Delinquent Peers Revisited: Does Network Structure Matter?[1]

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This study examines whether structural properties of friendship networks condition the association between friends' delinquency and an individual's own delinquent behavior. Data from the Add Health allows a more accurate conceptualization of the peer network and a more rigorous measurement of peer delinquency than previous research. Findings from this study indicate that friends' delinquency is associated with an adolescent's own delinquency involvement. However, characteristics of adolescents' friendship networks, such as its density and adolescents' centrality and popularity, condition the delinquency-peer association. Network density, in particular, emerges as an important component of the delinquency-peer association, with very cohesive networks containing stronger delinquency-peer associations than those that are less cohesive. These findings suggest that it is necessary to consider the underlying structural properties of friendship networks in order to understand the impact of peer influence on adolescent delinquency.

INTRODUCTION

An understanding of the relationship between peers and delinquency is at the heart of delinquency research. One of the most consistent and robust findings in the literature on adolescent delinquency involves the association between friends' delinquent behavior and a respondent's own de-

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linquency.[2] Dating back to the 1930s with Shaw and McKay's (1931) discovery that more than 80% of juveniles appearing before court had peer accomplices, researchers have noted the strong tendency for offenders to commit delinquent acts in the company of others (Akers et al. 1979; Elliott, Huizinga, and Ageton 1985; Elliott and Menard 1996; Jensen 1972; Kandel 1978; Krohn 1974; Matsueda 1982; Matsueda and Anderson 1998; Matsueda and Heimer 1987; Reiss 1986; Short 1957; Voss 1969; Warr 1996). In fact, many studies find that the relationship of peer delinquency to self-report delinquency exceeds that of any other independent variable, regardless of whether the focus is on status offenses, minor property crimes, violent crimes, or substance use (Akers et al. 1979; Elliott et al. 1985; Jensen 1972; Matsueda and Heimer 1987; Short and Nye 1958; Warr and Stafford 1991). Therefore, causal explanations of delinquency that emphasize delinquent peer associations (e.g., differential association, social learning, and developmental theories such as Thornberry's [1987] interactional theory) appear justified.

Although prior delinquency research establishes that adolescents are likely to behave in a manner consistent with their friends, it has yet to incorporate the network structure of friendship relations into empirical models. This omission of network structure is attributable, in part, to researchers' reliance on a one-dimensional conceptualization of peer influence as "exposure" to delinquent friends. However, by ignoring the underlying social structure of friendship patterns, prior research has failed to address whether network structure moderates peer influence. For example, in closely knit (dense) friendship networks, peer behavior may more strongly influence members' behavior than is the case in less cohesive networks.

This study departs from previous research by recognizing the multifaceted nature of peer groups. Most adolescents do not belong to a single, densely knit, isolated friendship clique, but instead are affiliated with many loosely bounded friendship groups with varying degrees of cohesion and permeability (Dunphy 1963). A measure of the number of delinquent friends is thus insufficient to truly capture the dynamics involved in the

[2] Adolescent delinquency is typically defined as activities that place youth at risk for adjudication, that is, violating the juvenile code (Henggler 1989; Thornberry 1987). These activities can vary widely in their seriousness and detrimental effects on others. Status offenses are at the low end of the seriousness continuum and reflect those activities for which adults would not be arrested or prosecuted (e.g., truancy, alcohol use, smoking, running away). Serious offenses are at the other end of the continuum and reflect criminal activity, which can have very detrimental consequences for victims and other members of the community (e.g., homicide, rape, aggravated assault, burglary, auto theft, and arson). Most criminology studies use an omnibus rather than offense-specific measure of delinquency.

peer delinquency association. Since it is generally acknowledged that peers play an important role in delinquency involvement, it is important to examine the factors that may affect the peer-adolescent relationship. This study incorporates the friendship networks in which delinquent and nondelinquent adolescents are enmeshed, in order to address the question: Do structural characteristics of the adolescent's friendship network condition the association between friends' behavior and delinquency involvement?

Data from the National Longitudinal Study of Adolescent Health (hereafter, Add Health) enable this question to be addressed in a novel manner, through the application of a social network perspective and methods.[3] Because these data contain detailed social network information on high school–age adolescents, more valid measures of peer delinquency are possible. In contrast to previous work, this study uses measures of peer delinquency that are based on responses from the peers themselves, rather than perceptions from respondents. In addition, these data allow incorporation of the underlying structural characteristics of friendship networks. This allows for a determination about whether the strength of the delinquency-peer association depends upon how tightly an adolescent is integrated into the peer network (density), the adolescent's position within the network (centrality), and the adolescent's prestige (popularity) among network members. The use of network methods will provide a deeper understanding of the role that adolescent friendship networks play in either facilitating or discouraging delinquent behavior.

LITERATURE REVIEW

Friendship Networks

Ethnographic studies of adolescents in school settings provide most of the information on the importance of friendship networks during adolescence. These studies consistently report that being with friends is the most important aspect of school life for most students (e.g., Corsaro and Eder 1990; Cusick 1973; Everhart 1983; Willis 1981) and that relational problems with peers are particularly distressing to adolescents (Ambert 1994). Part of the importance attributed to friendships derives from structural changes that occur in the school environment during the transitions from elementary to junior and senior high school. After this transition, adolescents are confronted with a larger and more heterogenous population of students, and status in this new setting often is based on "being known" by peers (Eder 1985). Subsequently, many students speak of the need to

[3] Add Health can be accessed online at http://www.cpc.unc.edu/addhealth.

expand their personal networks to avoid becoming lost and isolated in the new school setting (Eckert 1989).

The importance of finding a position within larger friendship networks suggests that adolescents are particularly susceptible to peer influence during these transition years, including behavioral constraints that may pull them toward or away from delinquent behavior. This concern over locating position within the school hierarchy and gaining a sense of belonging among their peers leads students to adapt a variety of strategies to enhance peer solidarity. One strategy involves the use of gossip to constrain friends' behaviors. As Eder and Enke (1991) explain, "this constraint stems from the fact that while adolescents appear comfortable challenging the evaluations made by an individual, they seem reluctant to challenge a 'group' evaluation. Once an initial evaluation was supported by another group member, it was never challenged" (p. 505). For boys, a mechanism of ensuring conformity among peers involves "policing masculinity" (Best 1983) with behaviors such as aggressiveness, dominance, and toughness encouraged among peers (Messerschmidt 2000). To ensure compliance with this masculine ideology, boys often use derogatory female and homosexual references to keep group members in line (Best 1983; Messerschmidt 2000).

These findings suggest that friendship networks and peers exert considerable influence over adolescents' behavior, including delinquency. While ethnographic research is invaluable in highlighting the social mechanisms that peers use to constrain friends' behavior, it cannot tell us whether structural characteristics of the friendship networks provide more or less opportunity for these mechanisms to operate. This requires detailed information on the structural characteristics of friendship networks for a large number of adolescents situated across many different contexts.

Delinquent Peer Networks

Though much is known about the relationship between delinquency and friends' behaviors, only a few studies present detailed information on friendship characteristics among delinquent adolescents. Warr (1996) innovatively uses Gold's (1970) National Survey of Youth (NSY) to examine specific features of delinquent subgroups, such as group organization and the instigator role within delinquent groups. A particularly important finding from a network perspective is highlighted in his study: individuals' network structure influences behavior over and beyond that of their stable individual traits. Specifically, Warr finds that the structure of the group, not an individual's attributes, affects which individual instigates delinquency. Results from his study also indicate that groups are more specialized in terms of delinquency involvement than individuals tend to be,

so that most delinquent offenders belong to multiple groups, with each group specializing in a smaller range of offenses. This finding also highlights the multifaceted nature of peer groups; individuals in school settings can be members of many different friendship groups and face differing degrees of constraint depending upon whether the behavior, norms, and values of the groups coincide or diverge.[4]

The nature of friendship relations in delinquent versus nondelinquent networks is developed in two influential studies. First, an often cited study by Giordano, Cernkovich, and Pugh (1986) finds that various dimensions of friendship relations do not differ markedly between delinquent and nondelinquent adolescents. In contrast to control theory's depiction of delinquents' friendships as cold and exploitive (Hirschi 1969), Giordano et al. (1986) find that both delinquent and nondelinquent adolescents report similar levels of attachment, intimacy, and contact with friends.[5] Similarly, Kandel and Davies (1991) investigate whether friendship networks among adolescents who do and do not use illicit drugs differ in terms of intimacy. Again, contrary to social control theory, the authors find few differences in the characteristics of the friendship network. In fact, among frequent drug users, they find more intimate friendships than among adolescents with no drug use or lower levels of drug use.[6]

While these two studies go beyond others by incorporating the nature of friendship relations, they are largely descriptive and do not consider whether characteristics of friendship relations condition the influence of friends' delinquency on an adolescent's own delinquency involvement. This is an important issue since Agnew (1991) finds that subjective characteristics of the social relations of friendships (e.g., attachment, contact, delinquency) condition the effect of friends' behavior on adolescents' serious delinquency. Specifically, the effect of peers is strongest when an adolescent has strong attachment to peers, much contact with friends, and when their peers display delinquent patterns.

These are noteworthy findings because they indicate that even in delinquent peer networks, individuals display substantial variation in their

[4] However, by incorporating the behavior of the group as a defining characteristic (i.e., delinquent group), Warr's study, while provocative, only examines descriptive characterization of group characteristics for delinquent adolescents.

[5] Girodano et al. (1986) do find that delinquent adolescents tend to report more conflict involved in their friendship relations than their nondelinquent counterparts; however, delinquent friendship patterns are also characterized by greater loyalty toward peers than is found in nondelinquent friendships.

[6] These findings stand in contrast to some research coming out of the developmental field that suggests that children most at risk of delinquency are those who are rejected by their peers at an early age and later in middle adolescence form less stable and less affectionate friendships with other peer-rejected adolescents (Patterson, DeBaryshe, and Ramsey 1989).

attachment to and the amount of time they spend with their peers—both of which condition peer influence. While Agnew's research suggests that members of a friendship network are not affected by the network's behavior in exactly the same way, it is unknown whether structural properties of the network, such as density, centrality, and popularity, similarly condition peer influence. The latter finding may suggest that both structural and emotional ties play a role in determining the strength of the association between delinquent peers and delinquency involvement.

Therefore, despite advancing understanding of the role that peers play in adolescents' delinquency, prior research does not account for the role of network structure on adolescent delinquency. The criminological literature, in particular, and sociological literature, in general, reflect a surprising lack of clarity in conceptualizing peer influences and little consideration of peer network structure. By focusing only on the number of delinquent friends reported by an adolescent, prior research assumes that everyone in the friendship network is affected similarly by the behavior of the friendship network, regardless of their position within the network or their status among network members. The assumption that persons and groups are independent overlooks how interconnections among persons influence behavior.

In contrast, a social network perspective posits that examining an important element of peer relations, the observed pattern of interpersonal friendship relations, provides insight into whether the susceptibility adolescents have to their friends' behaviors derives in part from their position within the peer network. The interrelationships among adolescents serve as the context in which social norms and cultural values regarding delinquency are shared. Because of the importance of peer relationships in delinquency, the fact that few accounts of the delinquency-peer association are based on a social network perspective provides an opportunity to see whether a network approach provides a deeper understanding of the delinquency-peer association.

Selection versus Socialization

In spite of the volume of research on the delinquency-peer association, the causal effect of peers on delinquency remains subject to debate. This dispute centers on two aspects of the relationship, the definition of peer delinquency used and the appropriate temporal ordering of delinquent friends and delinquency. Although this study addresses the definitional aspect of the debate (by using peer self-reported delinquency measures rather than respondents' reports), it is unable to address the second issue

adequately.[7] In regard to temporal ordering, there is some evidence that adolescents sort themselves into friendship networks based on aggressive personality (Cairns et. al. 1988; Patterson and Dishion 1985). Although this selection into particular friendship networks may partially explain the association between delinquent peers and delinquency, it should also increase delinquency through differential association and processes of social contagion (Cairns and Cairns 1994; Elliott and Menard 1996; Kandel 1978; Krohn et al. 1996; Matsueda and Anderson 1998; Thornberry 1987).

Furthermore, while some criminologists speak of friendship formation as a self-selection process where "birds of a feather flock together" (Glueck and Glueck 1950), early child socialization researchers (e.g., Kupersmidt, Coie, and Dodge 1990) suggest that a process of peer rejection drives the formation of more problematic (i.e., aggressive and delinquent) friendship networks. Additionally, many children and adolescents have to wait until a peer group selects them, although they can accept or veto participation. This is because the number and type of networks open to them are limited by many factors including age, gender, cultural, and socioeconomic factors—which may be even more important factors than personality or behavior orientation (Brown, Lohr, and Trujillo 1990). This suggests that children and adolescents do not have as much control/freedom in selecting their friends as the selection perspective argues. Limited opportunities to join particular networks may make the peer network that adolescents eventually find a particularly important source of influence on their behavior.

THEORETICAL FRAMEWORK

Two dominant perspectives on the etiology of delinquent behavior are Hirschi's (1969) social control theory and Sutherland's (1947) differential association theory. Because these theories rest on contradictory assumptions about motivation for delinquency, the model incorporated into this

[7] Although the Add Health data currently consists of two waves of data, the network data is only collected during the first wave of data collection via the in-school survey (see "Data" section for additional details on the data collection procedures). Therefore, despite having measures of delinquency involvement collected at two points in time, the network measures used to describe characteristics of friendship networks (i.e., egocentric networks) are only available at the first point in time. Sufficiently accounting for self-selection into friendship networks necessitates information from two points on time on both delinquency involvement and network characteristics. Controlling for earlier delinquency involvement is not sufficient since there is no way to untangle whether the previous delinquency resulted from network processes (with friendship formed at an earlier point in time) or determined the type of friendship network the adolescent self-selected into.

study relies on theoretical elaboration. Theoretical elaboration is useful because it does not require a resolution of differences in assumptions, only that the propositions of the model be consistent (Thornberry 1987). Drawing on Krohn's work explicating the possibilities of network studies for understanding delinquency (1986; Krohn et al. 1988; Krohn and Thornberry 1993), I discuss the important concepts from social control and differential association theory with emphasis on using a network perspective to link and elaborate on the concepts. This leads to the expectation that although friendship networks, on average, exert considerable social control over adolescents, this constraint will depend on (1) the friendship networks's normative behavior and (2) structural properties of the friendship network.

Social Control Theory

Travis Hirschi's (1969) social control theory of delinquency is based largely on the notion of social integration focal to the work of Durkheim (1951). Instead of focusing on why certain individuals commit crime, social control theory emphasizes the necessity of explaining why individuals refrain from criminal activity (Hirschi 1969). Offering motivation for criminality is unnecessary, according to Hirschi, because "we are all animals and thus all naturally capable of committing criminal acts" (1969, p. 31). Instead, he focuses on constraining influences and argues that adolescents tightly bonded to family, the school, and peers are less likely to engage in delinquent acts because these bonds restrain them from acting on their natural antisocial impulses (1969).[8]

Although Hirschi discusses four bonds responsible for constraining delinquent behavior—attachment, involvement, commitment, and belief—most research concentrates on the importance of the bond of attachment (Vold, Bernard, and Snipes 1998). According to social control theory, adolescents who have strong ties of affection to others (family, friends, school) are more behaviorally constrained than those lacking these bonds and thus less likely to become involved in delinquency. In terms of friendship networks, social control theory posits that the more bonds an adolescent has via friendship ties, which carry a connotation of attachment, the less delinquent the adolescent will be.

While research provides modest empirical support for Hirschi's theory

[8] Additionally, Hirschi argues that adolescents who have a stake in conformity (i.e., commitment) are far less likely to select delinquents as friends. On a related note, Hirschi believed that adolescents lacking stakes in conformity were likely to be delinquent and to self-select other delinquents as friends. This issue is part of the selection-socialization debate mentioned earlier.

(see a review of research on this issue in Jensen and Rojek [1992]), it is evident that a complete explanation of delinquent behavior is not offered by the theory. One of the more problematic aspects of social control theory involves its neglect of the context in which the social bonds occur. Specifically, while research establishes that in most cases social bonds via attachment are associated with a reduction in delinquency, they are not likely to reduce delinquency when adolescents are bonded to delinquent friends. When bonded to delinquent peers, the constraint of the bond is toward delinquency. Despite Hirschi's denial of the importance of delinquent friends, it is these delinquent associates who are implicated in the transmission of delinquency and to whom differential association theory attaches primary importance.

Although social control theory pays limited attention to the context in which social bonds occur, its focus on the constraining influence of social integration is consistent with a social network perspective (Krohn 1986).[9] Being integrated within a friendship network where adolescents are likely to report high attachment and time spent with peers (Giordano et al. 1986) either facilitates or discourages delinquency involvement depending upon the norms, values, and behaviors evident in the network (see also Krohn 1986; Elliott et al. 1985). Consistent with Eder and Enke's (1991) finding that although adolescents often discount a peer's evaluation, but never a group evaluation, is the notion that embeddedness within a social structure (such as a friendship network) acquires additional influence because it creates expectations for behavior, while reinforcing the social norms and beliefs of the network (Granovetter 1973, 1974, 1985). This idea of embeddedness ties nicely into Sutherland's theory of differential association since being enmeshed in a peer network provides access to expectations, norms, and sanctions that either support or discourage delinquent behavior.

Differential Association Theory

Edwin Sutherland's (1947) differential association theory is based on the premise that delinquency is learned through intimate social relations with friends where attitudes or "definitions" favorable to law violation are acquired. Thus, not only are adolescents' attachments to peers important for delinquency involvement, but more important, the context or norms of the friendship group determine whether attachment to friends results

[9] Because Hirschi's concept of a social bond is often construed around attachment, it is important to recognize that a social tie to others does not necessarily represent integration in Hirschi's framework. However, a friendship network where ties are implied on the basis of attachment to peers can be construed as integration.

in conventional or delinquent behavior. The social transmission of delinquency occurs within the friendship network through the dissemination of attitudes about the appropriateness of delinquent behavior (Sutherland 1947). While Sutherland's theory emphasizes the attitudes of peers in the transmission of delinquency, Aker's (1985) extension to differential reinforcement theory suggests that the adoption of delinquent behavior occurs through the imitation of peers' behavior or through the observation of its consequences (either positive or negative). Consistent with Aker's reformulation of differential association theory, research finds that the behavior of peers is more important than the attitudes of peers in influencing an individual's own delinquency (Warr and Stafford 1991).

Differential association theory, and Aker's extension to it, are particularly suited to an examination of friendship networks because "definitions favorable to violation of law" are learned in the intimate social networks of individuals (Sutherland and Cressey 1974). Moreover, several researchers drawing on differential association theory have argued that the effect of delinquent peers is conditioned by specific features of social relations (Agnew 1991; Orcutt 1983, 1987; Short 1957, 1960; Voss 1969). Because Sutherland's theory stipulates that the frequency, duration, priority, and intensity of associations are the most relevant for differential association, researchers have explored whether these features of social relations condition delinquent peer influences. Unfortunately, the imprecise definitions offered by Sutherland for the features of differential association leave room for subjective interpretation of the defining characteristic of social relations, and subsequent researchers have offered various definitions.

Instead of focusing on subjective properties of social relations, such as affection, a network perspective suggests that useful conceptualizations of social relations should also incorporate the underlying structural properties of interpersonal relationships in which definitions, favorable or unfavorable, to delinquency are transmitted. This may particularly be the case for Sutherland's property of intensity. For example, a more cohesive peer network in which everyone is friends with everyone (i.e., high density) will provide greater intensity in differential associations for adolescents than will location in a friendship network in which only certain members identify each other as friends. Additionally, an adolescent's structural location within the network may affect the intensity of differential associations. For example, adolescents located in more central positions within the network should experience greater differential association than adolescents located in more peripheral positions in their peer network.

In summary, a network perspective offers a structural approach to defining characteristics of social relationships. As discussed next, a network perspective suggests that (1) some group members are more susceptible to control by their friendship network due to their position within

the friendship network, and (2) some friendship networks are more effective in controlling the behavior of their members due to structural characteristics of the network. By reconnecting adolescents to the structures of relationships in which they are embedded, network methods and theory provide important tools to deepen understanding of the delinquency-peer association.

Social Network Perspective

A social network perspective provides a useful framework for expanding on social control and differential association theory.[10] Not only does the network perspective assume that networks constrain individual behavior to become consistent with the norms, expectations, and behaviors of the network, but that "the structure of a network has consequences for its individual members and for the network as a whole, over and above effects of characteristics and behaviors of the individuals involved" (Klovdahl 1985, p. 1204). This suggests that after accounting for relevant individual attributes, structural location and positioning within social networks influence behavior by moderating the effect of the network's behavior.

Social network analysis is uniquely suited for measuring and understanding the behavior of peers because it provides a formal means for "mapping" friendships and measuring properties of those friendships (Ennet and Bauman 1996). In most prior criminology/delinquency research designs, adolescents simply describe their perceptions of their friends' behavior. This is then construed as a measure of peer influence. Network analyses offer an alternative and more methodologically rigorous approach, where the beginning point is asking respondents both to describe their own behavior and to identify their friends. The second step involves locating and interviewing the friends, with the friends describing their own behavior and then identifying their friends, and so on. In a best case scenario (which the Add Health comes very close to), all adolescents and friends in the population of adolescents provide this information. This allows the links among friends to be established for the purpose of constructing analytical friendship networks with identifiable structural properties. The characteristics of the adolescent's friendship network, includ-

[10] A social network is defined as a set of nodes (e.g., persons) linked by a set of social relationships (e.g., friendships) of a specified type (Laumann, Marsden, and Prensky 1989). In network analysis, the pattern of linkages among a group of nodes is of primary interest (Friedman et al. 1999). An egocentric network, which is the focus of this study, centers on the individual and represents direct friendship links to other adolescents within the social environment (e.g., school).

ing peer delinquency, can then be treated as individual attributes of that respondent.

Because network methods are premised on the idea that patterns of friendship ties structure the flow of information, social norms, and social support, incorporating the friendship context is important for the study of delinquency since these ties potentially provide linkages for the transmission of delinquent behavior (Ennett, Bailey, and Federman 1999). These are the links through which differential associations are believed to occur. Despite advances in network methodologies that have pointed to the importance of social relations for understanding behavior (e.g., Bott 1957; Coleman 1961; Granovetter 1973; Kapferer 1969), most criminologists have not yet examined the different ways social networks influence adolescents' participation or nonparticipation in delinquency. Theories of adolescent delinquency have focused on the existence of peer networks (differential association theory) or on adolescents' feelings toward friends, such as attachment to friends (social control theory), without considering characteristics of the networks themselves (Krohn 1986).

Krohn and his colleagues (1986, 1988, 1993) represent some of the only criminologists who have recognized the benefits of applying a network perspective to the study of delinquency. To evaluate the degree to which delinquent behavior is within the purview of an individual's network, Krohn directed attention to two network characteristics he believed were especially important: muliplexity (defined as the number of activities in which individuals interact jointly) and density (defined as the extent to which all members in the network are connected by direct ties). Despite relying on survey data (where respondents were asked to describe network characteristics), Krohn's study is one of the first to suggest the importance of structural properties of networks for evaluating the probability of delinquency. That is, structural characteristics of friendship networks can help elucidate when network members have, more or less, control in enforcing common norms, expectations, and obligations for behavior. Unfortunately, little research in criminology has followed up on Krohn's lead.

This study expands on prior research in two important ways. First, peer networks are defined more rigorously as adolescents' egocentric friendship networks and are measured with network data on friendship nominations linking adolescents within schools. An adolescent's friendship network consists of all adolescents who the respondent directly nominates as friends, as well as those adolescents who directly nominate the respondent as a friend. Second, the behavior and structural characteristics of the personal friendship network are measured directly through information provided by all members of the friendship network, rather than by the perceptions of the respondent. Information on how delinquent the network is, as well as the structural properties of the friendship network,

are also based on friendship nomination data. If network structure matters, the structural properties of adolescents' friendship networks will condition the association between networks' delinquency and respondents' reported delinquency.

Network Characteristics and Expectations

By drawing linkages between social control and differential association theory, a network perspective suggests how structural properties of friendship networks may moderate the delinquency-peer association. These expectations are detailed below.

Density.—When network density is high and all members of the network are likely to know and interact with one another (Bott 1957), it is expected that the behavior evidenced in a friendship network will be more strongly associated with an adolescent's behavior than will be the case in less cohesive friendship networks. More cohesive networks contain higher levels of interaction and communication within them so that the opportunities for network members to express their views of appropriate behavior are maximized (Giordano et al. 1986). Additionally, when all network members know one another, the likelihood of knowing others outside the network is reduced compared to the opportunity to know outsiders in less dense friendship networks (Granovetter 1973). This suggests that outside pressures are less influential for adolescents located in dense friendship networks.

James Coleman (1990) discusses the advantages of social closure of this sort in an individual's network for the facilitation of a clear social identity. Conceptualizing networks in terms of social capital suggests that "a cohesive network conveys a clear normative order within which the individual can optimize performance, whereas a diverse, disconnected network exposes the individual to conflicting preferences and allegiances within which it is much harder to optimize" (Podolny and Baron 1997, p. 676). Thus, very dense social networks facilitate common identities and constrain the behavior of their members to be consistent with the network's behavior, whether that is toward delinquency or not.

Density is defined in this study as the number of ties present in the egocentric friendship network divided by the number of possible ties. A network's density would be completely maximized if every member had ties to every other member and at a minimum if others in the network were only connected to the respondent.

Centrality.—Similarly, it is expected that an individual's position within the friendship network affects how influential the network's behavior is on the adolescent's behavior. Adolescents located in more central positions are expected to report behavior more closely associated with their friends'

behavior than individuals located in more peripheral positions (Giordano 1983).[11] A central adolescent is defined as one who has ties to all or most of the network members in the friendship network so that information passed through the network will have to be passed through this central adolescent. This definition of centrality gauges whether adolescents are located in prominent positions within their friendship networks according to whether they are involved with many others in the network. It does not matter whether involvement is due to being the recipient of many friendship ties or the source of the ties—what is important is that a central adolescent is involved in many relationships with friends. This is an exposure argument—the central adolescents are exposed to greater communication and interaction within their friendship network than adolescents located in peripheral positions within the network.

Centrality is a measure of the number of links required to link all other adolescents in a respondent's friendship network; the lower the number of links necessary, the more central the respondent. The measure used in this study also accounts for the centrality of the adolescents to whom respondents are linked by weighting respondents' centrality scores by the centrality of those to whom respondents send ties. Therefore, this measure of influence not only depends on the adolescent's centrality within the network, but also on the positioning of those to whom he or she is connected.

Popularity.—Individuals who receive many friendship nominations (i.e., popularity) are expected to be more constrained by the behavior of the network than individuals who receive fewer friendship nominations. For example, individuals who are more popular may have behavior more similar to their friendship network than individuals with less status in the peer hierarchy. This expectation arises because the most popular students in the school have the most to lose (the furthest to fall in the status hierarchy) by not adopting the network's behavior. Supporting this idea, ethnographic research by Eder (1985) finds that the most popular adolescent girls in a junior high school perceived more limited friendship choices and experienced great stress associated with maintaining their dominant position within the student hierarchy. The stress resulting from maintaining positions within school hierarchies was partly attributable to the girls' considerable effort directed at ensuring that their behavior remained consistent with that expected from their elite position. Limited

[11] Conversely, it could be argued that more central actors (and more popular actors) have greater influence on the group's behavior. While unable to determine the direction of the relationship with cross-sectional data used in this study, either position implies that the association between friends' behavior and a respondent's behavior will be stronger when the respondent is located in a more central position within the friendship network.

friendship choices in a stratified setting suggest that popular students may have little option but to go along with group processes if they wish to maintain their high status. Popularity is defined in this study as the number of friendship nominations an adolescent receives from other adolescents located in the school.

The guiding premise of these expectations is that adolescent delinquency can better be understood by incorporating characteristics of social networks. A network perspective will enable integration of findings from social control and differential association theory by premising that adolescents engage in delinquency not only because their friends are participating, but because their location within the friendship network and other structural characteristics of the network determine whether the network has more or less social control over member's behavior. That is, integration within a friendship network will be associated with delinquency depending on the behavior of the network (pro- or antidelinquent), and the structural properties of the friendship network will maximize or minimize this association.

DATA

While fundamental, the effect of social networks within a school context on adolescents' delinquency has rarely been studied. In part, this is because the requisite data have not been available. Understanding social networks' influence on adolescent delinquency requires detailed population-level data on the structure of friendship patterns within a school, for many different schools. Until recently, the only data that approached these stringent requirements was Coleman's landmark study (1961) of social relationships among high school students in the 1960s. Although these data provided insight into the importance of peer relationships and adolescent culture, they were only available for a small number of schools, so that generalizability to other schools and adolescents as a whole was prevented.

This study utilizes data from the first wave of the Add Health survey, a newly available data set consisting of a nationally representative sample of adolescents in grades 7–12 nested within randomly selected schools in the United States during 1994–95. The innovative design of this sample, particularly its emphasis on the effects of multiple contexts of adolescents' lives, allows for an examination of the correlates of adolescent health and health behavior (including delinquency) that goes considerably beyond prior research.

In-School Interviews

In contrast to other nationally representative surveys of adolescent delinquency that use sample designs to randomly select adolescents from the schools, the Add Health study contains very detailed social network data for students in 129 randomly selected schools stratified by region, urbanicity, school type, ethnic mix, and size.[12] Within each school, brief interviews were conducted with every student attending the school on that day ($N = 90{,}000$). During this in-school phase, students were asked to identify their best male and best female friends from a school roster (up to 5 friends of each sex),[13] as well as provide some brief demographic information and describe their participation in a few minor delinquent activities. Because friendship nominations were recorded by student identification number located from school rosters, it is possible to link together most of the students in the schools, thereby recreating the social networks. From this complete network information, network characteristics and the mean delinquency rate of the respondent's friendship network are calculated.

Because this is a study of friendship networks within schools, it is important to acknowledge that the network data do not include detailed information on ties to friends who do not attend the school. Friends who do not attend school may be particularly likely to be delinquent (e.g., drop-outs), and delinquent adolescents attending school may be more likely to nominate these out-of-school friends. However, adolescents were able to nominate friends outside of the school, allowing a calculation of the number of out-of-school nominations per adolescent to be determined (this is the only information available on network structure outside of the school). This information reveals that the average number of outside nominations for adolescents is generally small, averaging 1.4 ties per adolescent. More important, out-of-school nominations do not significantly differ between delinquent and nondelinquent adolescents (1.4 vs. 1.3). Therefore, the assumption that delinquent and nondelinquent adolescents have friendship networks located within schools (rather than outside of school) appears reasonable.

In-Home Interviews

This project also draws on a second component of the Add Health study, which contains extensive in-home interviews with a randomly selected

[12] For information about the design of the Add Health study, see the "Research Design" section of the web site at http://www.cpc.unc.edu/projects/addhealth/design.html.

[13] Although the maximum number of nominations allowed was 10, very few students were affected by this restriction. In fact, the mean number of nominations an adolescent identified (from their send network) was 4.15 ($SD = 3.02$).

sample of adolescents. This nationally representative sample of adolescents in grades 7–12 was drawn from school rosters provided by each school, with students stratified by grade and sex. Approximately 200 adolescents were selected from each of the 80 pairs of schools (the high school and its feeder junior high school), yielding a sample of approximately 20,000 adolescents.[14]

These in-depth interviews involved the collection of more sensitive data such as an extensive series of questions that concern involvement in both property and violent delinquency. An additional advantage of this data involves the use of laptop computers to maintain confidentiality about sensitive subjects such as delinquency. This method of data collection allowed respondents to maintain their anonymity by listening to prerecorded questions about participation in different delinquent activities and then entering their responses directly into the computer. This self-report information on participation in a series of delinquent activities is used to construct the dependent variable—delinquency involvement—which is described in the following section. Because the dependent variable can only be constructed from the in-home survey (vs. the in-school survey), the in-home survey composes the main sample for this project. Network information from the in-school survey is appended to this sample. Drawing on these data components, the final sample for this study consists of approximately 13,000 adolescents nested within 120 schools who had completed both in-school and in-home interviews.

Dependent Variable

To assess an adolescent's involvement in delinquent behavior, this study employs a commonly used measure of delinquency involvement. This additive index of delinquency involvement is based on the self-reported responses from adolescents describing participation in a series of 14 different delinquent activities during the past year.[15] The 14 delinquency items incorporated into the index are listed in table 1 and include painted graffiti, damaged property, shoplifted, stole something worth less than $50, stole something worth $50 or more, burglarized, borrowed a car without the owner's permission, sold drugs, involved in a serious physical

[14] Of the 160 schools initially selected, 134 schools agreed to participate, yielding a response rate of 79%. Of the 134 schools, 129 (96%) arranged for an in-school survey to be completed between September 1994 and Sepember 1995.

[15] Short and Nye (1958) introduce the self-report method of measuring delinquency. Subsequent work has established that adolescents do report their delinquent behavior, these reports tend to be internally consistent, and the reports relate to differences in official delinquency status and to other differences predicted by research and theory (Hindelang, Hirschi, and Weis 1980).

TABLE 1
FREQUENCY DISTRIBUTIONS OF DELINQUENCY ITEMS

Dependent Variable	*N*	%
Delinquency index:*		
Painted graffiti:		
Never	12,332	91.2
One or more times	1,186	8.8
Damaged other's property:		
Never	11,135	82.4
One or more times	2,383	17.6
Shoplifted from a store:		
Never	10,247	75.8
One or more times	3,271	24.2
Stolen something worth less than $50:		
Never	10,813	80.0
One or more times	2,705	20.0
Stolen something worth more than $50:		
Never	12,885	95.3
One or more times	633	4.7
Burglarized a building		
Never	12,870	95.2
One or more times	648	4.8
Borrowed a car (w/o owner's permission):		
Never	12,204	90.3
One or more times	1,314	9.7
Sold drugs:		
Never	12,592	93.1
One or more times	926	6.9
Got into serious physical fight:		
Never	9,457	70.0
One or more times	4,061	30.0
Seriously injured someone:		
Never	11,186	82.7
One or more times	2,332	17.3
Taken part in group fight:		
Never	10,980	81.2
One or more times	2,538	18.8
Used or threatened to use weapon:		
Never	13,001	96.2
One or more times	517	3.8
Pulled a knife/gun on someone:		
Never	12,961	95.9
One or more times	557	4.1
Shot/stabbed someone:		
Never	13,303	98.4
One or more times	215	1.6

TABLE 1 (*Continued*)

Dependent Variable	*N*	%
Friends' delinquency index:†		
Smoked cigarettes:		
Never	8,275	64.4
One or more times	4,574	35.6
Drank alcohol:		
Never	5,787	45.1
One or more times	7,036	54.9
Got drunk:		
Never	8,869	69.5
One or more times	3,893	30.5
Raced on bike, boat, or car:		
Never	5,496	44.8
One or more times	6,770	55.2
Been in danger due to dare:		
Never	7,777	60.8
One or more times	5,011	39.2
Skipped school without an excuse:		
Never	8,981	69.9
One or more times	3,868	30.1

NOTE.—Data for all items include only the past 12 months.

* Summed index based on items 1–14, below (Cronbach's $\alpha = .83$; mean = 1.72; SD = 2.31).

† Items from the in-school interviews used to calculate mean delinquency of friendship send/receive-network (Cronbach's $\alpha = .82$; mean = 5.33; SD = 3.37).

fight, seriously injured another, used or threatened to use a weapon, participated in a group fight, pulled a knife/gun on someone, or shot/stabbed someone.

The particular questions ask students to report how often in the past 12 months they have participated in these activities. Each response is coded "0" if the respondent reported not participating in the activity during the past year or coded "1" if they reported participation.[16] Following common procedures used to measure self-report delinquency, a summated delinquency index is created based on responses to the 14 delinquency items. The Cronbach alpha of 0.83 indicates that these items have con-

[16] All analyses were additionally carried out with responses to each delinquency item coded on the original ordinal scale (0 = never participate to 3 = 5 or more times) and with separate property and violence delinquency indices. Findings from these additional analyses closely dovetailed those presented here for the overall delinquency index. Peer behavior was found to be just as robustly associated with property delinquency as it was with violent delinquency. Network characteristics also operated quite similarly to results presented here. The only differences to emerge were in regard to a few of the effects of control variables. Results are available upon request from the author.

siderable internal consistency.[17] Although the average delinquency levels for respondents is 1.7, with considerable variation around this mean, many respondents (44%) report never participating in any delinquent activities

Peer Delinquency

Most of the prior research on the delinquency-peer association assumes that respondents' perceptions of their friends' attitudes and behaviors accurately reflect the reality of these attitudes and behaviors without allowing for the powerful influence of assumed similarity (Jussim and Osgood 1989). Problems with this common approach to measuring the influence of peer behaviors have been highlighted in the developmental literature and, to a lesser extent, in the criminological literature. Generally, this literature notes that respondents' perceptions of friends' behavior are not very accurate assessments of the friends' actual behavior (Bauman and Fisher 1986; Billy, Rodgers, and Udry 1984). These findings give particular credence to Gottfredson and Hirschi's (1990, p. 157) argument that measures of peer delinquency are simply "another measure of self-reported delinquency." That is, when asked to report their peers' delinquent behavior, adolescents show a proclivity to report their own delinquent behavior. If this is the case, it casts considerable doubt on the frequently observed relationship between peers' delinquency and adolescents' own reports of their delinquency.

To avoid problems of projection (i.e., a respondent projecting his or her behavior to friends), this study relies on the actual responses of all identified friends to a series of questions about delinquency. During the in-school interview, every student was asked about his or her involvement in a series of six minor delinquent acts. Using the friendship nomination data, which links up all of the students in the school and this information on friends' delinquency involvement, a measure of peer network delinquency is created.[18] It is calculated as the average response of all identified friends to the minor delinquency items, which include smoked cigarettes, drank alcohol, got drunk, skipped school without an excuse, did dangerous things on a dare, and raced vehicles such as cars or motorcycles (see table 1 for a description of the six items). Table 1 indicates that the mean minor

[17] The items running away from home, lying to parents, and disorderly conduct had very low intercorrelations with the index and therefore were not included in the index.

[18] Thanks to a reviewer for pointing out that what I have measured in this study are really characteristics of the adolescent's egocentric network, which is not quite the same as a "peer group" in the sense that there is not identification of particular cliques or subgroups. Instead, the measure used in this study benefits from the fact that adolescents tend to belong to multiple cliques in school, some of which overlap, while others may not.

delinquency of a respondent's peer network is 5.3, signifying that members of the typical respondent's friendship network committed five minor delinquency activities once or twice in the past 12 months.[19] Although these are admittedly minor deviant activities, which may provide a conservative estimate of the association between peer behavior and an adolescent's more serious delinquency involvement, Osgood and colleagues (1988) present evidence for the generality of deviance, which provides some support for the use of this more conservative measure.

In addition to constructing the mean delinquency rate of the friendship network, the connections among adolescents are used to describe the different characteristics of their friendship network: density, centrality, and popularity. Table 2 provides definitions and calculation of the ego-centered network attributes, and table 3 displays the descriptive attributes of the sample. This latter table indicates that the average adolescent has a network density of 0.42 (range 0.20–0.83), revealing that less than half of an adolescent's egocentric network has close ties to each other. This finding is consistent with results from network studies, which find that most people are not in tightly knit, tightly bounded networks, but instead have sparsely knit, loosely bounded personal networks (Wellman 2000). In terms of positioning within the friendship network, the typical adolescent

[19] Unfortunately, information on friends' delinquency is only available from in-school interviews, which do not include the friends' involvement in the extensive list of delinquency items used to create the dependent variable (which were collected during the in-home portion of the interview). Therefore, a measure of friends' minor delinquency involvement is the only information available for all adolescents composing the respondent's friendship network in the schools included in the complete sample. In the Add Health data, in-home interviews were conducted with every adolescent attending school in 14 small schools, chosen because of their size, and in two large schools, which were purposefully selected. (This is referred to as a saturation sample). This very limited sample, therefore, contains information on friends' involvement in the more extensive list of 14 delinquency items, as well as the minor delinquency items. To gain an initial benchmark of how big a discrepancy there is between the association of friends' minor delinquency involvement and a respondent's more serious delinquency involvement—compared to the association between friends' more serious delinquency and a respondent's serious delinquency index—some preliminary regression analyses were conducted on the saturation sample. The correlation between friends' minor and friends' serious delinquency involvement in the saturation sample ($r = 0.47$) suggests that while the two indicators of friends' misbehavior are correlated substantially as expected, it is far from a perfect association. Next, regression analyses (using a negative binomial model) indicated that using friends' minor delinquency as a proxy for more serious delinquency involvement provides a more conservative estimate of the association between friends' delinquency and a respondent's behavior ($b = .06$ using friends' minor delinquency compared to $b = 0.11$ using friends' serious delinquency). Nonetheless, despite a weaker association, friends' minor delinquency involvement remained significantly associated with a respondent's more serious delinquency involvement and supports the use of this measure in subsequent analyses, so results can be generalized from a more representative sample.

TABLE 2
DEFINITION AND CALCULATIONS OF INDEPENDENT VARIABLES INCLUDED IN ANALYSES

Variable	Definition	Calculations/Value
Network characteristics:		
Mean friendship delinquency ...	Mean value of minor delinquency items for the respondent's friendship network	$\text{MEANDEL}_i = \Sigma x_j/n_j$, where x_j = the value of the delinquency index for the jth member of the adolescent's network and n_j = the number of nodes in the adolescent's network based on send and receive friendship nominations (excluding ego)
Popularity	Measures no. of times the respondent is nominated by other students in the school	IN-DEGREE = ΣX_{ji}, where ΣX_{ji} = the sum of the ith column of the total friendship network X
Density (relative)	No. of ties in respondent's friendship send/receive-network divided by the number of possible ties in the total friendship send/receive-network (corrected for the maximum number of ties a respondent can send)	$\text{ERSDEN}_i = [\Sigma SR/sr \times (sr - 1)]/\{abs[(10 \times sr)/sr(sr - 1)]\}$, where SR = total ego send/receive-network and sr = number of nodes (ties in SR)
Centrality (Bonacich)	Respondent's centrality, weighted by the centrality of those to whom he or she sends ties	$\text{BCENT}10 \times (\alpha,\beta)_1 = \alpha(I - \beta X)^{-1}X1$, where: α = a scaling vector; β = power weight (here = 0.1); I = identity matrix; and X = total friendship network
Control variables:		
Female (male reference)	Dummy variable indicating respondent is female	FEMALE = 1; MALE = 0
Black (white reference)	Dummy variable indicating that respondent is of African-American descent	Black = 1; white, other race = 0

Other race	Dummy variable indicating respondent is of Indian, Asian, or other racial descent (i.e., not white, or African-American)	Othrace = 1; white, black = 0
Age	Measures respondent's age at the time of the initial in-school survey	Continuous variables in years
Age^2	Measures the respondent's age squared	(Continuous variables in years)^2
Two-parent family	Dummy variable that indicates whether respondent lives in a household with two married parents present	TWOPAR = 1; other living arrangements = 0
Public assistance	Dummy variable indicating whether respondent's family acknowledged receipt of public assistance	PUBASSIST = 1; no public assistance = 0
Parental attachment index	Mean value of two items: (1) feel close to parents; (2) feel parents care about you (Cronbach α = .78)	Not at all = 1; very little = 2; somewhat = 3; quite a bit = 4; very much = 5 (average response of the two items)
School attachment index	Mean value of three items: (1) feel close to people at school; (2) feel like part of school; (3) happy to be at school (Cronbach α = .78)	Strongly disagree = 1; disagree = 2; neither agree/disagree = 3; agree = 4; strongly agree = 5 (average response of the three items)
Friend attachment	Response to How strongly do you believe that your friends care about you?	Strongly disagree = 1; disagree = 2; neither agree/disagree = 3; agree = 4; strongly agree = 5
Friend involvement	Response to During the past week, how many times did you just hang out with friends?	Not at all = 0; 1 = 1 or 2 times; 2 = 3 or 4 times; and 3 = five or more times

TABLE 3
MEANS AND SDs FOR SAMPLE

Variable	Mean (%)	SD	Min	Max	*N*
Dependent variables:					
Delinquency index	1.72	2.31	.00	14.00	13,518
Egocentric network characteristics:					
Mean friendship delinquency rate	5.34	3.37	.00	30.00	13,518
Popularity	4.55	3.61	.00	32.00	13,518
Centrality (Bonacich)	.82	.64	.00	4.29	13,518
Density (relative)	.42	.10	.20	.83	13,518
Background individual characteristics:					
Male (ref)	.48	. . .	.00	1.00	13,518
Female	.52	. . .	.00	1.00	13,518
White (ref)	.51	. . .	.00	1.00	13,518
Black	.23	. . .	.00	1.00	13,518
Other race	.26	. . .	.00	1.00	13,518
Age	15.61	1.70	11.00	19.00	13,516
Age^2	246.47	52.75	121.00	361.00	13,516
Two-parent family	.70	. . .	.00	1.00	13,518
Public assistance receipt ...	.07	. . .	.00	1.00	13,518
Parent attachment index ...	4.56	.77	.00	5.00	13,513
School attachment index ...	3.78	.86	1.00	5.00	13,365
Friend attachment	4.25	.80	1.00	5.00	13,507
Friend involvement	1.98	.99	.00	3.00	13,518

NOTE.—Data for students in schools with more than 50 respondents completing both in-school and in-home interviews.

has a centrality level of 0.82 (range 0–4.3) and 4.6 other adolescents in the school nominating him or her as a friend (popularity range: 0–32).

Control variables associated with delinquency in prior criminological research are included in this study, and measurement of these variables are also described in table 2. These control variables include gender, race, age, an indicator of family structure, receipt of public assistance, a parental attachment index, a school attachment index, a friend attachment index, and a measure of friend involvement. These control variables were selected because they either control for important demographic differences in delinquency propensity (e.g., age, gender, race, social class, family structure) or because they are implicated as key variables in social control and differential association theory (e.g., parental attachment, school attachment, peer attachment, friend involvement). Table 3 provides the descriptive characteristics of these variables and reveals that the average adolescent is white, lives in a two-parent family, has relatively high at-

tachment to parents and friends, and spends a considerable amount of time "hanging out" with friends.

ANALYSIS

Assessing whether peer network characteristics are associated with delinquency and condition the delinquency-peer relationship necessitates multivariate analyses with emphasis on interaction terms. However, determining the proper modeling procedure for the analyses requires examining the distribution of the dependent variable: delinquency involvement. While the mean value of the overall delinquency index is 1.7 (see table 1), the distribution of the variable is far from normal. Inspection of the frequency distribution for the delinquency index finds that the most common value is zero, indicating that many adolescents report no delinquency involvement. Additionally, a minority of respondents report involvement in a large number of delinquent activities (5% reports participating in six or more acts, and 1% reports participating in 10 or more). Due to a large number of zeros and a large positive skew in the distribution, the normality assumption of OLS cannot be approximated with a mathematical transformation. Therefore, negative binomial regressions, designed to handle dependent variables with distributions incorporating many zero values and large positive skews, are used in the results that follow.[20]

Because standard negative binomial models assume that regression coefficients are fixed between groups and that error terms are not correlated, these models are inadequate for complex sampling designs where individuals are nested within a larger macrounit (here schools; see Goldstein 1987; Lee and Bryk 1989; Raudenbush and Bryk 1986). Due to the clustering of the data and the correlated error structure, statistical techniques, which can correct for design effects and unequal probability of selection, are necessary to achieve unbiased parameter estimates.[21] In addition, since

[20] The negative binomial model differs from Poisson regression by the addition of a residual variance parameter that captures overdispersion in the dependent variable (which occurs when the standard deviation is greater than the mean [Gardner, Mulvey, and Shaw 1995]). Designed for dependent variables that are counts of events, negative binomial models utilize a distribution that characterizes the probability of observing any discrete number of events, given an underlying mean count of events (Osgood 1999). In the negative binomial regression model, $u_i = \exp(n_i)$, which indicates that a one-unit increase in X_{ij} multiplies the expected delinquency index by a factor of $\exp(B_j)$, and conversely, a one-unit decrease divides the expected index by the same amount (Gardner et al. 1995).

[21] See Kim Chantala and Joyce Tabor's 1999 article, "Strategies to Perform a Design-Based Analysis Using the Add Health Data," on the Add Health web site at http://www.cpc.unc.edu/projects/addhealth/strategies_Data.html.

dispersion or unexplained variation in individual outcomes is likely to vary across schools because of unidentified school-specific reasons (e.g., school delinquency rate, student-teacher ratio, school size, region of the country) a random-effects overdispersion model is used in all analyses. This type of random effects model allows dispersion to vary randomly from school to school. The software package Stata is used for all analyses, which allows incorporation of the survey design characteristics into the computational formulas.[22]

FINDINGS

Delinquency-Peer Association

Before addressing the main question about the moderation of delinquency-peer associations by network characteristics, it is useful to examine whether network characteristics are associated with delinquency and improve model fit after accounting for control variables. The multivariate analyses in table 4 present models that examine the association between delinquency involvement and background individual-level characteristics. Model 1 simply provides a baseline against which to assess model fit. Consistent with prior research, variables that tap dimensions of social control are associated with a reduction in delinquency involvement (the exception is attachment to friends), whereas involvement with friends (i.e., the amount of time spent with friends) is associated with increased delinquency involvement. Model 2, which is of more interest, assesses whether a measure of peer delinquency is associated with an adolescent's delinquency. Recall that a common critique of prior studies' findings of a strong association between delinquent peers and a respondent's self-report delinquency is that the friends' behavior is measured through the respondent's potentially biased perceptions.

Model 2 indicates that friends' delinquency is associated with a respondent's own delinquency; each unit increase in friends' delinquency yields a 4% increase in the respondent's mean delinquency level ($\exp(.04) = 1.04$). This finding indicates that friends' delinquency is not simply a measurement artifact reflecting a respondent's own delinquency involvement, but rather remains an important correlate of a respondent's delinquency even after controlling for a host of different individual-level factors. With maximum-likelihood estimates, it is possible to determine whether a more complex model provides a better fit to the data than do simpler models using likelihood ratio significance tests. Model 2 yields a

[22] The Stata procedure *xtnbreg* was used in all multivariate analyses.

TABLE 4

BASE-LINE MODELS: RANDOM EFFECTS NEGATIVE BINOMIAL MODEL OF DELINQUENCY INVOLVEMENT

	MODEL 1			MODEL 2			MODEL 3		
	Coeff.		β	Coeff.		β	Coeff.		β
Intercept	−2.21	(1.04)		−1.67*	(1.02)		−1.57*	(1.03)	
Control variables:									
Black	.17	(.03)	.07	.24	(.03)	.10	.25	(.03)	.11
Other race (nonwhite)	.20	(.03)	.09	.24	(.03)	.11	.24	(.03)	.11
Female	−.52	(.02)	−.25	−.50	(.02)	−.24	−.50	(.02)	−.24
Age	.53	(.13)	.86	.43	(.13)	.70	.41	(.13)	.67
Age^2	−.02	(.00)	−.60	−.02	(.00)	−.60	−.02	(.00)	−.60
Two-parent family	−.11	(.02)	−.06	−.09	(.02)	−.05	−.09	(.02)	−.05
Public assistance	.13	(.04)	.04	.13	(.04)	.04	.14	(.04)	.04
Friend involvement	.20	(.01)	.20	.18	(.01)	.18	.18	(.01)	.18
Friend attachment	−.03*	(.01)	−.02	−.02*	(.01)	.02	−.03	(.01)	−.02
Parent attachment index	−.13	(.01)	−.11	−.13	(.01)	−.11	−.13	(.01)	−.11
School attachment index	−.22	(.01)	−.19	−.20	(.01)	−.18	−.20	(.01)	−.18
Friends' delinquency	. . .			.04	(.00)	.13	.05	(.00)	.17
Network characteristics:									
Density	. . .			. . .			−.31*	(.18)	−.03
Centrality	. . .			. . .			−.01*	(.02)	−.01
Popularity	. . .			. . .			.02	(.00)	.07
Log likelihood	−22,243.87			−22,136.16			−22,123.27		
−2 log likelihood				215.54**			25.78**		

NOTE.—N = 12,971 adolescents clustered within 120 schools. All variables are significant at $P < .05$ unless otherwise noted. SEs are given in parentheses.

* Not significant.

** $P < .001$.

likelihood ratio value of 215.5 in comparison to the baseline model (model 1), which is statistically significant ($df = 1$, $P < .001$).

To assess the strength of the association between delinquent peers and delinquency compared to other control variables, it is useful to standardize the coefficients by multiplying the b_is by the X_is' standard deviations. The coefficients are thus expressed in terms of change in log(Y) per standard deviation of X_i . Column 3 for each model presents these standardized coefficients (exponentiating the results indicates the proportional change in delinquency per standard deviation of X_i). In terms of delinquent peers, each standard deviation is associated with a 13% increase in a respondent's delinquency (exp(.13) = 1.13). The effect of delinquent peers is thus larger than the effect of family structure (two-parent family), public assistance receipt, and attachment to friends; is comparable to the effect for race, parental attachment, and school attachment; and is smaller than the gender, age, and peer involvement effect. This finding that delinquent peers is not among the strongest (or weakest) variable in the model suggests that prior findings that delinquent peers have the strongest association in models may have overestimated the strength of the delinquency-peer association by using potentially biased respondent perceptions.

To determine the main effect of network characteristics on delinquency involvement (before assessing whether they condition the delinquency-peer association), model 3 incorporates the network measures of density, centrality, and popularity. Findings indicate that density and centrality within friendship networks are not associated with delinquency involvement when relevant control variables and peer delinquency are accounted for. Network popularity, in contrast, is associated with a small increase in delinquency involvement. Each additional friendship nomination received translates into a 2% increase in delinquency involvement. Peer delinquency remains associated with delinquency when the network characteristics are incorporated into the model.

Although results from this model suggest that structural characteristics of friendship networks are unassociated with delinquency when peer delinquency is accounted for, the model does not tell us whether network characteristics play a role in the degree to which peer behavior is translated into the adolescent's own behavior. Assessing this requires interaction models. Finding significant interactions between peer delinquency and network properties will suggest that network characteristics are not as important in regard to their main effect on delinquency, but are very important in understanding how the context of friendship networks determine the degree to which peer behavior is associated with an adolescent's own behavior. That is, network characteristics may determine the intensity of differential associations.

Interaction Models

Interactions between peer delinquency and each network characteristic of interest are examined in models 4–6 of table 5. Each model focuses on a particular network characteristic or property of an adolescent's friendship network. Model 4 examines whether the association between friends' delinquency and a respondent's own delinquency is conditioned by the cohesion within the friendship network (i.e., network density). Results reveal this is the case; the interaction between peer delinquency and density is very strong and significant (exp(.33) = 1.39), indicating that density in conjunction with delinquent peers is associated with a large increase in self-reported delinquency. In contrast, the coefficient for density, in model 4, suggests that when adolescents do not have delinquent peers, density is associated with a reduction in delinquency involvement (exp(−1.77) = 0.17). This provides strong evidence that network density is an important structural component of peer networks in its ability to moderate the delinquency-peer association.

Graphing this relationship in figure 1 reveals that high density in combination with a delinquent peer network translates into greater delinquency involvement, whereas low density is less related to delinquency. Specifically, when an adolescent is located in a friendship network reporting a minor delinquency index of 5, medium and low density in the peer network is associated with a respondent's serious delinquency index of 0.33; however, being enmeshed in a dense peer network translates into a serious delinquency index of 1.3. Moreover, when friends' delinquency is at higher levels (equals an index of 10), a less cohesive friendship network is associated with a respondent's mean delinquency index of 0.45 versus 1.75 for respondents located in very dense friendship networks. What is important in this graph is that as density increases, the association between peer delinquency and an adolescent's own delinquency involvement increases rapidly. This highlights that the relationship between friends' delinquency and a respondent's own delinquency is conditioned by the cohesion present in the friendship network.

Network centrality, an indicator of positioning within a friendship network, also moderates the delinquency-peer association. Specifically, model 5 indicates that location within a central position in a delinquent peer network is associated with an increased delinquency index (exp(.05) = 1.05). Conversely, location in a central position within a nondelinquent friendship network is associated with a reduction in delinquency involvement (exp(−.27) = 0.76). Graphing this relationship in figure 2 illustrates the interaction. With friendship delinquency equal to 5, there is little effect of network centrality (low, average, and high centrality = 0.28). With increased peer delinquency (equal to 10), low centrality corresponds to a

TABLE 5
INTERACTION MODELS: RANDOM EFFECTS NEGATIVE BINOMIAL MODEL OF DELINQUENCY INVOLVEMENT

	MODEL 4			MODEL 5			MODEL 6		
	Coeff.		β	Coeff.		β	Coeff.		β
Intercept	−1.08*	(1.02)		−1.37*	(1.02)		−1.27*	(1.03)	
Control variables:									
Black	.25	(.03)	.11	.26	(.03)	.11	.27	(.03)	.11
Other race (nonwhite)	.25	(.03)	.11	.25	(.03)	.11	.25	(.03)	.11
Female	−.50	(.02)	−.24	−.50	(.02)	−.24	−.51	(.02)	−.25
Age	.39	(.13)	.64	.41	(.13)	.67	.39	(.13)	.64
Age^2	−.02	(.00)	−.60	−.02	(.00)	−.60	−.02	(.00)	−.60
Two-parent family	−.09	(.02)	−.05	−.09	(.02)	−.05	−.09	(.02)	−.05
Public assistance	.12	(.04)	.03	.12	(.04)	.03	.13	(.04)	.04
Friend involvement	.18	(.01)	.18	.18	(.01)	.18	.17	(.01)	.17
Friend attachment	−.03	(.01)	−.02	−.02*	(.01)	.02	−.03	(.01)	−.02
Parent attachment index	−.13	(.01)	−.11	−.13	(.01)	−.11	−.13	(.01)	−.11
School attachment index	−.20	(.01)	−.18	−.20	(.01)	−.18	−.21	(.01)	−.18

Friends' delinquency	−.00*	(.01)	.00	.02	(.00)	.07	.02	(.00)	.07
Network characteristics:									
Density	−1.77	(.22)	−.16	. . .			. . .		
Centrality	. . .			−.27	(.03)	−.18	. . .		
Popularity	. . .			. . .			−.03	(.01)	−.11
Interactions:									
Density × friends' delinquency	.33	(.03)	.25	. . .			. . .		
Centrality × friends' delinquency	. . .			.05	(.00)	.21	. . .		
Popularity × friends' delinquency	. . .			. . .			.01	(.00)	.18
Log likelihood	−22,083.34			−22,089.36			−22,091.32		
−2 log likelihood (compared to model 2)	105.64**			93.6**			89.68**		

NOTE.—N = 12,971 adolescents clustered within 120 schools. All variables are significant at $P < .05$ unless noted in table. SEs are given in parentheses.
* Not significant.
** $P < .001$.

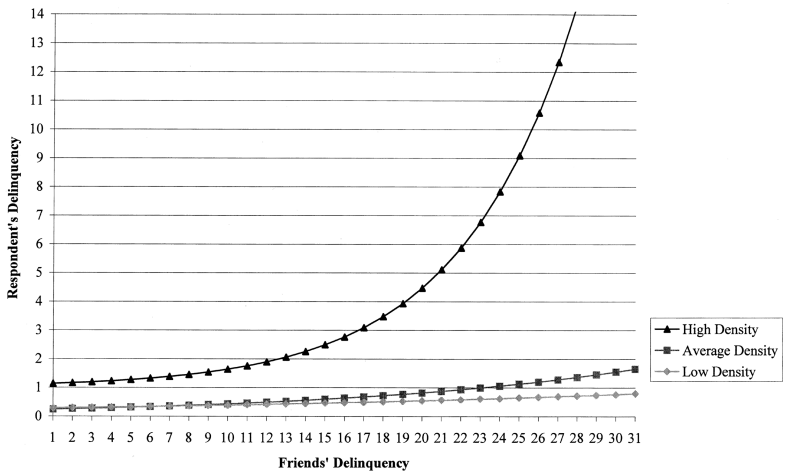

FIG. 1.—Interaction: density by friends' delinquency

delinquency index of 0.32, average centrality to a delinquency index of 0.37, and high centrality to a serious delinquency index of 0.56. These results indicate that the association between friends' delinquency and a respondent's own level of delinquency is stronger when the respondent is located within a central position in the friendship network

The last network characteristic, popularity, is examined in model 6. Here it is found that although the delinquency-peer relationship is conditional, popularity plays a smaller role in moderating the delinquency-peer association. When an adolescent is without delinquent friends, popularity has a small negative relationship with delinquency status (exp $(-.03) = 0.97$). In contrast, when located in a delinquent peer network, popularity is associated with a small increased delinquency index (exp$(.01) = 1.01$). Specifically, figure 3 indicates that when an adolescent is located in a peer network that averages a minor delinquency index of 5, high popularity is associated with a delinquency index of 0.37 compared to 0.34 and 0.32 for average and low popularity, respectively. With greater peer delinquency (index = 10), high popularity is associated with a delinquency index of 0.69 versus 0.47 and 0.39 for average and low popularity.

Overall, these results indicate that all of the network characteristics—density, centrality, and popularity—condition the delinquency-peer association. Incorporation of the underlying pattern of relationships among adolescents explains when friendship networks are more or less effective in constraining adolescents' behavior to resemble that of their peers. However, the size of the coefficients and graphs of the interactions

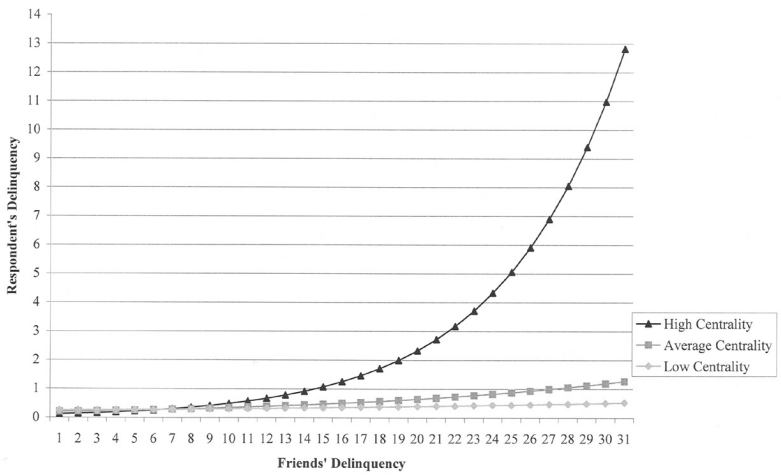

FIG. 2.—Interaction: centrality by friends' delinquency

suggest that network density (i.e., cohesion) is a particularly important structural property, followed by network centrality (i.e., positioning) and popularity.

To better assess which network property is more important in explaining when the behavior of peers is associated with an adolescent's own behavior, it is useful to examine a model with all three network interactions incorporated. This allows for the effect of each network characteristic to be assessed independently while controlling for the others. Model 6 in table 6 presents findings from this analysis and indicates that while all of the network interactions remain significant, that is, moderate the delinquency-peer association, density is the more important component of friendship networks. Peer delinquency in conjunction with greater cohesion is associated with an increased delinquency index (exp(.16) = 1.17), whereas centrality within the friendship network and popularity play much more modest roles (exp(b) = 1.03 and exp(b) = 1.01, for centrality and popularity, respectively) in moderating the delinquency-peer association. Graphing the relationship between peer delinquency and a respondent's delinquency in figure 4 reveals that when an adolescent is located in a friendship network with an average minor delinquency index of 10, high density within the network translates into a serious delinquency index of 1.64 versus 0.49 for centrality and 0.61 for popularity.

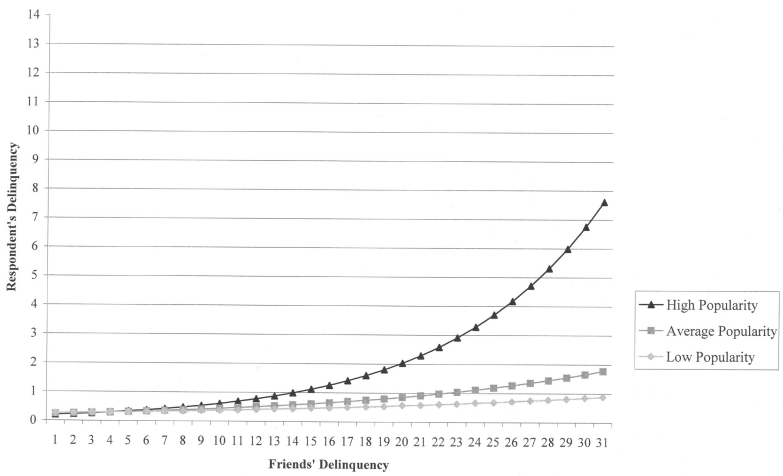

FIG. 3.—Interaction: popularity by friends' delinquency

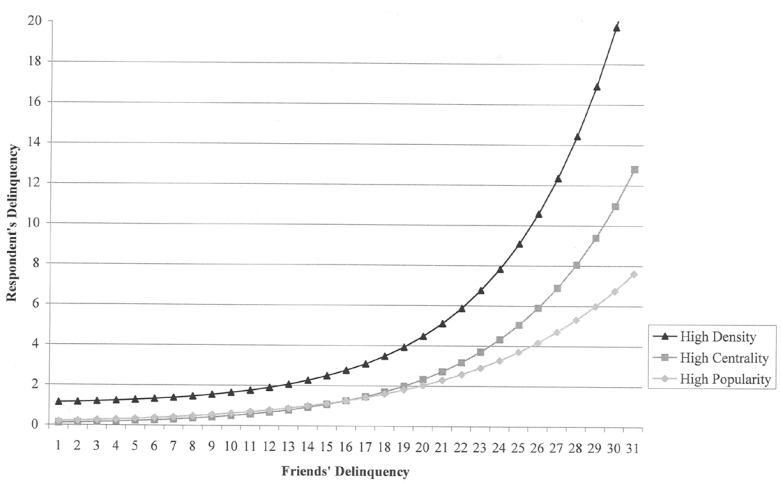

FIG. 4.—Interaction: high density, centrality, and popularity

TABLE 6
COMPLETE INTERACTION MODEL: RANDOM EFFECTS NEGATIVE BINOMIAL MODEL OF DELINQUENCY INVOLVEMENT

	MODEL 6		
	Coeff.		β
Intercept	−.98*	(1.02)	
Control variables:			
Black	.26	(.03)	.11
Other race (nonwhite)	.25	(.03)	.11
Female	−.50	(.02)	−.24
Age	.38	(.13)	.62
Age^2	−.02	(.00)	−.60
Two-parent family	−.09	(.02)	−.05
Public assistance	.13	(.04)	.04
Friend involvement	.17	(.01)	.17
Friend attachment	−.03	(.01)	−.02
Parent attachment index	−.13	(.01)	−.11
School attachment index	−.21	(.01)	−.18
Friends' delinquency	.00*	(.01)	.00
Network characteristics:			
Density	−1.20	(.36)	−.11
Centrality	−.15	(.04)	−.10
Popularity	.00*	(.01)	.00
Interactions:			
Density × friends' delinquency	.16	(.05)	.12
Centrality × friends' delinquency	.03	(.00)	.09
Popularity × friends' delinquency	.01	(.00)	.08

NOTE.—N = 12, 971 adolescents clustered within 120 schools. All variables are significant at $P <$ .05 unless noted. SEs are given in parentheses. Log likelihood = 22,062.06; 2 log likelihood (compared to model 2) = 148.2 ($P < .001$).

* Not significant.

CONCLUSION

In this project, the delinquency-peer association was explored guided by the premise that a more complete understanding of peer influence requires an examination of the characteristics of friendship networks in which adolescents are embedded. Although few adolescents report participation in many serious delinquent activities, the majority of adolescents report participation in at least one serious delinquent activity, with a minority reporting high levels of serious delinquent involvement. Moreover, most adolescents are located in friendship networks that report some minor delinquency involvement. By incorporating a social network approach, this research contributes to research and theory on the conditions under which differential associations are maximized. Overall, the findings present a picture more complex than that provided by social control theory and differential association theory alone and suggest that a network per-

spective can provide a coherent and powerful framework for addressing adolescent delinquency.

Two major findings emerge from this research. First, friends' delinquency, as measured by responses from friends who compose the adolescent's friendship network, is associated with an adolescent's own delinquency involvement. This is an important finding because the delinquency-peer association found in prior research has been criticized for inadequate and potentially misspecified measures of peers' behaviors. Since most prior research incorporates a measure of peer delinquency based on responses from the respondents rather than the peers themselves, Jussim and Osgood (1989) caution that peer delinquency may simply measure the respondent's own delinquent behavior due to processes of assumed similarity. In contrast, measures used in the present research incorporate the responses of friends themselves and indicate that the delinquency-peer association exists and remains robust regardless of controls for numerous other factors. The significant association consistently evidenced in this study gives credence to the idea that delinquency is best understood in the context of the friendship network where common norms and behaviors emerge from locations in structured patterns of relationships (Wellman 1988).

Second, network properties summarizing the structure of friendship networks moderate the delinquency-peer association. Specifically, delinquent friends have a lesser association with delinquency (and occasionally no association) when adolescents are located in a peripheral position within their peer network (low centrality), when their peer network is not very cohesive (low density), and when they have less prestige (low popularity). Conversely, peers' delinquency has a stronger association with an adolescent's delinquency when the adolescents are located in a central position within their friendship network, when their friendship network is very dense, and when they are nominated as friends by many others.

While all network characteristics were found to condition the delinquency-peer association to some degree, one network characteristic exerted stronger influences than others. In particular, network density emerged as an important moderator of peer delinquency. Because network density represents the number of ties present in the friendship network divided by the number of possible ties in the network, it serves as an ideal measure of peer cohesion. Greater network cohesion better facilitates a common identity as either delinquent or nondelinquent and subsequently places more constraint on the behavior of peer members to be consistent with the network's behavioral disposition. The premise that densely knit networks have stronger norms and better communication and control has an extensive history in sociological studies (e.g., Durkheim 1951; Sutherland 1947; Bott 1957; Fischer 1982), which makes it surprising

that criminological studies have yet to incorporate network cohesion as a variable central to the delinquency-peer association.

Popularity within the friendship network is a network property that plays a smaller role in conditioning the delinquency-peer association. Recall that popularity is indicative of the number of other adolescents in the school network that nominate the adolescent as a best friend. One explanation for the weaker interaction between popularity and peer delinquency is that prestige may be indicative of the permeability of peer group boundaries. That is, the extent to which members have contact with individuals outside their immediate peer clique. An adolescent who is located in a delinquent friendship network but also has high popularity may be well connected to other adolescents outside his or her immediate peer clique, resulting in weakened influence of the friendship network. In these situations, the intensity of the peer network may be reduced. In all likelihood, the more popular adolescents belong to several different peer cliques such that their egocentric network is large and heterogenous in terms of exposure to different behaviors, norms, and values in the school setting.

These results highlight the constraining influence of peer networks on individual behavior when certain structural components of friendship networks are maximized. With a friendship network centered around delinquent activities, adolescents are even more likely to report self-involvement in delinquency when they are located in a very cohesive peer network. Conversely, when peer networks do not incorporate peer delinquency, cohesion in the network is associated with lower risk of self-involvement in delinquency. This finding, if properly interpreted, is consistent in part with social control's emphasis on the constraining influence of social bonds, although it appears even more compatible with differential association and social learning theories' emphasis on the importance of the context of friendship networks. It is in this network context where social norms and values regarding delinquency are shared and validated. According to differential association and learning theories and consistent with this research, when delinquent peer networks are very cohesive, network members are at heightened exposure to definitions and behavioral patterns favorable to delinquency involvement.

However, an alternative explanation is offered for the influence of network structure on adolescent delinquency. Critics of differential association and social learning theories argue that the observed delinquency-peer association is not due to peer influence, but rather to self-selection into delinquent peer networks based on prior behavioral dispositions. The cross-sectional data on which this study is based do not allow explicit determination of whether the observed associations solely reflect network influences on adolescent behavior or whether they additionally reflect the

tendency of youth with similar behaviors to select each other as friends. However, studies with longitudinal data have found that both influence and selection processes are responsible for similarities in adolescent behavior (Bauman and Ennet 1996; Elliott and Menard 1996; Kandel 1978; Krohn et al. 1996; Matsueda and Anderson 1998; Thornberry 1987). Although the precise mechanism underlying the delinquency-peer associations cannot be specified with the available data, the findings do suggest that personal networks containing delinquent members provide, at a minimum, a supportive environment conducive to delinquency involvement.[23]

With this in mind, it is important to point out that if selection were mainly responsible for the association found between delinquent peers and self-involvement in delinquency, we would not expect to find the network characteristics conditioning the delinquency-peer association. For example, being located in a very dense peer network or in a very central position within the network should not influence the strength of the delinquency-peer association if adolescents are selecting peer networks to join that most closely match up with their own delinquent proclivities. Therefore, the strength and consistency of the pattern of network properties found to condition the delinquency-peer association suggest explanations more consistent with a differential association or social learning approach to peer influence. However, to explicitly test whether self-selection or socialization is the primary mechanism responsible for the association, longitudinal data incorporating the social networks of adolescents is necessary. In addition to longitudinal data on adolescent peer networks, a theory of delinquency is needed that incorporates an understanding of friendship formation. Such a theory would explain processes underlying selection into and out of peer networks.

The findings presented in this project should be considered in light of the following limitations. As noted earlier, the data that this project is based on are cross-sectional, which limits the causal inferences we can make about the relationships between network characteristics and delinquent behavior. Longitudinal data that allow measurement of changes in network characteristics and delinquency behavior over time would be extremely valuable. Such a data design would allow determination of whether delinquent behavior precedes selection into friendship networks or whether incorporation into peer networks occurs prior to delinquency involvement. Moreover, another reason for the use of longitudinal data

[23] Even if initial selection is viewed as the critical process, it remains unclear whether the initial selection is due to the attraction for peers similar to oneself or to structural forces that reduce freedom of movement in the social network, and thus predetermine the network to which one is exposed (Cairns and Cairns 1994). School tracking is a good example of a structural force that determines, in part, the selection of peers similar to oneself.

for investigating peer networks, as well as the difficulty with such analyses, involves the constantly changing nature of social networks. The dynamic nature of network structures suggests that it is rare for friendship networks to remain unchanged even in a short period of time. Capturing and modeling these changing network structures remains a challenge for longitudinal analyses.

The ideal longitudinal network analysis of friendship networks also would have included complete network data on a wide range of delinquency items including more serious delinquency items. As indicated earlier, a drawback of the present study is that friends' involvement in minor delinquency is used to predict the respondent's more serious delinquency involvement. Unfortunately, this strategy tends to underestimate the strength of the actual relationship between friends' serious delinquency and the respondent's own involvement in serious delinquency.

Additionally, while this study drew attention to common properties of peer networks, other network characteristics may be important and worthy of future investigation. For example, age, sex, and race heterogeneity of the friendship network and the percent of reciprocated friendship ties in the network are a few additional properties of peer networks that may condition the delinquency-peer association.

Despite these limitations, the present study's results show that the approach of identifying and examining peer social networks provides a coherent and promising framework for investigating a variety of ways that social relationship might be associated with adolescent delinquency. This framework's emphasis on the social connections among adolescents goes considerably beyond that of prior research, which viewed individuals as essentially separate from their social structure.

SUMMARY

Overall, this set of findings suggests that the patterning of adolescent relationships helps explain when peer delinquency is most and least important. Not all adolescents are influenced to the same degree by their peer associations, and when the patterning of relationships between adolescents provides more opportunities for interactions among members, peer delinquency plays a larger role in the adolescent's own delinquent behavior. Adolescents located within central positions in very cohesive friendship networks report behavior that is more closely associated with the delinquent behavior occurring in their network. This suggests that friendship networks expose these adolescents to more intense differential associations favoring delinquency involvement than are adolescents situated in more peripheral positions within less cohesive networks. Thus,

positioning in the peer network provides different opportunities for peer interaction resulting in varying exposure to delinquent behavioral models, communication of delinquent norms, access to information on delinquency opportunities, and opportunities for rewards or deterrents for delinquency. Examining properties of peer networks elucidates when the peer network is more or less effective in constraining the behavior of adolescents to be similar to that of their peers. This conclusion is consistent with the current emphasis on the significance of social contexts (e.g., community, neighborhood, schools) and suggests that an important context with implications for adolescents' behaviors is the peer networks in which youth are embedded.

APPENDIX

TABLE A1
CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Overall delinquency index	1.00	. . .													
Friends' deliquency	.16	1.00													
Network popularity	−.01	.01	1.00												
Network centrality	−.06	−.05	.37	1.00											
Network density	−.06	.13	.26	.01	1.00										
Female	−.19	−.07	.04	.06	.00	1.00									
Black	.01	−.19	−.08	−.09	−.16	.05	1.00								
Other race	.06	−.06	−.10	−.00	−.40	−.02	−.32	1.00							
Age	−.04	.12	−.05	−.10	−.09	−.05	−.03	.10	1.00						
Two-parent family	−.07	−.02	.09	.11	.10	.02	−.23	.02	−.00	1.00					
Public assistance	.04	−.01	−.08	−.06	−.07	.03	.11	.02	−.05	−.18	1.00				
Parental attachment index	−.09	−.07	.04	.07	.01	−.08	.04	−.04	−.16	.03	.00	1.00			
School attachment index	−.17	−.12	.13	.18	.03	−.03	−.03	−.01	−.09	−.07	−.03	.18	1.00		
Friend attachment	−.08	−.00	.14	.09	.07	.15	−.09	−.04	−.01	.07	−.06	.10	.21	1.00	. . .
Friend involvement	.14	.11	.10	.05	.00	−.06	−.05	−.04	.01	−.00	−.01	.02	.02	.10	1.00

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