks and the social status of aggressive and victimized students still holds in middle school and high school remains to be investigated. Many studies of peer networks have focused on identifying peer groups (see Rodkin & Ahn, 2009), and it has been widely documented that adolescents form more tightly structured peer groups (i.e., cliques) than children in middle childhood (see Berk, 2006). However, the role of peer groups' structural hierarchy (i.e., embeddedness) has not been explored for adolescents, and little is known about the effects of peer network structure, embeddedness in particular, on students' norms. Thus, we should be careful about presuming network structure effects among older students. Nevertheless, we do know that (a) the positive relationship between perceived popularity and aggression is generally higher for adolescents in middle or high school than for children in elementary school (see Asher & McDonald, 2009) and (b) relationships between perceived popularity and aggression are higher in classrooms with high embeddedness and high density, from the current study. Therefore, we might expect peer network structures in middle and high school to be more hierarchical and dense than those of elementary school children. The contribution of the present study lies in part in setting the stage for investigating the importance of network structure by demonstrating that group-based approaches to the understanding of social norms benefit from consideration of the structural features of peer ecologies.

Practical Implications

Educators have put great effort into facilitating more positive classroom climates where children show their disapproval of aggressive behaviors and provide emotional support for one another. Unfortunately, the fact that peer groups can encourage aggression by rewarding perpetrators with high popularity poses a real educational challenge. One message from this study is that

educators should not overlook classroom peer networks. Teachers vary widely in their knowledge of classroom social networks, with some teachers performing poorly in the accurate identification of friendship and affiliative networks in their classroom (Gest, 2006), and in being able to name all but the most popular groups (Pearl, Leung, Van Acker, Farmer, & Rodkin, 2007). It is important that teachers have knowledge of the peer ecologies in their classrooms, as network structures may serve as pathways in the transmission of values, attitudes, and behaviors (Kindermann & Gest, 2009; McLeod & Lively, 2003; Rodkin, 2004).

Teachers may have the power to serve as an "invisible hand" (Cairns & Cairns, 1994) to impact the structure of student social networks by increasing certain affiliation opportunities, for instance through the creation of subgroups for learning purposes. In fact, Hallinan and Smith (1989) suggest that the formation and dissolution of friendships can be attributed to the composition of instructional reading groups or other types of groups arranged by teachers. For example, teachers can facilitate interactions between members of cohesive subgroups (i.e., cliques) and children who are not in such cliques by assigning them in the same reading group. Giving students opportunities to affiliate with diverse peers might contribute to the formation of a more egalitarian and a more positive classroom climate with less bullying and peer harassment.

A noteworthy feature of this report has been the focus on classrooms as a unit of analysis. Theories of setting-level phenomena regarding late elementary school classrooms in particular have not been well-developed (Seidman, 2004; Weinstein, 2006). Nonetheless, the educational challenge is real. Educators often refer to social problems in classroom-level terms (e.g., "she has a tough classroom this year") and need to deal with the students in their classrooms as a collective. The empirical contribution of this report is the finding that the perceived popularity of aggressors and victims is sensitive to social structure: Hierarchical classrooms with dense social interconnections between students may be associated with group norms that favor aggression and bullying. This finding identifies a specific kind of classroom social structure that may be of particularly low quality and gives further depth to the conceptualization of popularity as a group-level construct (Rubin et al., 2006). We anticipate that this report will set the stage for dynamic, longitudinal analyses, where group-based approaches to the prevention of peer harassment will require consideration of how the entire classroom is socially organized and how that collective social organization might be improved.

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