

# **Sage Handbook of Social Network Analysis**

**Edited by John Scott & Peter J. Carrington**

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# Crime and Social Network Analysis

Peter J. Carrington

Applications of social network analysis in the study of crime fall mainly into three topic areas: the influence of the personal network on ego's delinquency or crime, the influence of neighborhood networks on crime in the neighborhood, and the organization of criminal groups and activities. Of course, the literature is not so neatly organized as this scheme suggests – even the boundaries of the relevant literature are fuzzy – but the following account is organized around these categories, while acknowledging the instances of work that straddle them, or lie only partly within them.

## INFLUENCE OF PERSONAL NETWORKS ON DELINQUENCY AND CRIME

The most common use of social network analysis in criminology has been in analyses of the effects of personal networks on adolescents' delinquency (and, to a lesser extent, on adults' crime). Almost all of this research is based, explicitly or implicitly, on one or both of two theories of crime and delinquency: differential association theory and social control theory.

### *Differential association theory*

According to this theory of delinquency, first formulated in 1939 by Edwin Sutherland (1939; Sutherland et al., 1992), criminal attitudes

and behavior are not innate, but are learned from “intimate personal groups.” According to the sixth proposition of this theory, the likelihood that a child or adolescent will be delinquent is affected by the relative strength of criminal and anticriminal “definitions” (i.e., norms) among his or her close associates:

6. *A person becomes delinquent because of an excess of definitions favorable to violation of law over definitions unfavorable to violation of law. This is the principle of differential association. It refers to both criminal and anticriminal associations and involves counteracting forces.* (Sutherland et al., 1992: 89)

Later reformulations of differential association theory have resulted in the “social learning” theory (Burgess and Akers, 1966) and “peer influence” theory of delinquency (Warr, 1993, 2002): the latter claiming that “peer influence is the *principal proximate cause* of most criminal conduct” (Warr, 2002: 136; emphasis in the original).

Consistently strong empirical correlations between subjects' delinquency and that of their friends or “peer group,” even in the presence of controls for other factors, has been interpreted as strong support for differential association theory (Shoemaker, 2005: 152; Warr, 2002: 76). However, the theory has been criticized on the grounds (among others) of the difficulty of measuring the relative strength of pro- and anticriminal definitions among ego's associates (Shoemaker, 2005: 151; see also “Measuring peers' delinquency” below).

Sutherland's seventh proposition offered some guidance on this issue:

*7. Differential associations may vary in frequency, duration, priority, and intensity. (Sutherland et al., 1992: 89)*

Luckenbill commented in 1992 on the measurement issue:

In a precise description of the criminal behavior of a person, these modalities would be rated in quantitative form and a mathematical ratio would be reached. A formula in this sense has not been developed, and the development of such a formula would be extremely difficult. (Sutherland et al., 1992: 89)

To anyone familiar with social network analysis, its potential usefulness in operationalizing the main concepts in differential association theory is obvious. The "intimate personal groups" in which criminal learning occurs are simply ego's personal network (Chua et al., this volume). Measuring the "frequency, duration, priority, and intensity" of associations is a staple of personal networks research (Hanneman and Riddle, this volume). Evaluating communication processes and the diffusion of information in networks are staples of social network research on communication and information diffusion (e.g., Monge and Contractor, 2003; Myers, 2000; Shih and Chang, 2009; Valente, 1995). Differential association theory can be seen as a specific instance of the more general network theory of social learning, that ego's attitudes and behavior are affected by the attitudes and behavior of the members of his or her personal network, and the effects are conditioned by the characteristics of the network. This would be consistent with Sutherland's own insistence that "the processes which result in systematic criminal behavior are fundamentally the same in form as the processes which result in systematic lawful behavior" (cited in Warr, 2002: 75).

### **Social control theory**

Social control theory, first formulated by Hirschi (1969), proposes that the propensity for antisocial, deviant, or criminal behavior is innate but is normally restrained by internalized and external informal social control, due to bonding to social control agents such as parents, family, peers, school, and community – that is, to the social integration of the individual. Thus, delinquency and crime are a result of weak social bonds.

Social control theory has been interpreted in network terms to imply that delinquents tend to be social isolates, rejecting and being rejected by their peers (Ekland-Olson, 1983: 275–76) and other potential agents of informal social control, and conversely that nondelinquents tend to be well connected with such agents. This is in clear contrast with differential association theory, which characterizes both delinquents and nondelinquents as being embedded in peer and family networks but with differing normative balances. The contradictory implications of the two theories of delinquency have motivated social network research researchers to attempt to assess the level of empirical support for each theory.

### **Krohn's network theory of delinquency**

Marvin Krohn's (1986) network theory represents an early attempt to apply social network analysis explicitly to the explanation of delinquency. Krohn's theory combines elements of social control and differential association theories of delinquency. According to this theory, the social cohesion of ego's personal network, as indicated by its multiplexity and density, affects both ego's social integration (as in social control theory) and the balance of influences of procriminal and anticriminal definitions in the network (as in differential association theory). At the macrostructural level, the delinquency rate of a community will be inversely related to the density and multiplexity of its social networks, which are affected by social structural characteristics of the community, such as population density, geographic mobility, and the social stratification system.

Krohn's theory treats attachment to parents, teachers, and other adults as an aspect of social bonding, and therefore as an element of social control theory, not of differential association theory. This distinction between adults and age peers is consistent with much of the subsequent research that tests or employs differential association theory, whether informed by social network analysis or not: the "intimate personal groups" within which the balance of procriminal and anticriminal definitions are measured are often assumed to be exclusively composed of the young person's age peers, or "friends," so that differential association theory is treated as being equivalent to peer influence theory (Warr, 2002: 73). Relationships with parents and family are taken as evidence of social bonding. However, Sutherland's formulation of differential association theory does not distinguish between adult agents of social

control such as parents, and the young person's age peers (Sutherland et al., 1992: 89; Warr, 2002: 73). Differential association research that is more informed by social network analysis considers the influence of persons in *any* role vis-à-vis ego, using the type and strength of the tie, not generational equivalence, as the criterion of inclusion in the personal network.

Krohn's network theory of delinquency has received limited attention. Following Friday and Hage (1976), Krohn et al. (1988) found that multiplexity or role overlap in personal networks, including parents and friends, partly explained the cigarette smoking behavior of high school students in a Midwestern city: youth who participated jointly with their parents or friends in activities, such as homework, athletics, church, and membership in other organizations, were less likely to smoke cigarettes. Haynie (2001) found that personal network density is an important conditioner of the association between ego's and peers' delinquency: the relationship was stronger for egos with higher-density networks. Going beyond Krohn's theory, she found that ego's centrality and popularity also condition the relationship, but less so than network density: the relationship is stronger for egos with higher centrality and higher popularity.

### **Network composition**

Most of the research that refers to social networks in relation to differential association or social control theory is concerned only with the *composition* of the peer network – the number or proportion of delinquent friends and (in some cases) of family members – and ignores its structural features (e.g., Capowich et al., 2001; Deptula and Cohen, 2004; Elliott and Menard, 1996; Giordano et al., 1993; Gutierrez-Lobos et al., 2001; Hanson and Scott, 1996; Laird et al., 1999; Lee, 2004; McCarthy and Hagan, 1995; Weerman and Bijleveld, 2007). In one of the more sophisticated attempts to measure the balance of criminal and anticriminal definitions in the peer network, Haynie (2002) found that it is the proportion of friends who are delinquent that is most strongly correlated with ego's delinquency, rather than the number of delinquent friends, the average level of delinquency of friends, or the total level of friends' delinquency. She also found that consensus (either pro- or antidelinquency) in the peer network was most strongly associated with ego's own behavior. Bruinsma (1992) is a rare example of differential association research that includes parents as possible sources of deviant definitions in ego's personal network. Using data on 1,096 Dutch

secondary school students and stepwise path analysis, he found that frequency of contact with deviant parents and with deviant peers both have positive influences on the respondent's formation of positive definitions of deviant behavior, which in turn increases the frequency of the respondent's criminal behavior; however, the impact of deviant friends was much greater. Lonardo et al. (2009) found that parents' and peers' deviance were associated with adolescents' deviance, but having a deviant romantic partner was especially influential.

### **Measuring peers' delinquency**

Research on delinquent peers traditionally relied on the respondent's assessment of his or her peers' delinquency. This approach has been criticized for vulnerability to measurement error due to limitations on the respondents' ability to observe and remember their peers' delinquent attitudes and behavior, and also to bias arising from projection by respondents of their own attitudes and behavior onto their peers; thus inflating the crucial correlation between the delinquency of self and of peers (see Meldrum et al., 2009, for a review of this issue). Research comparing the size of the correlations obtained from respondents' reports and peers' own reports of their delinquency has found that the correlation is indeed considerably larger when respondents' reports are used. Weerman and Smeenk (2005: 518) interpret this finding to mean that the true correlation lies somewhere between the two estimates. This is an instance of the more general measurement problem in research on egocentric networks: that "proxy reports" provided by ego of alters' characteristics and behavior are of variable accuracy, depending on the type of information solicited (see Marsden, this volume, for a discussion).

### **Gender composition**

A somewhat different approach to the relationship between peer network composition and ego's delinquency is to examine the gender composition of the peer network. The general idea is that female-dominated networks tend to provide "more social control, fewer opportunities and less motivation for offending and may therefore discourage crime," for both males and females, but especially for females (McCarthy et al., 2004). This suggests social control theory, but the effect of female-dominated networks may also be due to differential association, as females are much less criminal than males. Lacasse et al. (2003) found that the gender composition of adolescents' friendship networks affects the incidence of potentially offensive sexual behavior but not the subject's tolerance of such behavior. Haynie and Piquero

(2006) found that the relationship between the onset of puberty and violent victimization is moderated by the gender composition of boys' personal networks: the relationship is weaker for boys with a higher proportion of girls in their network. For girls, no moderating effect of network composition was found. In a sample of adult heroin injectors in Baltimore, Curry and Latkin (2003: 482) found that "for females but not males, a higher number of females in one's network was associated with a lower frequency of arrests." Lichtenstein (1997) found that in a small sample of Alabama women incarcerated for drug-related crimes, their personal networks comprised mainly male intimates, and the use of crack cocaine was attributed to the influence of these male intimates. Weerman and Bijleveld (2007) found that differences in the personal networks of non-, minor, and serious delinquents in a sample of Dutch high school students were mainly due to cross-gender friendships. Delinquent students appeared to be more popular than nondelinquents in cross-gender friendships (girls nominated delinquent boys more often, boys nominated delinquent girls more often), while non-, minor, and serious delinquents were on average not more or less popular among students from their own gender.

### **Types of ties**

Houtzager and Baerveldt (1999) differentiated different types of ties among Dutch high school students. They found that a respondent's level of self-reported delinquency was not associated with the emotional closeness of peer relations, the occurrence of positive relations such as practical support, emotional support, friendship and intimate friendship, or with unpopularity. Using the same data, Baerveldt et al. (2004) analyzed 10 different types of ties and found no evidence that delinquents have poorer peer relationships, and evidence of a correlation between ego's level of delinquency and that of both weakly and strongly tied peers – implicitly suggesting support for differential association theory but not for social control theory. Weerman and Smeenk (2005) found that both "regular friends" and "best friends" in the networks of Dutch high school students affect ego's delinquency, with little difference in strength of effect.

Patacchini and Zenou (2008) analyzed data from the Add Health survey within the framework of Granovetter's (1973) "strength of weak ties" theory. Granovetter proposed that the individuals to whom one is weakly tied are more likely to be sources of influence for change than those to whom one is more strongly tied. Strong ties, such

as family and close friends, tend to know one another and therefore tend to form closed communication circles, in which the same information and attitudes are recycled. Furthermore, following the principle of homophily (McPherson et al., 2001; and see below, under "Gangs, groups and networks"), one's close friends tend to hold attitudes and opinions similar to one's own. In contrast, persons to whom one is weakly tied, such as acquaintances, school friends and colleagues, and more distant family members, are more likely to have attitudes that are less congruent with one's own and to belong to social circles that one is not a member of. Thus, weak ties are more likely to form "bridges" between otherwise unconnected social circles and consequently to be sources of new information and attitudes. In relation to delinquency, Granovetter's theory implies that the close friends of nondelinquents will also be nondelinquent, and it is the weak ties of nondelinquents who are more likely to be delinquent and therefore to exert a delinquent influence. Patacchini and Zenou (2008) found support for this hypothesis: the proportion of weak versus strong ties in the friendship network was found to have a positive impact on the onset of delinquency.

### **Structure: centrality, cohesiveness, and bridging**

Baerveldt and Snijders (1994) found no support for hypotheses concerning the relationship between ego's delinquency and segmentation in the network. Baron and Tindall (1993) found that the strength of a gang member's delinquent attitudes was positively associated with his or her centrality (betweenness and geodesic closeness) in the gang, as well as to weak conventional bonds. Pearson and West's (2003) study of the adoption of "risky behaviors" (smoking and cannabis use) by students in a Scottish high school suggests that ego's position in the peer network ("as a group member, a group peripheral or a relative isolate") and the cohesiveness of the network both have positive effects on ego's influence on other members of the network. Lee (2004) used data from the National Household Survey on Drug Abuse to examine the network positions of marijuana users, nonusers, and sellers. Users tended to cluster in subgroups that were both more central and more cohesive than those of nonusers; sellers tended to be at the center of user groups. However, the centrality and cohesiveness of groups of users varied significantly across survey sampling units.<sup>1</sup>

Using a cross-sectional analysis of data from the first wave of the AddHealth survey, Schreck et al. (2004) found that centrality in dense



delinquent peer networks was associated with higher risk for violent victimization, while centrality in dense conventional networks had the opposite effect. McGloin and Shermer (2009) used longitudinal analysis of data from the same survey to examine the roles of network density, Bonacich centrality, and ego's involvement with the peer network, as well as ego's self-control (Gottfredson and Hirschi, 1990) and other variables on ego's future delinquency. Concerning direct network effects, McGloin and Shermer found that network density reduces delinquency and that centrality and involvement increase it; the strength of the effect of centrality is positively related to the overall level of deviance in the peer network (2009: 53). Involvement with the peer network is inversely related to ego's self-control (2009: 59). Mangino (2009: 147) found that "African American boys who are a social bridge across two or more large but cohesive peer groups are less delinquent than are their counterparts who are members of a single peer group," and this is due to the enhanced prosocial influence of parents on these bridging children.

### **Peer influence versus selection**

The strong and consistent correlation observed between adolescents' delinquency and that of their peers is susceptible of at least three interpretations: (1) differential association – that peers influence ego's delinquency; (2) selection (homophily), or the "birds of a feather [flock together]" theory – that individuals prefer to associate with people who are similar to them; or (3) neither, because the correlation is spurious. Researchers have used longitudinal social network analyses to assess the relative explanatory power of the influence and selection theories. The consensus is that the two processes reinforce each other through interaction (as Thornberry [1987] proposed), but the evidence on the relative contribution of each process to the correlation is mixed.

Structural equation modeling of a three-wave cross-lagged panel model of data from the National Youth Survey led Elliott and Menard (1996) to conclude that peer influence leading to delinquency tends to precede and be stronger than selection of delinquent peers. However, another cross-lagged panel model analysis of data from the same survey found that "the effect of delinquency on peer associations is larger than that of peer associations on delinquency" (Matsueda and Anderson, 1998). Brook et al. (2003) found that marijuana use at T1 in a sample of Colombian adolescents predicted having marijuana-using friends at T2 (i.e., selection).

Espelage et al. (2007) used  $p^*$  modeling (Robins, this volume) to study the microstructures in a seventh-grade friendship network and their relationships with bullying behavior; they found evidence of both homophily (selection) and peer influence.

From their analyses of a two-wave survey of Dutch high school students, Snijders and Baerveldt (2003) found that similarity in delinquency affects both tie formation and tie dissolution. This provides support for the selection hypothesis, but the study did not test the influence hypothesis. Using actor-oriented social network modeling ("SIENA" – see Snijders, this volume) with data on students in 16 Dutch high schools, Baerveldt et al. (2008) found that influence was a "universal" process, found in all 16 schools; whereas selection operated in only four schools. The strength of selection depended on network differences between the schools. The authors suggested that the networks with significant selection were dominated by a small number of lifetime persistent delinquents. From a longitudinal analysis of a sample of Swedish adolescents, employing SIENA, Burk et al. (2007, 2008) concluded that both selection and peer influence play roles in the co-evolution of early adolescent friendship networks, but the role of peer influence is stronger.

Using data from the AddHealth survey, Haynie and Osgood (2005: 1109) found that "the normative influence of peers on delinquency is more limited than indicated by most previous studies, [and] normative influence is not increased by being more closely attached to friends or spending more time with them." They also found support for the *opportunity theory* of Osgood et al. (1996), which derives from Cohen and Felson's (1979) routine activity theory: that having delinquent friends provides more opportunities for delinquent behavior, regardless of their normative influence. Using data from the same survey, McGloin (2009) found support for a version of peer influence theory modified by balance theory: an imbalance at T1 between ego's and the best friend's level of delinquency predicts a change in ego's delinquency in the direction of the best friend's level at T2. Using SIENA to analyze data on middle-school students in Oregon, Light and Dishion (2007) tested the "confluence hypothesis": that rejection by peers leads to the formation of cliques of high-risk youth, who then reinforce one another's deviant propensities. Thus, peer rejection leads to selection of deviant peers, who influence ego's own delinquency. They found strong support for the first part of the hypothesized causal chain – that rejected youth form cliques – but only weak support for peer influence within these cliques.

### ***Diffusion in peer networks***

Kirke (1990, 1995, 2006) studied the diffusion of illicit drug use in the networks of teenagers' strong peer ties. She concluded that drug use is diffused through strong ties from users to nonusers, who then become users and potential sources of new diffusion to additional nonusers; thus, "a cycle of drug diffusion occurs in which, under specified social conditions, the structure influences individual action and individual action influences the structure" (1990: Abstract). Korobow et al. (2007) analyzed an agent-based simulation model of tax (non-) compliance incorporating social networks and found that individuals with limited knowledge of their immediate network neighbors' payoffs are more likely to be compliant than those who can factor knowledge of neighbor payoffs into their decisions.

### ***Desistance***

Personal networks have also been implicated in desistance from delinquency, crime, or drug abuse. Gainey et al. (1995) studied the personal networks of a sample of heavy cocaine users who were seeking treatment. They found that the sample had "stable and supportive conventional bonds (1995: 27) and their closest emotional ties were to nonusers. However, they were significantly more likely to have certain types of functional ties, such as lending or borrowing things or money, with users. Gainey et al. speculated that the nature of cocaine users' social networks may partly explain the decision to seek treatment. Sommers et al. (1994) found that forming new personal networks was part of the process of "getting out of the life" of female long-term street offenders. The supportiveness of the personal network was also found by Shivy et al. (2007) to be a factor influencing successful re-entry into the workforce of ex-offenders. Zhang (1998) advocates the inclusion of data on social networks in evaluation of the effectiveness of boot-camp treatments for delinquents.

There is a sizeable literature on the role of personal networks in the success of substance abuse treatment programs. The consensus finding of these studies is that the composition of the personal network – primarily the number or proportion of deviant peers – and its emotional supportiveness, especially the quality of ties with family members, have a substantial impact on the likelihood of treatment success (e.g., Griffith et al., 1998; Knight and Simpson, 1996; Skeem et al., 2009; Sung et al., 2004; Wild et al., 2006).

### ***Reverse or complex causality***

Some research has examined the effect that delinquency and crime have on ego's personal network, or the mediating role of personal networks in three-variable causal schemes. Following up earlier research results suggesting that one's occupation may affect the quality of one's personal network, Romans et al. (2001) found no differences in network quality between the networks of a convenience sample of female sex workers and those of two large community samples of age-matched women in New Zealand. Kandel and Davies (1991) found that illicit drug use led to strong bonds among young adult males but not among females. Moss et al. (2003) found that the children of drug-dependent fathers are more likely to have deviant peers from preadolescence through mid-adolescence, and speculated that these deviant affiliations may lead to the children's own antisocial behavior. Van der Poel and van de Mheen (2006) found that crack use by a sample of 16- to 24-year-olds accelerated a process of marginalization that had begun before their drug abuse. With crack use, their personal networks shrank and the proportion of crack users in them increased. Schroeder et al. (2007) found that changes in the personal network, especially partner criminality, partly mediate the effect of illicit drug use on future offending. Bernburg et al. (2006) found that deviant peer affiliations mediate the impact of juvenile justice intervention on future delinquency.

### ***Conclusion***

The differential association and social control theories of crime and delinquency both invoke the immediate micro-level social environment of the individual to explain his or her behavior. Social network analysis has been used to operationalize, or model, this environment as a *personal network*. Variations in the attributes of the personal network, such as its composition, types of ties, and structural features, have been used to explain variations in ego's delinquency or crime and to assess the competing claims of the social control and differential association theories. Much work remains to be done on measuring the relevant attributes of personal networks and on establishing causal pathways.

### **NEIGHBORHOOD NETWORKS**

Social network analysis has also been applied to the explanation of crime at the level of the

neighborhood. It has long been observed that crime rates are higher in disadvantaged and heterogeneous neighborhoods. One explanation for this phenomenon proposes that crime is caused by social disorganization, or the breakdown of informal social control, in the neighborhood, which in turn is caused by socioeconomic disadvantage, ethnic heterogeneity, and residential mobility (Shoemaker, 2005). While this explanation is usually treated as a theory in itself, it can also be seen as a neighborhood-level version of the social control theory of individual criminality. A competing explanation proposes that delinquent and criminal peer influences are stronger in disadvantaged neighborhoods; this is differential association theory but at the neighborhood level.

### **Social disorganization theory**

The precise meaning of the mediating concept of “social disorganization” was left unspecified for a long time after the theory was first proposed by Shaw et al. (1929). Sampson (1987) argued that social disorganization is a weakening of social bonds within the community, consequently a weakening of *informal social control*. Certain structural conditions in the neighborhood, such as concentrated disadvantage, ethnic heterogeneity, and residential mobility, impair the community’s ability to informally regulate behavior in the neighborhood to conform to its shared values – resulting in an increased level of crime, whether committed by residents or by outsiders (Sampson, 2006a: 49–50). Thus, social disorganization theory is a form of social control theory, but at the level of the neighborhood rather than the individual. Sampson (2004a, 2004b; Sampson et al., 1997: 918) later introduced the concept of *collective efficacy*: “defined as social cohesion among neighbors combined with their willingness to intervene on behalf of the common good.” Sampson (1987: 110) and Leighton (1988: 365) suggested that this cohesion among neighbors might rest on social networks among residents of the community, and Sampson (2006b: 151–153) emphasized the role of the weak ties that are said to characterize neighborly relations in the modern city. Sampson’s conceptualization of social disorganization as impaired collective efficacy is a “contextual” and “situational” view, not an individual-developmental one: “. . . whereas collective efficacy predicts the event-based rate of violence in a neighborhood, it does not necessarily predict rates of offending by neighborhood youth” (2006a: 50).

In a similar vein, Clear (2008) introduced neighborhood social networks as the intervening variable in the effect of high incarceration rates on

high crime rates: high rates of incarceration of parent-aged men, concentrated in certain neighborhoods, can damage local social networks (and other prosocial neighborhood institutions), and this in turn leads to lower collective efficacy and higher community crime rates. Other researchers (e.g., Galster and Killen, 1995; Galster and Mikelsons, 1995; Kennedy et al., 1998) have also found links between neighborhood structural conditions, social networks, and crime but have relied on the concepts of social cohesion and social capital. According to Sampson (2006a: 37; see also Sampson, 2003), while social networks contribute to social cohesion, this in itself is insufficient to capture the concept of collective efficacy, which includes the additional elements of “mutual trust and shared expectations.”

### **Differential social organization theory**

Other research has found that the relationship between neighborhood networks and the neighborhood crime rate is not always the straightforward negative one implied by social control or collective efficacy theory (e.g., Friedman et al., 2007; Gayne, 2004; Triplett et al., 2003; Warner and Rountree, 1997). Pattillo (1998) showed that in a black, middle-class community in Chicago, the dense social networks attributable to home ownership and residential stability were criminogenic as well as protective. These dense networks of kin, friends, and neighbors facilitated informal social control of neighborhood youth, consistent (but inversely) with social disorganization theory, but also facilitated the integration of local criminals and their criminogenic influence. This finding suggests support also for differential association and peer influence theories but at the level of the neighborhood: some types of neighborhoods are differentially likely to foster an excess of procriminal over anticriminal definitions via their criminogenic networks of deviant adolescents and adults.

Matsueda (2006) theorized the varying composition, structure, and prosocial versus antisocial effects of neighborhood social networks in terms of Sutherland’s (1939) little-known theory of differential social organization – the “sociological counterpart to his social psychological theory of differential association” (Matsueda 2006: 3):

Society has become organized in such a way that a premium has been placed both on perpetrating crime and on refraining from crime. An individual may now be a member of a group organized for

crime and at the same time be a member of a group organized against crime. (Sutherland et al., 1992: 105–6)

In other words, differential social organization at the neighborhood level leads to differential association at the individual level.

Consistent with this theory, Browning et al. (2004) found that social networks in Chicago neighborhoods characterized by a high level of social organization and a high level of crime play a dual role: promotion of prosocial collective efficacy but also provision of social capital to offenders. James et al. (2004) analyzed data from semi-structured interviews with a random sample of 24 women in the American CASAWORKS substance abuse program and found that residence in poor neighborhoods exposed women to local law-breaking and substance-abusing networks, while at the same time limiting their access to supportive, prosocial networks. Harding (2009) compared the age composition of adolescent boys' social networks and their criminogenic influence in neighborhoods with varying levels of disadvantage. He found that the boys in more disadvantaged neighborhoods were more likely to spend most of their time with older males and that this resulted in "cross-cohort socialization" into crime.

### Conclusion

The social disorganization and differential social organization theories that explain the rates of crime and delinquency in neighborhoods can be seen as the neighborhood-level analogues of the social control and differential association theories of individual crime and delinquency. Social network analysis has been used to model neighborhood networks, and variations in the attributes of neighborhood networks have been used to explain variations in their rates of crime and delinquency.

In Sutherland's differential social organization theory, structural aspects of the neighborhood such as disadvantage, heterogeneity, and residential mobility, are exogenous variables that affect the balance of antisocial and prosocial influences in neighborhood networks, which in turn affect neighborhood crime rates. This theory and associated research can therefore be subsumed under the influence of personal networks on individual criminality, and social network research in this tradition generally analyzes the characteristics of personal networks of potential delinquents and criminals, as outcomes of exogenous structural conditions.

But social disorganization theory, in its modern version as Sampson's collective efficacy theory, is radically different. Collective efficacy theory and research sees neighborhood networks as *networks of (prosocial) residents*, which vary, according to exogenous structural conditions, in their efficacy in exerting informal social control of crime and delinquency in the neighborhood – whether due to locals or to outsiders. In this theory, the social control that reduces neighborhood crime is exerted not through the personal networks of potential delinquents or criminals but through the personal networks of prosocial residents, who are seen as putative social control agents. The implication for collective efficacy research using social network analysis is that it is not the attributes of the personal networks of potential delinquents and criminals that explain neighborhood crime but the attributes of the whole network existing among the residents of the neighborhood, particularly its cohesion and its capacity for the mobilization of collective action.

A major conceptual difficulty in collective efficacy theory, as some of the cited research suggests, is that the population of the neighborhood cannot be divided so neatly into potential delinquents and criminals, and prosocial residents who are potential social control agents; many, if not most, residents fall into both categories, as each individual experiences some balance of prosocial and antisocial definitions. Furthermore, the whole network of the neighborhood contains ties not only among the supposedly prosocial residents, but also among the supposedly antisocial residents who are potential delinquents or criminals, and finally, between members of these nonmutually exclusive groupings. As Sweetser (1942: 533) put it,

. . . that many boys in the most delinquent areas fail to absorb the delinquent "tradition" and remain law-abiding is thus possible if the culture of the delinquency area be conceived in terms of the spatial interpenetration of a delinquent and a law-abiding tradition, perpetuated by differential acquaintance and association among neighbors.

A methodological difficulty of research on neighborhood networks is that it is extremely difficult to collect data on the attributes of, and ties among, the population of the whole neighborhood. In practice, this research has relied on the personal networks of samples of residents. However, inference from sampled personal networks to whole networks is by no means straightforward (Frank, this volume). More research is needed that addresses these conceptual and methodological issues.

## CRIMINAL NETWORKS

Social network analysis is also used to model the social organization of crime. Network models are employed in this literature to provide static and dynamic representations of criminal groups and criminal activities. This research tends to be exploratory and descriptive rather than theory-testing, although two theoretical issues underlie much of it:

- 1 What intra- and inter-organizational network structures emerge in response to various task-related and environmental contingencies? and
- 2 What are the performance-related consequences of the adoption of various intra- and inter-organizational network structures? (Here, "performance" refers mainly to indicators of organizational success, such as profitability, longevity, etc.)

These are also two of the fundamental questions in the sociology of organizations (e.g., Aldrich, 1979; Handel, 2003; Perrow, 1986) and of industrial organization studies (e.g., Pepall et al., 2008; Williamson, 1975), and social network analysis is used in the study of criminal networks in ways that parallel its applications in those disciplines (e.g., Burt, 1983, 1992, 2000; Carrington, 1981; Cross and Parker, 2004; Kilduff and Krackhardt, 2008; White, 1981, 2002).

Waring (2002: 43) has argued that the nature of criminal activity makes it best conceptualized as a network form of organization, rather than other forms, such as the hierarchy or market, and that criminal activity is therefore subsumed within a broader class of activities organized as networks, including policy coalitions, joint ventures, movie projects, friendships, and business, political, and community elites. Felson (2009) identified four levels of criminal cooperation, ranging from "primordial clusters" to "an extended patrimonial system."

A key difference between network research on criminal networks and on peer influence and neighborhood networks is that, in principle, criminal networks include only people who are already involved in criminal activity, so the research questions involve not the etiology of crime, but its organization and the causes and consequences thereof. Also, in contrast to peer network studies, criminal network analyses are usually of whole networks rather than of personal or egocentric networks: that is, the networks are generally not conceptually centered on individuals, but comprise entire criminal groups, however defined. (However, these "whole networks" are often assembled from egocentric network data

arising from police investigations [Renée van der Hulst, personal communication].)

## ***Gangs, groups, and networks***

Studies reviewed in this section mainly deal with applications of social network analysis to criminal groups that have fewer members than those studied under the rubric of "organized crime," and commit more localized and relatively unsophisticated "street crime." Many of these studies concern "youth gangs" or "delinquent groups," which are further distinguished from organized crime not only by the age of the members but also by the presumed motives for participation: primarily instrumental in the case of organized crime, but a mix of instrumental and expressive motives in the case of youth gangs.

Analysis of sociograms and sociomatrices (Hanneman and Riddle, this volume), recording subjects' friends or companions (and co-offenders), has a long history in the study of criminal organization: indeed, it was Moreno's invention of this technique to study the social structure of incarcerated offenders at Sing Sing prison (1932) and the Hudson School for Girls (1934) that is identified by many historians as the birth of social network analysis (e.g., Freeman, 2004: 7). However, Moreno's invention of sociometry is predated by Shaw and McKay's (1931: 200–221) use of a two-mode incidence matrix (Borgatti and Halgin, this volume) to study co-offending cliques.<sup>2</sup> Spaulding (1948) reviewed the early development of the use of the concepts and methods of social network analysis to study "cliques, gangs, and networks."

## ***Do gangs exist?***

Social network analysis has been used to address a central question in the literature on delinquent and criminal groups and gangs: Do they really exist? Or are so-called gangs really just spontaneous, temporary, and opportunistic loosely knit, shifting alliances of unorganized individuals? There is a striking parallel to the question (see below) of the degree of "organization" of so-called organized crime groups. Network analyses of putative gang members have generally found that they – like so-called organized crime groups – exhibit local clustering within larger loosely knit networks, that is, small groups with two to a dozen or so members, with varying degrees of connection to other such groups (Daly, 2005; Fleisher, 2002; Hood and Sparks, 1970; Klein and Crawford, 1967; McGloin, 2005; Reiss, 1988; Sarnecki, 1990, 2001, 2009; Short and Strodtbeck, 1965; Spergel, 1990: 203–4;

Warr, 1996, 2002: 39; Whyte, 1943). These findings motivate the use of local clustering (clique) analysis to identify delinquent groups within larger networks (e.g., Cadwallader and Cairns, 2002; Clarke-McLean, 1996; Sarnecki, 2001).

A different way of asking whether criminal groups are really groups is to analyze the temporal stability of their composition, that is, their membership. Warr, for example, writes of “. . . the extreme instability of [the membership of] most delinquent groups . . . all groups are . . . so short-lived that it may make little sense to even speak of delinquent groups at all . . .” (1996: 33; emphasis in the original). Other research on delinquent groups has reached similar, though not always so extreme, conclusions (Sarnecki, 1990, 2001; van Mastrigt, 2008; Warr, 1996). On the other hand, Clarke-McLean (1996) found “reasonably stable” networks among a sample of 92 incarcerated youth – perhaps because they were incarcerated.

### *Homophily*

Network research on delinquent groups has generally found evidence of homophily (McPherson et al., 2001) in relation to age, place of residence, and criminal experience (Clarke-McLean, 1996; Daly, 2005; Sarnecki, 2001). There is strong gender homophily (Clarke-McLean, 1996), but it is weaker for female offenders (Daly, 2005; Fleisher, 2002; Sarnecki, 2001, 2004; Warr, 1996). Carrington (2002) used a probabilistic model and Canadian co-offending data to show that the lower level of homophily among female offenders is explained by the offender sex ratio, and it does not imply any preference (see also van Mastrigt, 2008). Other research on mixed-sex delinquent groups has found evidence of recruitment of girls by older males and of male influence over, and exploitation of, females (Fleisher and Krienert, 2004; but cf. Pettersson, 2005), as well as gendered criminal roles in the group (Mullins and Wright, 2003; Waring, 1993). There is racial or ethnic homophily in delinquent groups in the United States (Clarke-McLean, 1996; Daly, 2005) and, in a more complex way, in Sweden (Pettersson, 2003; Sarnecki, 2001).

### *Structure*

Waring (1993) used data from presentence reports for white-collar criminals sentenced in U.S. federal courts during the 1980s to study the structures of white-collar co-offending networks. She constructed 377 co-offending networks involving 747 sample members, focusing on networks that had either of two configurations: the complete (sub-)network, or clique, in which all members are directly connected to one another; and the star

(sub-)network, in which a central member is connected to all other members, none of whom is connected to one another. Within these two structural types, she also distinguished networks by their size and role differentiation. She used qualitative analysis to explore why networks take on these forms and to look at the consequences of these structures for the activities of network members. In a simulation study, Calvó-Armengol and Zenou (2004) found that Nash equilibria for delinquent competition and cooperation are determined by the structure of links in the criminal network.

Morselli and Tremblay (2004) showed that nonredundancy in ego’s criminal contacts affects his or her criminal success, measuring nonredundancy by the “effective size” of the egocentric criminal network (Burt, 1992). McGloin and Piquero (2010) showed that redundancy, measured by the density of ties in the egocentric criminal network, is positively associated with crime type specialization in ego’s co-offenses.

Individual centrality – and its inverse, peripherality – has been used as an indicator of the extent of ego’s embeddedness in a criminal group (Sarnecki, 2001, 2004). Central members tend to be the most criminally experienced and active (Sarnecki, 1990, 2001), to have the most criminal attitudes (Baron and Tindall, 1993), and to be at most risk of violent victimization (Schreck et al., 2004). Females tend to be less central than males (Sarnecki, 2004). Using data from the AddHealth Survey and Nash equilibrium analysis, Calvó-Armengol et al. found that an adolescent’s Bonacich centrality in a network of delinquents “is a key determinant of her level of [delinquent] activity” (2005: 1).

McGloin (2005: 625–26) suggested that gang suppression efforts concentrate on members who are “cut-points” – that is, individuals who constitute the only connections between two individuals or groups and are therefore ideally placed as “contagion agents” for a “deterrence message.” However, the effectiveness of such “key player” interdiction strategies (Borgatti, 2006) is called into question by empirical research discussed below (Milward and Raab, 2006; Morselli and Petit, 2007), suggesting the adaptability of criminal networks in the face of threats, and by simulations that treat network structure as endogenous (Easton and Karaivanov, 2009).

### *Intergang networks*

Papachristos (2009) studied the “social structure of gang homicide” by analyzing the social network formed by gang-related homicides in Chicago in 1994. The 66 gangs whose members were involved in the homicides as perpetrators or

victims were defined as the nodes of the network, and the homicides themselves defined the directed ties from the gang of the perpetrator to the gang of the victim. Longitudinal analyses supported the hypothesis of contagion (diffusion) of homicidal behavior. Structural analyses confirmed that homicides were influenced by, and in turn affected, the nature of members' gang affiliations and the dominance structure of intergang relations.

### **Organized crime**

The distinction between organized crime and criminal gangs and groups is not clear-cut, but it points to differences in scale, reach, type of criminal activity, and motivation. The following review of network analyses of organized crime is necessarily selective; additional references are available in two recent literature reviews (Morselli, 2009b; von Lampe, 2009).

Early research in the United States on the organization of the Mafia used a formal organization or hierarchical model, epitomized by the reports in the 1950s and 1960s of the Kefauver and McClellan Committees of the U.S. Senate (Albanese, 2007: 105–6; Cressey, 1969). However, lack of fit with data on many criminal organizations and activities led to dissatisfaction with this model as being overly structured. On the other hand, the economic enterprise model (Reuter, 1983), which conceptualizes criminal businesses and markets as operating according to the same principles of economic rationality as legal business enterprises, has also been criticized for its inadequacy (Liddick, 1999) – as it has in the analysis of legal business activity (Powell, 1990; White, 1981, 2002; Williamson, 1975).

Some early research (e.g., Albini, 1971; Ianni, 1974; Ianni and Reuss-Ianni, 1972; Lupsha, 1983) suggested a network model, in which no particular structure is assumed *a priori*, but rather the social organization of the group is derived “bottom-up” (von Lampe, 2009: 94) from the observed configurations and qualities of connections and transactions among the actors, and the attributes of the actors. While network analysis makes no prior assumptions about structure, a preference for the “network model” of organized crime implies rejection of both the formal organization model and the economic model: the former having too much structure, the latter too little (Waring, 2002: 33). Thus, in the network model, criminal groups and activities are seen as “a system of loosely structured [profit-oriented] relationships” (Albini, 1971, cited in Albanese, 2007: 110). However, adoption of network analysis *methods* does not necessarily imply adoption of the network *model*: for example, Natarajan (2000) used

network analysis to study the organization of a cocaine trafficking group and found that it did fit the classic “corporate” type of organization.

On the other hand, in a study of wiretapped conversations among 294 members of a heroin-dealing network in New York City, combining network concepts and measures, such as cohesiveness (density), subgroups (cliques), and individuals' power (centrality), with several other forms of analysis, Natarajan (2006) concluded that this population did not form a unitary organization or “conspiracy” but was a “loosely structured network . . . with little or no hierarchy” (189). However, while this network had little “formal organization,” it did not lack what might be called “network organization”: there were elements of local clustering and stratification of centrality. Similar conclusions are reached by several other recent studies of smuggling and trafficking, such as Kenney's (2007) analysis of the Colombian drug trade, Heber's (2009a) analysis of drug traffickers in Stockholm, Desroches's (2005) study of drug trafficking in Canada, Xia's (2008) review of organizational structures in Chinese organized crime, and several studies of human smuggling and trafficking (Kleemans, 2009; Lehti and Aromaa, 2006; Soudijn and Kleemans, 2009; Surtees, 2008; Zhang, 2008; Zhang and Gaylord, 1996).

### **Social capital**

Two recurrent themes in the literature on organized crime are the related problems of trust and of access to resources. Criminal enterprise requires the cooperation and coordination of multiple actors, sometimes very distant from one another geographically, but criminal actors lack recourse to conventional legal procedures for enforcement of agreements. Thus, the issue of trust is especially salient in criminal enterprise, and social relations support trust, whether they are preexisting (e.g., family, ethnicity, friendship) or have developed in the course of criminal collaboration (Bruinsma and Bernasco, 2004; Felson, 2009; Granovetter, 1985: 492; Kleemans, 2007; Kleemans and de Poot, 2008; Kleemans and van de Bunt, 1999; Morselli, 2003, 2005; Tremblay, 1993; von Lampe and Johansen, 2004; von Lampe, 2009; Waring, 2002: 38–39; but cf. van de Bunt, 2008). Another theme is the need for connections – with suppliers, customers, and sources of funding and expertise (Morselli, 2005). Kleemans and his colleagues define the “social opportunity structure” as “social ties providing access to profitable criminal opportunities” (Kleemans and de Poot, 2008: 75) and emphasize that access to such opportunities is limited and

distributed unequally over the population and over the life course (van Koppen et al., 2010). Their “social opportunity structure” is very similar to the concept of social capital. For example, Lin (2001: 19) defines social capital as “investment in social relations with expected returns in the marketplace,” or alternatively, “a social asset by virtue of actors’ connections and access to resources in the network or group of which they are members.” Thus, Bouchard and Nguyen (2010) contrasted the payoff from the *social capital* of a sample of young cannabis cultivators, defined as “who you know – connections” or “resources in social networks,” with the payoff from *criminal capital*, defined as “what you know – talent” or “[criminal] education, training, experience” (the equivalent of *human capital* in the noncriminological literature). McCarthy and Hagan (1995; Hagan, 1997; Hagan and McCarthy, 1998) linked the notions of “who” and “what” one knows by defining criminal capital as the criminal knowledge and skill that are derived from embeddedness in criminal networks.

### Structure

Bruinsma and Bernasco (2004) found differences in cohesiveness (density), multiplexity, and clustering in the structures of networks operating in the Netherlands and involved in international trafficking in heroin, women, and stolen cars. Networks of heroin trafficking – a high-risk activity – were characterized by dense, multiplex ties in a single cluster. Ties among those involved in the trafficking of women and stolen cars were less dense, tended to be uniplex and instrumental, and each network had two or more clusters, connected in a chain by intermediate individuals or clusters. They concluded that these differences “appear to be related to the legal and financial risks . . . and . . . the [consequent] required level of trust” (2004: 79). Canter (2004) used partial-order scalogram analysis to compare the organization of 29 British drug-dealing, property-crime, or hooligan networks, along six dimensions of network structure. He identified three types of groups – ad hoc, oligarchies, and organized criminals – that differed on two dominant axes related to group size and leadership centrality. There was only a weak relationship between the tripartite typologies of criminal activities and of organizational structures. Heber (2009b) identified two central roles in the Swedish black market in construction labor: “fixers” and “network entrepreneurs”, and described the characteristics of the networks of each. McNally and Alston (2006) used intelligence data on the associations and communications of members of three Canadian

outlaw motorcycle gangs to assess structural “weaknesses and vulnerabilities” in these groups by identifying core, peripheral, and cut-point members, and estimating overall gang cohesion and communication flow paths, based on measures of density, centrality, clustering, and bridging.

Morselli (2003, 2005) used the concept of structural holes (Burt, 1992; Hanneman and Riddle, this volume) to analyze the careers of two organized criminals, in an instance of criminal network analysis that uses personal networks rather than whole networks. In a combined crime-script and network analysis, Morselli and Roy (2008) used two measures of brokerage (Burt, 2005) – *betweenness centrality* (Hanneman and Riddle, this volume), and *brokerage leverage* (Gould and Fernandez, 1989) – to analyze two Canadian “ringing networks” involved in the sale of stolen vehicles. Morselli (2009a) used degree centrality and betweenness centrality (brokerage) to study the organization of the criminal activities of the Hells Angels motorcycle club in the province of Quebec – in particular to test the hypothesis that they exhibited the tightly structured hierarchical organization of the traditional organized crime paradigm. The results indicated that the organization of criminal activities was more complex and nuanced.

### Implications for interdiction

Extending the work of Calvó-Armengol and colleagues (above), Easton and Karaivanov (2009) identified “optimal criminal networks” by finding Nash equilibria for simulated networks whose size and structure were allowed to vary (i.e., were endogenous) according to individuals’ decisions concerning their level of criminal activity and their links to others in the network, taking into account crime-reduction efforts of the authorities. They concluded that models that assume fixed (i.e., exogenous) criminal network size and structure can produce misleading results; for example, the policy of “taking out” the key player (Borgatti, 2006) may not reduce crime, because criminals may reconfigure their network in response. Milward and Raab (2006: 333) concluded from their review of research on the responses of Al Qaeda and of Colombian cocaine traffickers to efforts by control agents to suppress them that the resilience of “dark networks” lies in their ability to “rebalance differentiation and integration mechanisms in their internal structure.” Morselli and Petit (2007) reached a similar conclusion from their analysis of the reaction of a drug importation network in Montreal, Canada, to law enforcement targeting.



### **Methodological and programmatic work**

A substantial part of the literature on criminal networks, or more generally “dark networks,”<sup>3</sup> consists of methodological and programmatic papers that advocate the adoption of the “network model” or the use of social network analysis to study organized crime or that explain how to do network analysis, sometimes with illustrative case studies. Classic examples are Davis (1981), Ianni and Reuss-Ianni (1990), and Sparrow (1991a, 1991b). More recent examples include McIllwain (1999), Coles (2001), Chattoe and Hamill (2005), McAndrew (2000), Robins (2009), and van der Hulst (2009). Many recent programmatic contributions present new analytic methods or software for criminal network analysis (e.g., Borgatti, 2006; Carley et al., 2002; Chen, 2002; Hadjidj et al., 2009; Hu et al., 2009; Huang, 2005; Kaza et al., 2009; Marshall et al., 2008; Oatley, 2006; Oatley et al., 2005; Oatley et al., 2008; Rhodes and Keefe, 2007; Schwartz and Rouselle, 2009; Smith and King, 2002; Stovin and Davies, 2008; Tsvetovat and Carley, 2007; Tutzauer, 2007; Xu and Chen, 2003, 2005a, 2005b; Xu et al., 2004).

### **Conclusion**

Much of the social network research on criminal networks is exploratory and descriptive, and it seeks to give a (literally) graphic account of the structure of the networks being studied. Some research goes beyond description and explores the causes or consequences of compositional and morphological variations in criminal networks. Researchers on organized crime networks, whose members are presumed to be predominantly rational-instrumental in their behavior, have explored both task-related and environmental determinants of network attributes and also the outcomes of these attributes in terms of organizational success. Research on criminal networks has also investigated the implications of network attributes for interdiction strategies.

As van der Hulst (this volume) has pointed out in relation to network analyses of terrorism, researchers on criminal networks tend, with a few exceptions, to fall into two distinct classes, each operating under severe constraints. Academic researchers have expertise in criminological theory and research but tend to lack “domain expertise” and access to good data. Operational (crime) analysts have domain expertise and access to classified data but tend to lack the motive or training to do research on criminological issues – or may be prevented by secrecy considerations from

publishing their research. More generally, accurate and comprehensive data on “dark networks” are, as the term implies, inherently difficult to obtain. The empirical research cited in this section is a testament to the ingenuity and assiduousness of the authors. Perhaps the gradual diffusion of knowledge of the value of social network analysis in the study of criminal groups will result in better access for criminologists to classified data.

### **DISCUSSION**

The use of social network analysis in criminology is in its infancy. The great majority of so-called network studies of crime and delinquency consider only the composition, or characteristics, of the members or of the networks, and not of the structure of their relationships. Most analyses of network structures are impressionistic, relying on visual examination of sociograms, rather than being computational. Even the computational analyses tend to limit themselves to the simplest network concepts and indices, such as density and centrality. Few criminologists appreciate the usefulness of social network analysis in modeling criminological concepts and propositions, or are trained in network methods, or use network analysis software. Suitable data are difficult to obtain or to generate.

Nevertheless, a small number of criminologists are knowledgeable in the concepts and methods of social network analysis, and some have shown great ingenuity in finding or generating suitable data. They have produced a number of sophisticated and powerful criminological network analyses over the past decade. Much more needs to be done, particularly in training in social network analysis and access to data. The recent publication of the first pedagogical article on social network analysis to appear in a criminological journal (McGloin and Kirk, 2010) may be a harbinger of future developments.

### **NOTES**

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1 For explanations of these and other network concepts, please see the chapters in this volume by Hanneman and Riddle.

2 Frank and Carrington (2007; Frank, 2001) also used a two-mode incidence matrix and a probabilistic model to estimate the “dark figures” in estimates of co-offending and individual criminal activity based on official data.

3 “Dark networks” include both criminal and terrorist networks, which are sometimes not distinct. I have included sources on “dark networks” in this chapter if they are particularly germane to the study of organized crime; for a review of the literature on social network analysis of terrorist networks, please see the chapter by van der Hulst in this volume.

## REFERENCES

- Albanese, J.S. (2007) *Organized Crime in Our Times*. 5th ed. Newark, NJ: LexisNexis.
- Albini, J.L. (1971) *The American Mafia: Genesis of a Legend*. New York: Irvington.
- Aldrich, H. (1979) *Organizations and Environments*. Englewood Cliffs, NJ: Prentice-Hall.
- Baerveldt, C. and Snijders, T.A.B. (1994) ‘Influences on and from the segmentation of networks – hypotheses and tests’. *Social Networks*, 16(3): 213–32.
- Baerveldt, C., Van Rossem, R., Vermande, M. and Weerman, F. (2004) ‘Students’ delinquency and correlates with strong and weaker ties: A study of students’ networks in Dutch high schools’. *Connections*, 26(1): 11–28.
- Baerveldt, C., Voelker, B. and Van Rossem, R. (2008) ‘Revisiting selection and influence: An inquiry into the friendship networks of high school students and their association with delinquency’. *Canadian Journal of Criminology and Criminal Justice*, 50(5): 559–87.
- Baron, S.W. and Tindall, D.B. (1993) ‘Network structure and delinquent attitudes within a juvenile gang’. *Social Networks*, 15(3): 255–73.
- Bernburg, J.G., Krohn, M.D. and Rivera, C.J. (2006) ‘Official labeling, criminal embeddedness, and subsequent delinquency – A longitudinal test of labeling theory’. *Journal of Research in Crime and Delinquency*, 43(1): 67–88.
- Borgatti, S. (2006) ‘Identifying sets of key players in a social network’. *Computational & Mathematical Organization Theory*, 12(1): 21–34.
- Bouchard, M. and Nguyen, H. (2010) ‘Is it who you know, or how many that counts? Criminal networks and cost avoidance in a sample of young offenders’. *Justice Quarterly*, 27: 130–58.
- Brook, J.S., Brook, D.W., Rosen, Z. and Rabbitt, C.R. (2003) ‘Earlier marijuana use and later problem behavior in Colombian youths’. *Journal of the American Academy of Child and Adolescent Psychiatry*, 42(4): 485–92.
- Browning, C.R., Feinberg, S.L. and Dietz, R.D. (2004) ‘The paradox of social organization: Networks, collective efficacy, and violent crime in urban neighborhoods’. *Social Forces*, 83(2): 503–34.
- Bruinsma, G.J.N. (1992) ‘Differential association theory reconsidered: An extension and its empirical test’. *Journal of Quantitative Criminology*, 8: 29–49.
- Bruinsma, G.J.N. and Bernasco, W. (2004) ‘Criminal groups and transnational illegal markets – A more detailed examination on the basis of Social Network Theory’. *Crime Law and Social Change*, 41(1): 79–94.
- Burgess, R.L. and Akers, R.L. (1966) ‘A differential association-reinforcement theory of criminal behavior’. *Social Problems*, 14: 128–47.
- Burk, W.J., Kerr, M. and Stattin, H. (2008) ‘The co-evolution of early adolescent friendship networks, school involvement, and delinquent behaviors’. *Revue Française de Sociologie*, 49(3): 499–522.
- Burk, W.J., Steglich, C.E.G. and Snijders, T.A.B. (2007) ‘Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors’. *International Journal of Behavioral Development*, 31(4): 397–404.
- Burt, R.S. (1983) *Corporate Profits and Cooptation*. New York: Academic Press.
- Burt, R.S. (1992) *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.
- Burt, R.S. (2000) ‘The network structure of social capital’, in Robert I. Sutton and Barry M. Staw (eds), *Research in Organizational Behavior*. Greenwich, CT: JAI Press.
- Burt, R.S. (2005) *Brokerage and Closure: An Introduction to Social Capital*. Oxford: Oxford University Press.
- Cadwallader, T.W. and Cairns, R.B. (2002) ‘Developmental influences and gang awareness among African-American inner city youth’. *Social Development*, 11(2): 245–65.
- Calvo-Armengol, A., Patacchini, E. and Zenou, Y. (2005) *Peer Effects and Social Networks in Education and Crime. Working Paper*. Vol. 645. Stockholm: Research Institute of Industrial Economics.
- Calvo-Armengol, A. and Zenou, Y. (2004) ‘Social networks and crime decisions: The role of social structure in facilitating delinquent behavior’. *International Economic Review*, 45(3): 939–58.
- Canter, D. (2004) ‘A partial order scalogram analysis of criminal network structures.’ *Behaviormetrika*, 31(2): 131–52.
- Capowich, G.E., Mazerolle, P. and Piquero, A. (2001) ‘General strain theory, situational anger, and social networks – An assessment of conditioning influences’. *Journal of Criminal Justice*, 29(5): 445–61.
- Carley, K.M., Lee, J.-S.L. and Krackhardt, D. (2002) ‘Destabilizing networks’. *Connections*, 24(3): 79–92.
- Carrington, P.J. (1981) ‘Horizontal co-optation through corporate interlocks’. Doctoral dissertation, University of Toronto.
- Carrington, P.J. (2002) ‘Sex homogeneity in co-offending groups’, in J. Hagberg (ed.), *Contributions to Social Network Analysis, Information Theory and Other Topics in Statistics. A Festschrift in Honour of Ove Frank*. Stockholm: Stockholm University. pp. 101–16.

- Chattoe, E. and Hamill, H. (2005) 'It's not who you know – It's what you know about people you don't know that counts – Extending the analysis of crime groups as social networks'. *British Journal of Criminology*, 45(6): 860–76.
- Chen, H.C. (2002) 'From digital library to digital government: A case study in crime data mapping and mining'. Digital Libraries: People, Knowledge, and Technology, Proceedings. *Lecture Notes in Computer Science*, vol. 2555. Berlin: Springer-Verlag.
- Clarke-McLean, J.G. (1996) 'Social networks among incarcerated juvenile offenders'. *Social Development*, 5(2): 203–17.
- Clear, T.R. (2008) 'The effects of high imprisonment rates on communities', in Michael Tonry (ed.), *Crime and Justice: A Review of Research*. Vol. 37. Chicago: University of Chicago Press. pp. 97–132.
- Cohen, L.E. and Felson, M. (1979) 'Social Change and Crime Rate Trends: A Routine Activity Approach'. *American Sociological Review*, 44: 588–608.
- Coles, N. (2001) 'It's not what you know – It's who you know that counts. Analysing serious crime groups as social networks'. *British Journal of Criminology*, 41(4): 580–94.
- Cressey, D.R. (1969) *Theft of the Nation*. New York: Harper Row.
- Cross, R.L. and Parker, A. (2004) *The Hidden Power of Social Networks: Understanding How Work Really Gets Done in Organizations*. Cambridge, MA: Harvard Business Press.
- Curry, A.D. and Latkin, C.A. (2003) 'Gender differences in street economy and social network correlates of arrest among heroin injectors in Baltimore, Maryland'. *Journal of Urban Health*, 80: 482–93.
- Daly, R.M. (2005) 'Delinquent networks in Philadelphia: The structure of co-offending among juveniles'. Ph.D. thesis, University of Pennsylvania.
- Davis, R.H. (1981) 'Social network analysis – An aid in conspiracy investigations'. *FBI Law Enforcement Bulletin*, 50(12): 11–19.
- Deptula, D.P. and Cohen, R. (2004) 'Aggressive, rejected, and delinquent children and adolescents: A comparison of their friendships'. *Aggression and Violent Behavior* 9(1): 75–104.
- Desroches, F.J. (2005) *The Crime That Pays: Drug Trafficking and Organized Crime in Canada*. Toronto: Canadian Scholars' Press.
- Easton, S.T. and Karaivanov, A.K. (2009) 'Understanding optimal criminal networks'. *Global Crime*, 10(1): 41–65.
- Ekland-Olson, S. (1983) 'Deviance, social control and social networks'. *Research in Law, Deviance and Social Control*, 4: 271–99.
- Elliott, D.S. and Menard, S. (1996) 'Delinquent friends and delinquent behavior: Temporal and developmental patterns', in J. D. Hawkins (ed.), *Delinquency and Crime: Current Theories*. Cambridge: Cambridge University Press. pp. 28–67.
- Espelage, D.L., Green, H.D., Jr. and Wasserman, S. (2007) 'Statistical analysis of friendship patterns and bullying behaviors among youth'. *New Directions for Child and Adolescent Development*, 118: 61–75.
- Felson, M. (2009) 'The natural history of extended co-offending'. *Trends in Organized Crime*, 12(2): 159–65.
- Fleisher, M.S. (2002) 'Doing field research on diverse gangs: Interpreting youth gangs as social networks', in C. Ronald Huff (ed.), *Gangs in America*. Thousand Oaks, CA: Sage. pp. 199–217.
- Fleisher, M.S. and Krienert, J.L. (2004) 'Life-course events, social networks, and the emergence of violence among female gang members'. *Journal of Community Psychology* 32: 607–22.
- Frank, O. (2001) 'Statistical estimation of co-offending youth networks'. *Social Networks*, 23(3): 203–14.
- Frank, O. and Carrington, P.J. (2007) 'Estimation of offending and co-offending using available data with model support'. *Journal of Mathematical Sociology*, 31(1): 1–46.
- Freeman, L.C. (2004) *The Development of Social Network Analysis*. Vancouver, BC: Empirical Press.
- Friday, P.C. and Hage, J. (1976) 'Youth crime in postindustrial societies: An integrated perspective'. *Criminology*, 14: 347–68.
- Friedman, S.R., Mateu-Gelabert, P., Curtis, R., Maslow, C., Bolyard, M., Sandoval, M. and Flom, P.L. (2007) 'Social capital or networks, negotiations, and norms? A neighborhood case study'. *American Journal of Preventive Medicine*, 32(6): S160–S170.
- Gainey, R.R., Peterson, P.L., Wells, E.A., Hawkins, J.D. and Catalano, R.F. (1995) 'The social networks of cocaine users seeking treatment'. *Addiction Research*, 3: 17–32.
- Galster, G.C. and Killen, S.P. (1995) 'The geography of metropolitan opportunity – A reconnaissance and conceptual-framework'. *Housing Policy Debate*, 6(1): 7–43.
- Galster, G.C. and Mikelsons, M. (1995) 'The geography of metropolitan opportunity – A case-study of neighborhood conditions confronting youth in Washington, DC'. *Housing Policy Debate*, 6(1): 73–102.
- Gayne, M.K. (2004) 'Illicit wigmaking in eighteenth-century Paris'. *Eighteenth-Century Studies*, 38(1): 119–37.
- Giordano, P.C., Cernkovich, S.A. and Demaris, A. (1993) 'The family and peer relations of black-adolescents'. *Journal of Marriage and the Family*, 55(2): 277–87.
- Gottfredson, M.R. and Hirschi, T. (1990) *A General Theory of Crime*. Stanford, CA: Stanford University Press.
- Gould, R.V. and Fernandez, R.M. (1989) 'Structures of mediation: A formal approach to brokerage in transaction networks', in Clifford C. Clogg (ed.), *Sociological Methodology*. Vol. 19. Oxford: Basil Blackwell. pp. 89–126.
- Granovetter, M. (1973) 'Strength of weak ties'. *American Journal of Sociology*, 78(6): 1360–80.
- Granovetter, M. (1985) 'Economic action and social structure: The problem of embeddedness'. *American Journal of Sociology*, 91: 481–510.
- Griffith, J.D., Knight, D.K., Joe, G.W. and Simpson, D.D. (1998) 'Implications of family and peer relations for treatment engagement and follow-up outcomes: An integrative model'. *Psychology of Addictive Behaviors*, 12(2): 113–26.
- Gutierrez-Lobos, K., Eher, R., Grunhut, C., Bankier, B., Schmidl-Mohl, B., Fruhwald, S. and Semler, B. (2001) 'Violent sex offenders lack male social support'.

- International Journal of Offender Therapy and Comparative Criminology*, 45(1): 70–82.
- Hadjidj, R., Debbabi, M., Lounis, H., Iqbal, F., Szporer, A. and Benredjem, D. (2009) 'Towards an integrated e-mail forensic analysis framework'. *Digital Investigation*, 5(3–4): 124–37.
- Hagan, J. (1997) 'Crime and capitalization: Toward a developmental theory of street crime in America', in Terence P. Thornberry (ed), *Developmental Theories of Crime and Delinquency*. Vol. 7 of *Advances in Criminological Theory*. New Brunswick, NJ: Transaction. pp. 287–308.
- Hagan, J. and McCarthy, B. (1998) *Mean Streets: Youth Crime and Homelessness*. Cambridge, UK: Cambridge University Press.
- Handel, M.J. (ed) (2003) *Sociology of Organizations: Classic, Contemporary and Critical Readings*. Thousand Oaks, CA: Sage.
- Hanson, R.K. and Scott, H. (1996) 'Social networks of sexual offenders'. *Psychology Crime and Law*, 2(4): 249–58.
- Harding, D.J. (2009) 'Violence, older peers, and the socialization of adolescent boys in disadvantaged neighborhoods'. *American Sociological Review*, 74(3): 445–64.
- Haynie, D.L. (2001) 'Delinquent peers revisited: Does network structure matter?' *American Journal of Sociology*, 106(4): 1013–57.
- Haynie, D.L. (2002) 'Friendship networks and delinquency: The relative nature of peer delinquency'. *Journal of Quantitative Criminology*, 18(2): 99–134.
- Haynie, D.L. and Osgood, D.W. (2005) 'Reconsidering peers and delinquency: How do peers matter?' *Social Forces*, 84(2): 1109–30.
- Haynie, D.L. and Piquero, A.R. (2006) 'Pubertal development and physical victimization in adolescence'. *Journal of Research in Crime and Delinquency* 43(1): 3–35.
- Heber, A. (2009a) 'The networks of drug offenders'. *Trends in Organized Crime*, 12(1): 1–20.
- Heber, A. (2009b) 'Networks of organised black market labour in the building trade'. *Trends in Organized Crime*, 12(2): 122–44.
- Hirschi, T. (1969) *Causes of Delinquency*. Berkeley: University of California Press.
- Hood, R. and Sparks, R. (1970) *Key Issues in Criminology*. New York: McGraw-Hill.
- Houtzager, B. and Baerveldt, C. (1999) 'Just like normal: A social network study of the relation between petty crime and the intimacy of adolescent friendships'. *Social Behavior and Personality*, 27(2): 177–92.
- Hu, D., Kaza, S. and Chen, H. (2009) 'Identifying significant facilitators of dark network evolution'. *Journal of the American Society for Information Science and Technology*, 60(4): 655–65.
- Huang, C.Y. (2005) 'File sharing as a form of music consumption'. *International Journal of Electronic Commerce*, 9(4): 37–55.
- Ianni, F.A.J. (1974) *Black Mafia: Ethnic Succession in Organized Crime*. New York: Simon and Schuster.
- Ianni, F.A.J. and Reuss-Ianni, E. (1972) *A Family Business*. New York: Russell Sage Foundation.
- Ianni, F.A.J. and Reuss-Ianni, E. (1990) 'Network analysis'. In Paul P. Andrews, Jr. and Marilyn B. Peterson (eds), *Criminal Intelligence Analysis*. Loomis, CA: Palmer Enterprises. pp. 67–84.
- James, S.E., Johnson, J. and Raghavan, C. (2004) "'I couldn't go anywhere" – Contextualizing violence and drug abuse: A social network study'. *Violence against Women*, 10(9): 991–1014.
- Kandel, D. and Davies, M. (1991) 'Friendship networks, intimacy, and illicit drug-use in young adulthood – A comparison of 2 competing theories'. *Criminology*, 29(3): 441–469.
- Kaza, S., Xu, J., Marshall, B. and Chen, H. (2009) 'Topological analysis of criminal activity networks: Enhancing transportation security'. *IEEE Transactions on Intelligent Transportation Systems*, 10(1): 83–91.
- Kennedy, B.P., Kawachi, I. and Brainerd, E. (1998) 'The role of social capital in the Russian mortality crisis'. *World Development*, 26(11): 2029–43.
- Kenney, M. (2007) 'The architecture of drug trafficking: Network forms of organisation in the Colombian cocaine trade'. *Global Crime*, 8(3): 233–59.
- Kilduff, M. and Krackhardt, D. (2008) *Interpersonal Networks in Organizations: Cognition, Personality, Dynamics, and Culture*. Cambridge, UK: Cambridge University Press.
- Kirke, D.M. (1990) 'Teenage drug abuse: An individualistic and structural analysis'. Ph.D. thesis. University College, Dublin.
- Kirke, D.M. (1995) 'Teenage peer networks in the community as sources of social problems: A sociological perspective', in T. S. Brugha (ed.), *Social Support and Psychiatric Disorder: Research Findings and Guidelines for Clinical Practice*. Cambridge: Cambridge University Press.
- Kirke, D.M. (2006) *Teenagers and Substance Use*. New York: Palgrave-Macmillan.
- Kleemans, E.R. (2007) 'Organized crime, transit crime, and racketeering. Crime and justice in the Netherlands', in Michael Tonry and Catrien Bijleveld (eds) *Crime and Justice: A Review of Research*. Vol. 35. Chicago: University of Chicago Press. pp. 163–215.
- Kleemans, E.R. (2009) 'Human smuggling and human trafficking', in Michael Tonry (ed.), *The Oxford Handbook of Crime and Public Policy*. Oxford: Oxford University Press.
- Kleemans, E.R. and van de Bunt, H.G. (1999) 'Social embeddedness of organized crime'. *Transnational Organized Crime*, 5(1): 19–36.
- Kleemans, E.R. and de Poot, C.J. (2008) 'Criminal careers in organized crime and social opportunity structure'. *European Journal of Criminology*, 5(1): 69–98.
- Klein, M.W. and Crawford, L.Y. (1967) 'Groups, gangs, and cohesiveness'. *Journal of Research in Crime and Delinquency*, 4(1): 63–75.
- Knight, D.K. and Simpson, D.D. (1996) 'Influences of family and friends on client progress during drug abuse treatment'. *Journal of Substance Abuse*, 8(4): 417–29.
- Korobow, A., Johnson, C. and Axtell, R. (2007) 'An agent-based model of tax compliance with social networks'. *National Tax Journal*, 60: 589–610.

- Krohn, M.D. (1986) 'The web of conformity: A network approach to the explanation of delinquent behavior'. *Social Problems*, 33(6): S81–S93.
- Krohn, M.D., Massey, J.L. and Zielinski, M. (1988) 'Role overlap, network multiplexity, and adolescent deviant behavior'. *Social Psychology Quarterly*, 51(4): 346–356.
- Lacasse, A., Purdy, K.T. and Mendelson, M.J. (2003) 'The mixed company they keep: Potentially offensive sexual behaviours among adolescents'. *International Journal of Behavioral Development*, 27(6): 532–40.
- Laird, R.D., Pettit, G.S., Dodge, K.A. and Bates, J.E. (1999) 'Best friendships, group relationships, and antisocial behavior in early adolescence'. *Journal of Early Adolescence*, 19: 413–37.
- Lee, J.S. (2004) 'Generating networks of illegal drug users using large samples of partial ego-network data'. Intelligence and Security Informatics, Proceedings. *Lecture Notes in Computer Science*, vol. 3073. Berlin: Springer-Verlag.
- Lehti, M. and Aromaa, K. (2006) 'Trafficking for sexual exploitation', in Michael Tonry (ed.), *Crime and Justice: A Review of Research*, 34: 133–227.
- Leighton, B. (1988) 'The community concept in criminology – Toward a social network approach'. *Journal of Research in Crime and Delinquency*, 25(4): 351–74.
- Lichtenstein, B. (1997) 'Women and crack-cocaine use: A study of social networks and HIV risk in an Alabama jail sample'. *Addiction Research*, 5(4): 279–96.
- Liddick, D. (1999) 'The enterprise 'model' of organized crime: Assessing theoretical propositions'. *Justice Quarterly*, 16(2): 403–30.
- Light, J.M. and Dishion, T.J. (2007) 'Early adolescent antisocial behavior and peer rejection: A dynamic test of a developmental process'. *New Directions for Child and Adolescent Development*, 118: 77–89.
- Lin, N. (2001) *Social Capital*. Cambridge, UK: Cambridge University Press.
- Lonardo, R.A., Giordano, P.C., Longmore, M.A. and Manning, W.D. (2009) 'Parents, friends, and romantic partners: Enmeshment in deviant networks and adolescent delinquency involvement'. *Journal of Youth and Adolescence*, 38(3): 367–83.
- Lupsha, P. (1983) 'Networks versus networking: Analysis of an organized crime group', in G. Waldo (ed.), *Career Criminals*. Beverly Hills, CA: Sage. pp. 59–87.
- Mangino, W. (2009) 'The downside of social closure: Brokerage, parental influence, and delinquency among African American boys'. *Sociology of Education*, 82(2): 147–72.
- Marshall, B., Chen, H. and Kaza, S. (2008) 'Using importance flooding to identify interesting networks of criminal activity'. *Journal of the American Society for Information Science and Technology*, 59(13): 2099–114.
- Matsueda, R.L. (2006) 'Differential social organization, collective action, and crime'. *Crime Law and Social Change*, 46: 3–33.
- Matsueda, R.L. and Anderson, K. (1998) 'The dynamics of delinquent peers and delinquent behavior'. *Criminology*, 36(2): 269–308.
- McAndrew, D. (2000) 'The structural analysis of criminal networks', in David Canter and Laurence Alison (eds), *The Social Psychology of Crime: Groups, Teams and Networks*. Vol. III. Aldershot, UK: Ashgate. pp. 51–94.
- McCarthy, B., Felmlee, D. and Hagan, J. (2004) 'Girl friends are better: Gender, friends, and crime among school and street youth'. *Criminology*, 42(4): 805–35.
- McCarthy, B. and Hagan, J. (1995) 'Getting into street crime – The structure and process of criminal embeddedness'. *Social Science Research*, 24(1): 63–95.
- McGloin, J.M. (2005) 'Policy and intervention considerations of a network analysis of street gangs'. *Criminology and Public Policy*, 4(3): 607–36.
- McGloin, J.M. (2009) 'Delinquency balance: Revisiting peer influence'. *Criminology*, 47(2): 439–77.
- McGloin, J.M. and Kirk, D.S. (2010) 'An overview of social network analysis'. *Journal of Criminal Justice Education*, 21: 169–81.
- McGloin, J.M. and Piquero, A.R. (2010) 'On the relationship between co-offending network redundancy and offending versatility'. *Journal of Research in Crime and Delinquency*, 47: 63–90.
- McGloin, J.M. and Shermer, L.O'N. (2009) 'Self-control and deviant peer network structure'. *Journal of Research in Crime and Delinquency*. 46(1): 35–72.
- McIlwain, J.S. (1999) 'Organized crime: A social network approach'. *Crime Law and Social Change*, 32(4): 301–23.
- McNally, D. and Alston, J. (2006) 'Use of social network analysis (SNA) in the examination of an outlaw motorcycle gang'. *Journal of Gang Research*, 13(3): 1–25.
- McPherson, M., Smith-Lovin, L. and Cook, J.M. (2001) 'Birds of a feather: Homophily in social networks'. *Annual Review of Sociology*, 27: 415–44.
- Meldrum, R.C., Young, J.T.N. and Weerman, F.M. (2009) 'Reconsidering the effect of self-control and delinquent peers: implications of measurement for theoretical significance'. *Journal of Research in Crime and Delinquency*, 46: 353–76.
- Milward, H.B. and Raab, J. (2006) 'Dark networks as organizational problems: Elements of a theory'. *International Public Management Journal*, 9(3): 333–60.
- Monge, P.R. and Contractor, N. (2003) *Theories of Communication Networks*. New York: Oxford University Press.
- Moreno, J.L. (1932) *Application of the Group Method to Classification*. New York: National Committee on Prisons and Prison Labor.
- Moreno, J.L. (1934) *Who Shall Survive?* Washington, DC: Nervous and Mental Disease Publishing Company.
- Morselli, C. (2003) 'Career opportunities and network-based privileges in the Cosa Nostra'. *Crime Law and Social Change*, 39(4): 383–418.
- Morselli, C. (2005) *Contacts, Opportunities, and Criminal Enterprise*. Toronto: University of Toronto Press.
- Morselli, C. (2009a) 'Hells Angels in springtime'. *Trends in Organized Crime*, 12(2): 145–58.
- Morselli, C. (2009b) *Inside Criminal Networks*. New York: Springer.

- Morselli, C. and Petit, K. (2007) 'Law-enforcement disruption of a drug importation network'. *Global Crime*, 8(2): 109–30.
- Morselli, C. and Roy, J. (2008) 'Brokerage qualifications in ringing operations'. *Criminology*, 46(1): 71–98.
- Morselli, C. and Tremblay, P. (2004) 'Criminal achievement, offender networks and the benefits of low self-control'. *Criminology*, 42(3): 773–804.
- Moss, H.B., Lynch, K.G. and Hardie, T.L. (2003) 'Affiliation with deviant peers among children of substance dependent fathers from pre-adolescence into adolescence: Associations with problem behaviors'. *Drug and Alcohol Dependence*, 71: 117–25.
- Mullins, C.W. and Wright, R. (2003) 'Gender, social networks, and residential burglary'. *Criminology*, 41(3): 813–39.
- Myers, D.J. (2000) 'The diffusion of collective violence: infectiousness, susceptibility, and mass media networks'. *American Journal of Sociology*, 106: 173–208.
- Natarajan, M. (2000) 'Understanding the structure of a drug trafficking organization: A conversational analysis'. *Crime Prevention Studies*, 11: 273–98.
- Natarajan, M. (2006) 'Understanding the structure of a large heroin distribution network: A quantitative analysis of qualitative data'. *Journal of Quantitative Criminology*, 22(2): 171–92.
- Oatley, G. (2006) 'Decision support systems for police: Lessons from the application of data mining techniques to "soft" forensic evidence'. *Artificial Intelligence and Law*, 14: 35–100.
- Oatley, G.C., Belem, B., Fernandes, K., Hoggarth, E., Holland, B., Lewis, C., Meier, P., Morgan, K., Santhanam, J. and Squires, P. (2008) 'The gang gun crime problem – Solutions from social network theory, epidemiology, cellular automata, Bayesian networks and spatial statistics'. *Computational Forensics*. New York: Springer.
- Oatley, G., Zeleznikow, J., Leary, R. and Ewart, B. (2005) 'From links to meaning: A burglary data case study'. Knowledge-based Intelligent Information and Engineering Systems, Part 4, Proceedings. *Lecture Notes in Artificial Intelligence*, vol. 3684. Berlin: Springer-Verlag.
- Osgood, D.W., Wilson, J.K., O'Malley, P.M., Bachman, J.G. and Johnston, L.D. (1996) 'Routine activities and individual deviant behavior'. *American Sociological Review*, 61: 635–55.
- Papachristos, A.V. (2009) 'Murder by structure: Dominance relations and the social structure of gang homicide'. *American Journal of Sociology*, 115(1): 74–128.
- Patacchini, E. and Zenou, Y. (2008) 'The strength of weak ties in crime'. *European Economic Review*, 52(2): 209–36.
- Pattillo, M.E. (1998) 'Sweet mothers and gangbangers: Managing crime in a black middle-class neighborhood'. *Social Forces*, 76(3): 747–74.
- Pearson, M. and West, P. (2003) 'Drifting smoke rings: Social network analysis and Markov processes in a longitudinal study of friendship groups and risk-taking'. *Connections*, 25(2): 59–76.
- Pepall, L., Richards, D. and Norman, G. (eds) (2008) *Industrial Organization: Contemporary Theory and Empirical Applications*. 4th ed. Malden, MA: Blackwell.
- Perrow, C. (1986) *Complex Organizations: A Critical Essay*. 3rd ed. New York: McGraw-Hill.
- Pettersson, T. (2003) 'Ethnicity and violent crime: The ethnic structure of networks of youths suspected of violent offences in Stockholm'. *Journal of Scandinavian Studies in Criminology and Crime Prevention*, 4(2): 143–61.
- Pettersson, T. (2005) 'Gendering delinquent networks. A gendered analysis of violent crimes and the structure of boys' and girls' co-offending networks'. *Young Nordic Journal of Youth Research*, 13(3): 247–67.
- Powell, W. (1990) 'Neither hierarchies nor markets', in Barry Shaw and L. L. Cummings (eds), *Research in Organizational Behavior*. Vol. 12. Greenwich, CT: JAI Press. pp. 295–336.
- Reiss, A.J., Jr. (1988) 'Co-offending and criminal careers', in Michael Tonry and Norval Morris (eds), *Crime and Justice: A Review of Research*. 10" 117–70.
- Reuter, P. (1983) *Disorganized Crime: The Economics of the Visible Hand*. Cambridge, MA: MIT Press.
- Rhodes, C.J. and Keefe, E.M.J. (2007) 'Social network topology: A Bayesian approach'. *Journal of the Operational Research Society*, 58(12): 1605–11.
- Robins, G. (2009) 'Understanding individual behaviors within covert networks: The interplay of individual qualities, psychological predispositions, and network effects'. *Trends in Organized Crime*, 12(2): 166–87.
- Romans, S.E., Potter, K., Martin, J. and Herbison, P. (2001) 'The mental and physical health of female sex workers: A comparative study'. *Australian and New Zealand Journal of Psychiatry*, 35(1): 75–80.
- Sampson, R.J. (1987) 'Communities and crime', in Michael R. Gottfredson and Travis Hirschi (Eds.), *Positive Criminology*. Beverly Hills, CA: Sage. pp. 91–114.
- Sampson, R.J. (2003) 'The neighborhood context of well-being'. *Perspectives in Biology and Medicine*, 46(3): S53–S64.
- Sampson, R.J. (2004a) 'Networks and neighbourhoods: The implications of connectivity for thinking about crime in the modern city', in Helen McCarthy, Paul Miller and Paul Skidmore (eds), *Network Logic: Who Governs in an Interconnected World?* London, UK: Demos. 157–66.
- Sampson, R.J. (2004b) 'Neighbourhood and community: Collective efficacy and community safety'. *New Economy*, 11: 106–13.
- Sampson, R.J. (2006a) 'How does community context matter? Social mechanisms and the explanation of crime rates', in Per-Olof Wikström and Robert J. Sampson (Eds.), *The Explanation of Crime: Context, Mechanisms, and Development*. Cambridge, UK: Cambridge University Press. pp. 31–60.
- Sampson, R.J. (2006b) 'Collective efficacy theory: Lessons learned and directions for future inquiry', in Francis T. Cullen, John Paul Wright and Kristie R. Blevins (eds), *Taking Stock: The Status of Criminological Theory*. Vol. 15. New Brunswick, NJ: Transaction. pp. 149–67.
- Sampson, R.J., Raudenbush, S.W. and Earls, F. (1997) 'Neighborhoods and violent crime: A multilevel study of collective efficacy'. *Science*, 277(5328): 918–24.
- Sarnecki, J. (1990) 'Delinquent networks in Sweden'. *Journal of Quantitative Criminology*, 6(1): 31–50.

- Sarnecki, J. (2001) *Delinquent Networks: Youth Co-offending in Stockholm*. Cambridge: Cambridge University Press.
- Sarnecki, J. (2004) 'Girls and boys in delinquent networks'. *International Annals of Criminology*, 42: 29–57.
- Sarnecki, J. (2009) 'Delinquent networks: youth co-offending', in Hans Joachim Schneider (ed.), *Internationales Handbuch der Kriminologie*. Vol. 2. Berlin: Walter de Gruyter. pp. 995–1023.
- Schreck, C.J., Fisher, Bonnie S. and Miller, J.M. (2004) 'The social context of violent victimization: A study of the delinquent peer effect'. *Justice Quarterly*, 21: 23–47.
- Schroeder, R.D., Giordano, P.C. and Cernkovich, S.A. (2007) 'Drug use and desistance processes'. *Criminology*, 45(1): 191–222.
- Schwartz, D.M. and Rouselle, T. (2009) 'Using social network analysis to target criminal networks'. *Trends in Organized Crime*, 12(2): 188–207.
- Shaw, C.R. and McKay, H.D. (1931) *Social Factors in Juvenile Delinquency. Report on the Causes of Crime*. Vol. II. Washington, DC: National Commission on Law Observance and Enforcement.
- Shaw, C.R., Zorbaugh, F.M., McKay, H.D. and Cottrell, L.S. (1929) *Delinquency Areas*. Chicago: University of Chicago Press.
- Shih, H.-Y. and Chang, T.-L.S. (2009) 'International diffusion of embodied and disembodied technology: A network analysis approach'. *Technological Forecasting and Social Change* 76: 821–34.
- Shivy, V.A., Wu, J.J., Moon, A.E., Mann, Shay C., Holland, J.G. and Eacho, C. (2007) 'Ex-offenders reentering the workforce'. *Journal of Counseling Psychology*, 54(4): 466–73.
- Shoemaker, D.J. (2005) *Theories of Delinquency*. 5th ed. New York: Oxford University Press.
- Short, J.F., Jr. and Strodtbeck, F.L. (1965) *Group Process and Gang Delinquency*. Chicago, IL: University of Chicago Press.
- Skeem, J., Louden, J.E., Manchak, S., Vidal, S. and Haddad, E. (2009) 'Social networks and social control of probationers with co-occurring mental and substance abuse problems'. *Law and Human Behavior*, 33(2): 122–35.
- Smith, M.N. and King, P.J.H. (2002) 'Incrementally visualising criminal networks'. Proceedings of the Sixth International Conference on Information Visualisation, 2002.
- Snijders, T.A.B. and Baerveldt, C. (2003) 'A multilevel network study of the effects of delinquent behavior on friendship evolution'. *Journal of Mathematical Sociology*, 27(2–3): 123–51.
- Sommers, I., Baskin, D.R. and Fagan, J. (1994) 'Getting out of the life – crime desistance by female street offenders'. *Deviant Behavior*, 15(2): 125–49.
- Soudijn, M.R.J. and Kleemans, E.R. (2009) 'Chinese organized crime and situational context: Comparing human smuggling and synthetic drugs trafficking'. *Crime, Law and Social Change*, 52: 457–74.
- Sparrow, M.K. (1991a) 'The application of network analysis to criminal intelligence – An assessment of the prospects'. *Social Networks*, 13(3): 251–74.
- Sparrow, M.K. (1991b) 'Network vulnerabilities and strategic intelligence in law enforcement'. *International Journal of Intelligence and Counterintelligence*, 5(3): 255–74.
- Spaulding, C.B. (1948) 'Cliques, gangs and networks'. *Sociology and Social Research*, 32: 928–37.
- Spergel, I.A. (1990) 'Youth gangs: Continuity and change', in Michael Tonry and Norval Morris (eds), *Crime and Justice: A Review of Research*. Vol. 12. Chicago: University of Chicago Press. pp. 171–275.
- Stovin, G. and Davies, C. (2008) 'Beyond the network: A crime science approach to organized crime'. *Policing*, 2(4): 497–505.
- Sung, H.E., Belenko, S., Feng, L. and Tabachnick, C. (2004) 'Predicting treatment noncompliance clients: A theoretical and among criminal justice-mandated empirical exploration'. *Journal of Substance Abuse Treatment*, 26(1): 315–28.
- Surtees, R. (2008) 'Traffickers and trafficking in Southern and Eastern Europe: Considering the other side of human trafficking'. *European Journal of Criminology*, 5(1): 39–68.
- Sutherland, E.H. (1939) *Principles of Criminology*. 3rd ed. Philadelphia, PA: Lippincott.
- Sutherland, E.H., Cressey, D.R. and Luckenbill, D.F. (1992) *Principles of Criminology*. 11th ed. Dix Hills, NY: General Hall.
- Sweetser, F.L., Jr. (1942) 'A new emphasis for neighborhood research'. *American Sociological Review*, 7: 525–33.
- Thornberry, T.P. (1987) 'Toward an interactional theory of delinquency'. *Criminology*, 25(4): 863–91.
- Tremblay, P. (1993) 'Searching for suitable co-offenders', in Ronald V. Clarke and Marcus Felson (Eds.), *Routine Activity and Rational Choice. Advances in Criminological Theory*. 5: 17–36.
- Triplett, R.A., Gainey, R.R. and Sun, I.Y. (2003) 'Institutional strength, social control and neighborhood crime rates'. *Theoretical Criminology*, 7(4): 439–67.
- Tsvetovat, M. and Carley, K. (2007) 'On effectiveness of wiretap programs in mapping social networks'. *Computational and Mathematical Organization Theory*, 13(1): 63–87.
- Tutzauer, F. (2007) 'Entropy as a measure of centrality in networks characterized by path-transfer flow'. *Social Networks*, 29: 249–65.
- Valente, T.W. (1995) *Network Models of the Diffusion of Innovations*. Cresskill, NJ: Hampton Press.
- van de Bunt, H. (2008) 'A case study on the misuse of hawala banking'. *International Journal of Social Economics*, 35(9): 691–702.
- van der Hulst, R.C. (2009) 'Introduction to Social Network Analysis (SNA) as an investigative tool'. *Trends in Organized Crime*, 12(1): 101–21.
- van der Poel, A. and van de Mheen, D. (2006) 'Young people using crack and the process of marginalization'. *Drugs-Education Prevention and Policy*, 13(1): 45–59.
- van Koppen, M.V., de Poot, C.J., Kleemans, E.R. and Nieuwbeerta, P. (2010) 'Criminal trajectories in organized crime'. *British Journal of Criminology*, 50: 102–23.

- van Mastrigt, S.B. (2008) *Co-Offending: Relationships with Age, Gender and Crime Type*. Ph.D. thesis. University of Cambridge.
- von Lampe, K. (2009) 'Human capital and social capital in criminal networks: introduction to the special issue on the 7th Blankensee Colloquium'. *Trends in Organized Crime*, 12(2): 93–100.
- von Lampe, K. and Johansen, P.O. (2004) 'Organized crime and trust: On the conceptualization and empirical relevance of trust in the context of criminal networks'. *Global Crime*, 6: 159–84.
- Waring, E.J. (1993) 'Co-offending in white-collar crime: A network approach'. Ph.D. thesis, Yale University.
- Waring, E.J. (2002) 'Co-offending as a network form of social organization', in Elin J. Waring and David Weisburd (eds), *Crime and Social Organization*. Vol. 10. New Brunswick, NJ: Transaction. pp. 31–47.
- Warner, B.D. and Rountree, P.W. (1997) 'Local social ties in a community and crime model: Questioning the systemic nature of informal social control'. *Social Problems*, 44(4): 520–36.
- Warr, M. (1993) 'Age, peers, and delinquency'. *Criminology*, 31(1): 17–40.
- Warr, M. (1996) 'Organization and instigation in delinquent groups'. *Criminology*, 34(1): 11–37.
- Warr, M. (2002) *Companions in Crime: The Social Aspects of Criminal Conduct*. Cambridge, UK: Cambridge University Press.
- Weerman, F.M. and Bijleveld, C. (2007) 'Birds of different feathers: School networks of serious delinquent, minor delinquent and non-delinquent boys and girls'. *European Journal of Criminology*, 4(4): 357–83.
- Weerman, F.M. and Smeenk, W.H. (2005) 'Peer similarity in delinquency for different types of friends: A comparison using two measurement methods'. *Criminology*, 43(2): 499–523.
- White, H.C. (1981) 'Where do markets come from?' *American Journal of Sociology*, 87: 517–47.
- White, H.C. (2002) *Markets from Networks: Socioeconomic Models of Production*. Princeton, NJ: Princeton University Press.
- Whyte, W.F. (1943) *Street Corner Society*. Chicago: University of Chicago Press.
- Wild, T.C., Cunningham, J.A. and Ryan, R.M. (2006) 'Social pressure, coercion, and client engagement at treatment entry: A self-determination theory perspective'. *Addictive Behaviors*, 31(10): 1858–72.
- Williamson, O.E. (1975) *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Macmillan.
- Xia, M. (2008) 'Organizational formations of organized crime in China: Perspectives from the state, markets, and networks'. *Journal of Contemporary China*, 17(54): 1–23.
- Xu, J. and Chen, H.C. (2003) 'Untangling criminal networks: A case study'. Intelligence and Security Informatics, Proceedings. *Lecture Notes in Computer Science*, vol. 2665. Berlin: Springer-Verlag.
- Xu, J. and Chen, H.C. (2005a) 'Criminal network analysis and visualization'. *Communications of the ACM*, 48(6): 100–107.
- Xu, J. and Chen, H.C. (2005b) 'CrimeNet explorer: A framework for criminal network knowledge discovery'. *ACM Transactions on Information Systems*, 23(2): 201–26.
- Xu, J., Marshall, B., Kaza, S. and Chen, H.C. (2004) 'Analyzing and visualizing criminal network dynamics: A case study'. Intelligence and Security Informatics, Proceedings. *Lecture Notes in Computer Science*, vol. 3073. Berlin: Springer-Verlag.
- Zhang, S.X. (1998) 'In search of hopeful glimpses: A critique of research strategies in current boot camp evaluations'. *Crime & Delinquency*, 44(2): 314–34.
- Zhang, S.X. (2008) *Chinese Human Smuggling Organizations. Families, Social Networks and Cultural Imperatives*. Stanford, CA: Stanford University Press.
- Zhang, S.X. and Gaylord, M.S. (1996) 'Bound for the Golden Mountain: The social organization of Chinese alien smuggling'. *Crime Law and Social Change*, 25: 1–16.