INFLUENCE AND SELECTION PROCESSES IN WEAPON CARRYING DURING ADOLESCENCE: THE ROLES OF STATUS, AGGRESSION, AND VULNERABILITY*

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The role of peers in weapon carrying (guns, knives, and other weapons) inside and outside the school was examined in this study. Data stem from a longitudinal study of a high-risk sample of male students (7th to 10th grade; N = 167) from predominantly Hispanic low-socioeconomic-status schools in the United States. Longitudinal social-network models were used to test whether similarity in weapon carrying among friends results from peer influence or selection. From a goal-framing approach, we argue that weapon carrying might function as a status symbol in friendship networks and, consequently, be subject to peer influence. The findings indicate that weapon carrying is indeed a result of peer influence. The role of status effects was supported by findings that weapon carrying increased the number of friendship nominations received by peers and reduced the number of given nominations. In addition, peer-reported aggressiveness predicted weapon carrying 1 year later. These findings suggest that adolescent weapon carrying emerges from a complex interplay between the attraction of weapon carriers for affiliation, peer influence in friendship networks, and individual aggression.

The presence of weapons inside and outside of schools represents a serious threat to the lives and safety of adolescents. Both in the United States and Europe, weapon carrying increases the health risks for adolescents and their environment (Pickett et al., 2005). In the United States, homicide is the second leading cause of mortality for people between 15 and 24 years of age, and it is the leading cause of death for African American and Hispanic youth (CDC, 1999; Kochanek and Hudson, 1992). A necessary precondition for weapon use is having ready access to a weapon, particularly carrying one. In Western countries, the percentages of adolescents that carried a weapon in the previous 30 days was highest in the United States (21 percent) but still was sizable in European countries, which varied between 10 percent (Belgium) and 17 percent (Portugal) (Pickett et al., 2005).

For weapon carrying, adolescents must first have the opportunity to obtain weapons. At least in the United States, access to knives and even firearms does not seem to be a high hurdle (Sorenson and Vittes, 2004; Vaughan et al., 1996). When given access to weapons, what motivates adolescents to carry them? Barlas and Egan (2006: 67) summarized their research by stating that "the only firm conclusion that can be drawn is that weapon carrying is driven by several motivations." The most prominent reason for weapon carrying suggested in the literature is to be part of a delinquent lifestyle or to respond defensively to threats in the environment (Webster, Gainer, and Champion, 1993). Empirical evidence supports both explanations. Weapon carrying has been related to different

problem behaviors, such as delinquency, aggression, and vandalism; the use of cigarettes, alcohol, and drugs (Bailey, Flewelling, and Rosenbaum, 1997; Barlas and Egan, 2006; Durant et al., 1999; Estell et al., 2003; Kingery, Coggeshall, and Alford, 1999; Kulig et al., 1998; Simon et al., 1998); as well as different indices of threats such as victimization, fearfulness, and self-protection (Arria, Borges, and Anthony, 1997; Goldstein, Young, and Boyd, 2008; Kingery, Pruitt, and Heuberger, 1996; Martin et al., 1996; Rudatsikira et al., 2007). Although in the current study the influence of aggression and vulnerability (victimization) as two aspects that best represent both explanations were taken into account, our main focus was on the effect of peers on weapon carrying.

In criminological research, the study of peer influence dates back to the earliest work of Sutherland (1947). Building on his work, Burgess and Akers (1966) specified different mechanisms that underlie the processes of peer influence. They stated that socialization in peer groups emerges from the imitation of behavior, positive and negative behavior reinforcement by peers, and definitions that evaluate behavior in terms of good and bad (Burgess and Akers, 1966; see also Akers et al., 1979). Similarly, it has been argued that peers who carry weapons serve as role models for this behavior, which in turn affects attitudes and perceived norms among peers (Bailey, Flewelling, and Rosenbaum, 1997; Myers et al., 1997). This modeling process is thought to influence the beliefs of adolescents that weapon carrying is accepted or even expected (Bailey, Flewelling, and Rosenbaum, 1997).

It is, however, premature to conclude that the similarity between the weapon carrying of an individual and the weapon carrying of his or her peers results from the socializing influence of peers because this claim has not been tested appropriately. The biggest threat to this conclusion is that, in many studies aimed at evaluating similarity in weapon carrying, cross-sectional correlational designs were used (e.g., Myers et al., 1997; Williams et al., 2002), thus, limiting inferences in regard to the direction of effects (for a similar argument, see Steinman and Zimmerman, 2003). An equally plausible alternative interpretation of similarity in the weapon carrying of adolescent friends is that adolescents select others as friends based on whether they too carry (or do not carry) weapons. This idea that delinquency precedes friendship selection and, consequently, the idea that similarity among peers emerges from a selection process also have been advocated for other forms of delinquency (Glueck and Glueck, 1950; Gottfredson and Hirschi, 1990).

Similarity in weapon carrying among friends, therefore, might result from weapon-carrying behavior prior to the formation of friendship ties (i.e., selection) rather than as a result of peer influence. Only longitudinal data can allow for these dynamic processes of influence and selection to be

adequately tested (Valente, 2003). Peer influence would be indicated when friends remain the same but behavior changes. Selection processes would be implicated by the reverse pattern—behavior stays the same, but friends change.

For weapon carrying, the two processes never have been tested simultaneously. Whether peer influence is involved is critical to understanding the proliferation of weapon-carrying behavior, and, consequently, to designing interventions. If in the context of peer friendships, youths imitate others with regard to weapon carrying (i.e., influence), then peers will be a major factor in the proliferation of—and, correspondingly, intervention efforts for reducing—this phenomenon. However, if similarity in weapon carrying among friends primarily results from preexisting tendencies of individuals to carry weapons prior to friendship formation (i.e., selection), then interventions that target influence processes are unlikely to be beneficial in reducing weapon carrying.

Although influence and selection processes represent competing explanations for behavioral similarity, they are not mutually exclusive. The findings of several studies on delinquency have shown that both processes often operate simultaneously (Haynie, 2001, 2002; Krohn et al., 1996; Matsueda and Anderson, 1998). In several of these studies, a social-network perspective was used, which takes into account the social-network conditions and relationships between individuals to examine the relative contribution of peers' delinquency on the delinquency of adolescents (e.g., Aseltine, 1995; Haynie, 2001, 2002; Kandel, 1978). For example, Haynie (2002) showed that the proportion of delinquent friends was predictive for delinquency across time rather than the total number of delinquent friends. The incorporation of a social-network perspective in the study of peer delinquency has enhanced our knowledge about how the delinquency of adolescents is related to the delinquency of peers. However, conclusions about the extent to which selection or influence accounts for delinquency in peer networks have been limited by the fact that, until recently, statistical techniques to test for influence and selection effects in regard to problem behaviors suffered several limitations (Steglich, Snijders, and Pearson, 2010).

First, changes in behavior and friendships that occur between two time points were not modeled in previous statistical models. Specifically, feedback processes between the dynamics of behavior and selection, which are unobserved between two measurement points, were not controlled for in previous models. For example, at an initial time point, individual A might consider person B as a friend. If at time point two, A has changed his behavior to be similar to B, this change is considered as influence. However, what happened between the two time points is unobserved and, therefore, unclear. It is possible that, after the initial friendship between B

and A, the relationship ended, and A changed his behavior in the absence of a relationship with B. After he has changed his behavior, A might again form a friendship with B, which is observed at the second time point. Based on the two observations, changes in the behavior of individual A are attributed to the friendship with individual B and, as such, are considered to result from influence. However, as is clear in this example, the change in behavior occurred when the relationship between A and B was absent. As a consequence, the influence of B on the behavior of A likely is to be overestimated. Therefore, a true test of influence and selection effects should take such unobserved changes into account to avoid overestimation of both effects.

A second limitation of previous models is their failure to control for the effect of the network structure on changes in behavior and relations. Several structural network effects are known to play a role in friendship formation and influence processes, such as network reciprocity, transitivity, and density (Steglich, Snijders, and Pearson, 2010). These structural network effects could affect estimates of influence and selection processes with regard to a particular outcome. For example, it is widely known that friendships are more likely to be established when individuals share a common friend (transitivity) (Davis, 1970). Therefore, transitivity (i.e., friends of my friends are my friends), rather than similarity in weapon carrying, might account for friendship formation between individuals A and B. Specifically, the likelihood of a relationship between A and B increases when both share the same friend C. Not controlling for such structural network tendencies in the analyses easily leads to overestimation of selection effects, which, in turn, affects the influence estimates by failing to rule out selection effects with a statistically sound method (Steglich, Snijders, and Pearson, 2010).

A third limitation of previous models is the failure to account fully for the interdependence of actors in the network, which violates the assumption of independence in observations made using traditional statistical models (Steglich, Snijders, and Pearson, 2010). The unraveling of influence and selection effects requires data that include not only information from the point of view of the individual (ego networks) but also information from the others in the network (complete networks). However, complete networks that contain information from all individuals in the network, and their relations as well as their behaviors, are not independent. Independence, however, often is assumed in traditional statistical techniques because they rely on randomly sampled data to make population inferences. The violation of the independence of observations can lead to biases in the estimates and errors in inferential conclusions. Collectively, these shortcomings of traditional data analytic approaches challenge

extant conclusions about influence and selection processes in regard to problem behaviors in peer networks.

To our knowledge, the current study is the first in which these shortcomings that examine the role of peers in regard to weapon carrying were overcome. To achieve this result, we used a stochastic actor-based model to analyze network and behavior dynamics simultaneously. In the Simulation Investigation for Empirical Network Analyses (SIENA) software package, influence and selection effects on behavior (here, weapon carrying) are estimated simultaneously and separated in a methodologically sound way by accounting for the mentioned shortcomings (Snijders, Steglich, and Schweinberger, 2007; Steglich, Snijders, and Pearson, 2010). First, estimates were based on a simulation procedure in SIENA in which unobserved changes between time points are modeled. Second, structural network indices (e.g., reciprocity, transitivity, and density) in SIENA were taken into account, which for the reasons given yielded more reliable estimates for selection and influence. Third, the violation of independence of observations is controlled for in SIENA by examining complete networks.

To examine peer influence and selection effects on weapon carrying, we used longitudinal data on weapon carrying and friendship networks in a high-risk male sample of predominantly Hispanic low-socioeconomic-status (SES) adolescents. To control for individual characteristics that have been related to weapon carrying either as a defensive response or as part of a delinquent lifestyle (Webster, Gainer, and Champion, 1993), we also examined the effects of vulnerability (victimization) and aggression on weapon carrying 1 year later.

THEORY

In the study of network and group processes, homophily is often assumed to be the basic mechanism of attraction to others and group formation (Byrne, 1971). This finding would favor the assumption that weapon carriers might select each other as friends (and noncarriers would select other noncarriers as friends). However, findings from a recent study (Dijkstra, Lindenberg, and Veenstra, 2007) support the idea that it is more fruitful to consider goals first and then ask whether goals are served by homophily rather than to assume homophily is a basic human tendency for affiliation. From a goal-framing perspective (Lindenberg, 2006), it was hypothesized that goals influence what people attend to, what knowledge is activated, how people evaluate things, and how they process information. In this regard, behaviors and characteristics of others are evaluated in the light of their contribution to the goal achievement of individuals. From this perspective, the key to understanding attraction to others and their

characteristics is the extent to which affiliation helps a person to achieve important social goals.

Two important goals are the achievement of status and the achievement of affection (Lindenberg, 1996; Ormel et al., 1997). When possible, people will attempt to realize both goals simultaneously. Adolescents also are likely to strive for status in combination with the realization of friendship (affection) (cf. Coleman, 1961; Corsaro and Eder, 1990). To achieve status and affection, it may be useful to choose as friends higher status peers rather than peers of equal status. Affiliation with higher status peers can elevate one's own status, which is referred to as "basking in reflected glory" (Cialdini and Richardson, 1980). Empirical support comes from the findings of ethnographic studies (Adler and Adler, 1998; Eder, 1985; Short and Strodtbeck, 1963) as well as empirical research (Dijkstra et al., 2010a), which showed that the more closely adolescents affiliate with high-status peers, the higher their own status. Yet, those who are admired by peers also influence what behaviors are imitated (e.g., Cohen and Prinstein, 2006). Not only does imitation increase the chances of affiliation with high-status peers and decrease the chances of exclusion from their "inner circle," but imitation of "successful" status behavior also is likely to enhance a person's own status (Adler and Adler, 1998; Eder, 1985).

Higher status peers could advance their own status and affection by choosing, in addition to other high-status friends, some friends from lower ranks and by impressing them by engaging in forbidden and potentially dangerous behavior (Harris Survey, 1993; MORI, 2003). Particularly in adolescence, risky or delinquent behaviors that emphasize maturity and adultness have been related to status among peers (Allen, Weissberg, and Hawkins, 1989; Bukowski, Sippola, and Newcomb, 2000; Dijkstra et al., 2009; Moffitt, 1993). It has been argued that engagement in these behaviors can help adolescents bridge the gap between biological maturation and being considered socially as an adult (Luthar and McMahon, 1996; Moffitt, 1993). Adolescents involved in these risky delinquent behaviors, therefore, seem (at least to peers) to bridge this maturity gap successfully, which in turn enhances their status with peers.

For adolescents from disadvantaged backgrounds (as in our sample of predominantly low-SES, Hispanic students), who are more likely to be subjected to structural criminogenic conditions such as having witnessed serious violence and as having increased chances of being members of a gang (McNulty and Bellair, 2003), the relation between delinquency and status might be enhanced by and intertwined with masculine norms that emphasize toughness, daring, and gaining respect (Anderson, 1999; Warr, 2002). These disadvantaged youth might experience difficulties in gaining

status through legitimate means, for instance, through academic performance (Merton, 1938; see Steinberg, Dornbusch, and Brown, 1992). Tentative evidence comes from the findings of studies showing that weapon carrying is related to skipping school (Kulig et al., 1998; Simon et al., 1998) as well as to various kinds of problematic behavior, such as aggressiveness; vandalism; early initiation of sex; being arrested; using alcohol, cigarettes, and drugs; selling drugs; and gang membership (Bailey, Flewelling, and Rosenbaum, 1997; Barlas and Egan, 2006; Black and Ricardo, 1994; Callahan and Rivara, 1992; Durant et al., 1995; Kulig et al., 1998; McNabb et al., 1996; Sheley, 1994; Valois and McKeown, 1998).

Consequently, weapons can be one way to gain status among befriended peers (cf. Anderson, 1999; Myers et al., 1997). Higher status peers can impress lower status peers by carrying weapons; the latter can impress higher status peers by daring them to carry weapons too and, consequently, enhance their own status among befriended peers. If so, status achievement by carrying a weapon might function as a reward that not only reinforces weapon carrying across time but also evokes imitation processes in others (Akers, 1985). As such, status enhancement through delinquency is an important mechanism responsible for the proliferation of delinquency among peers, in general (Warr, 2002), and is important for weapon carrying, in particular.

The status effect of carrying weapons derives also from the risky and dangerous nature of the behavior (especially in the context of recent zero-tolerance polices for in-school weapon carrying). As a consequence, weapon carrying is likely not to be advertised widely but kept to an inner circle (cf. Ash et al., 1996). Because adolescent weapon carrying is illegal, weapon carriers are likely to keep it out of sight from others and only display this behavior in close friendship networks. The implication of this behavior is that (status- and affection-related) peer influence on weapon carrying should thrive in contexts with fairly closed friendship networks. Friendship networks, therefore, should be characterized by high levels of reciprocity and transitivity, which suggests close, dense friendship networks.

If these conjectures are true, then weapon carrying should be subject to friendship influence. Therefore, our primary hypothesis in this study was that weapon carrying was subject to the influence of friends. Conversely, we hypothesized that similarity in weapon carrying among befriended peers was not from mutual selection of peers who carry weapons (i.e., selection effects with regard to weapon carrying are not likely).

If the influence mechanism is indeed from the simultaneous realization of status and affiliation goals, and if weapon carrying is a status symbol, then weapon carrying should have four other distinct effects as well. First,

because of imitation, weapon carrying should increase in friendship networks with weapon carriers. In line with this implication, the findings of a study by Williams, Mulhall, Reis, and DeVille (2002) showed that weapon carrying was more likely when adolescents affiliated with peers who considered weapon carrying "cool" than when they affiliated within peer groups where weapon carrying was absent. In these latter peer groups, it is plausible that weapon carrying is less likely to function as a status symbol, and the proliferation of weapons is, therefore, less likely. This reasoning implies that weapon carrying proliferates particularly in friendship networks with some initial weapon carriers.

Second, weapon carrying should affect positively the number of "best-friend" nominations a person receives because if weapon carrying is associated with higher status, then it could make an adolescent more attractive to others as a potential friend. Third, weapon carrying should affect negatively the best-friend nominations an adolescent gives to others because high-status adolescents are more discriminating in friendship choices (Adler and Adler, 1998; Eder, 1985).

Fourth, if friendship influence on weapon carrying operates through the combination of status and affection, then it is not likely to be the result of protective measures (e.g., carrying a weapon to prevent oneself from being bullied). It has been argued that adolescents might be motivated to carry a weapon to protect themselves, avoid vulnerability, and cope with feelings of unsafeness and fearfulness (Arria, Borges, and Anthony, 1997; Durant et al., 1999; Kingery, Pruitt, and Heuberger, 1996; McNabb et al., 1996; Rudatsikira et al., 2007). Although this reasoning might be a defensive rationalization of those who carry weapons, it is not likely to be the cause if our argumentation about status and affection effects is correct. Thus, to the degree that individual characteristics play a role, we expected (in line with the findings of other studies—Durant et al., 1995; Webster, Gainer, and Champion, 1993) that it would be aggressiveness rather than vulnerability (here, victimization) that feeds the likelihood of carrying weapons.

THE STUDY

To our knowledge, the current study is the first to examine simultaneously the extent to which weapon carrying among adolescents results from an influence, selection process, or both. To test these processes, we used longitudinal data on weapon carrying and friendship networks in a high-risk male sample of predominantly Hispanic low-SES adolescents. We focused on boys only because they are more likely to carry weapons than girls (Bailey, Flewelling, and Rosenbaum, 1997; Kulig et al., 1998; Pickett et al., 2005; Rudatsikira et al., 2007; Steinman and Zimmerman, 2003; Valois et al., 1995). Because weapon carrying inside and outside the school

have been related to the same underlying etiology (Rountree, 2000), we included weapon carrying (guns, knives, and other weapons) irrespective of the context. We used social-network analyses in the SIENA program (Snijders, Steglich, and Schweinberger, 2007; see also Snijders, 2001, 2005), which allowed us to unravel the unique effects of influence and selection effects on the weapon carrying of adolescents.

METHOD

PARTICIPANTS

Participants in this longitudinal study were recruited from two middle schools that fed into one high school located in New Jersey close to New York City. The three schools served primarily low-income minority students. Based on a composite indicator of SES that took into account census information about the 1) percentage of population with no high-school diploma, 2) percentage with some college education, 3) occupation, 4) population density, 5) income, 6) unemployment, and 7) poverty, the New Jersey Department of Education ranked the area where the three schools were located as the second-lowest SES grouping in the state. This sample also was selected based on risk. The schools in our sample were predominantly populated by low-SES Hispanic youth, who are more likely to carry weapons and to experience weapon-related threats than non-Hispanic and high-SES youth (Callahan and Rivara, 1992; Price, Desmond, and Smith, 1991).

Time 1 assessments of weapon carrying (and other measures) began when the participants were in the spring semester of grades 7, 8, and 9. Time 2 assessments occurred 1 year later during the spring when the participants were in grades 8, 9, and 10. The students attended two different middle schools for grades 7 and 8 and then attended a single high school for grades 9 and 10, which resulted in five networks at time 1 and four networks at time 2. At time 1, the 7th-grade students had two networks—one for each middle school—and two for 8th-grade students. The fifth network was for the 9th graders, who were already in high school. Time 2 also had two networks—one in each middle school—for the 8th graders. However, now the 9th- and the 10th-grade students each formed one network. Consequently, they could nominate each other as best friends.

The longitudinal sample consisted of boys for whom information existed about best-friend nominations and weapon carrying for at least one time point. The SIENA program allows for the inclusion of cases with missing data by minimizing their influence on the estimation of results (Huisman and Steglich, 2008). At time 1, the target sample consisted of 207 male participants. Information on best-friend relationships and weapon carrying for at least one time point was available for 167 male participants. For

three boys (2 percent) at time 1, and for 29 boys (17 percent) at time 2, information about weapon carrying was missing. Attrition analyses revealed that participants with missing weapon-carrying information from one time point did not differ from respondents with complete weapon-carrying data [t (165) = 1.37, p = .17 at time 1; t (165) = .73, p = .47 at time 2], aggression [t (165) = .27, p = .79], or victimization [t (165) = .82, p = .41]. For the best-friend nominations, information for one respondent was missing at time 1; information for 30 respondents was missing at time 2. This latter group did not differ significantly in their level of weapon carrying from other respondents at time 1 [t (162) = .83, p = .41].

PROCEDURE

At both waves, all students were given a letter to take to their parents that described the study and asked for active consent to participate in the study (for the student to participate, the parents had to sign and return the consent form). In addition, respondents were asked to sign an assent form, which provided a written description of the study. The participants also were informed that, at any time during the administration of the questionnaires, they were free to leave questions unanswered or to discontinue participation entirely. Parents and participants were assured that all responses were completely confidential and that participants would not be identified in any way. Participants were administered preslugged (i.e., preassigned identification numbers without any other identifying information) questionnaires to ensure confidentiality. Parental consent and child assent were required to participate in data collection at time 2, and identical procedures were maintained to ensure confidentiality. In total, 18 percent of all male students did not provide consent to participate, which resulted in an initial target sample of 209 male participants.

The measures were administered at school in small groups of about ten participants that lasted approximately 55 minutes each. Questions were read aloud by trained graduate research assistants while the children read along and marked their responses. Two trained research assistants conducted the testing sessions, which provided a context in which students were attentive to the task at hand and behavioral disruptions were minimized. At the beginning of each session, children were asked specifically whether they preferred a Spanish version of the questionnaires (none requested a Spanish version). The participants were assured of the confi-

dentiality of their responses and were given a small token of appreciation following the completion of the measures (a gift certificate for a local restaurant).

MEASURES

Weapon Carrying

Participants were asked to indicate the number of times they carried a gun, knife, or other weapon (like box cutters or brass knuckles) each in the previous 60 days. For all three weapons, questions were asked about in-school as well as out-of-school weapon carrying. These questions were identical for the time 1 and time 2 assessments. The number of times participants carried each of the three types of weapons were summed to yield a frequency of weapon-carrying scores for each wave. Internal reliabilities were high, with Cronbach's alpha coefficients of .73 for time 1 and .81 for time 2. Because the SIENA program requires the dependent behavioral variable to be a discrete ordinal scale, we constructed the following five categories of weapon carrying: never, 1 time, 2–5 times, 6–9 times, and 10 or more times (see also table 1 and table 2).

Best Friends

Participants were provided with a list of all same-gender peers in their grade and asked to nominate their best friends. The number of nominations was unlimited. Descriptive statistics showed that the average number of friends (either asymmetrical or mutual) was 18.22 at time 1 and 15.87 at time 2. The density of the network, calculated using the number of relations relative to the total number of all possible relations, was similar for both measurement points (.11 and .10, respectively; see table 1). Descriptive statistics with regard to changes in best-friend relations showed that 1,610 best-friend nominations remained stable between time 1 and time 2 (not presented here). Furthermore, in 896 cases, best-friend nominations were given at time 1 but were absent at time 2 (desisting relations). The reverse pattern (emergent relations) was found for 847 relations. For all friendship networks (as mentioned), matrices were composed, which contained information on whether a best-friend relation was absent (zero) or present (one). These different networks were taken together in one matrix separated by structural zeros (to indicate that members of the different networks could not nominate each other as a friend). Using one overall matrix that contained all different networks as input for the SIENA program allows for the simultaneous estimation of parameters for all networks, which renders aggregation of the estimates of the individual networks unnecessary (Snijders, Steglich, and Schweinberger, 2007).

Aggression and Victimization

A peer-nomination inventory was used to assess both aggression and vulnerability, which was operationalized as victimization. Several questions allowed respondents to nominate an unlimited number of same-sex peers in their grade with regard to aggression and victimization. Aggression was based on the number of nominations respondents received on the following three items: "He hits and pushes others around" (M = .95; standard deviation (SD) = 1.26); "he makes fun of people" (M = 1.75; SD = 1.66); and "he's just plain mean" (M = .37; SD = .77). The internal consistency of the aggression scale was .67. For victimization, the following items were used: "He gets picked on by other kids" (M = .83; SD = 1.15); "he gets hit and pushed by other kids" (M = .83; SD = 1.11); and "kids make fun of him" (M = 1.23; SD = 1.37). For victimization, the internal consistency was .84. After the individual items were standardized by school, grade, and gender, scores were summed up and divided by the number of items. This resulted in a mean score of .07 (SD = .07) on the aggression scale and .07 (SD = .08) on the vulnerability scale (see table 1). Contrary to the dependent behavioral variable (i.e., weapon carrying), which is required to be a discrete ordinal variable, individual predictors in the SIENA program are allowed to be continuous measures. Because both scales were based on aggregated scores across multiple respondents, no data were missing for either aggression or victimization. Reliability of the peer nomination scales was uniformly high. Even single-item, peer-nomination scales tended to be remarkably high (Coie, Dodge, and Kupersmidt, 1990).

Table 1. Descriptive Statistics for Network and Individual Characteristics (N = 167)

	Time 1	Time 2
Network Characteristics		
Density	.11	.10
Average degree	18.22	15.87
Number of ties	3,020	2,494
Individual Characteristics[a]		
Weapon carrying	1.72 (1.13)	1.85 (1.45)
Aggression	.07 (.07)	—
Victimization	.07 (.08)	—

[a]Mean. Standard deviation in parentheses.

STATISTICAL ANALYSES

For the analyses, we used the SIENA program.[1] SIENA was used to estimate an actor-based model for the coevolution of networks and behaviors across time (Snijders, Steglich, and Schweinberger, 2007) and to carry out the statistical estimation of a stochastic actor-based model of network dynamics (Snijders, 2001, 2005). The model expressed that, in response to the current network structure and the current behavior of other individuals in the network, individuals can change either their network ties (here, make a new friend or break a relationship) or their behavior (here, increase or decrease weapon carrying) between two time points. Influence effects manifest themselves in behavior change; selection effects show up in changes of network ties. It was assumed that changes might occur continuously between discrete time points. A simulation procedure was used to estimate the likelihood of changes in behavior as well as networks in response to the current network structure and behavior of others. Estimates were derived from iterative simulations within a Markov chain Monte Carlo (MCMC) approach (Snijders, 2005; Snijders, Steglich, and Schweinberger, 2007).

To estimate parameters using the model, likely developmental trajectories were imputed between time points; the information from time 1 was used as a starting point. These estimates were based on transition probabilities between probable states in the state space of possible network and behavior combination configurations. Estimates indicated the probability of specific change patterns for both individual behaviors and network relations, given the observed data.

Within the SIENA program, the estimation of behavioral changes (changes in the dichotomous or discrete ordinal variables) and network changes (changes in the dichotomous variable reflecting the absence or presence of a relation) were modeled simultaneously—the so-called coevolution of network and behavior. Therefore, the program allowed one to test both selection and influence effects while controlling for the other (Burk, Steglich, and Snijders, 2007; Snijders et al., 2007; Steglich, Snijders, and Pearson, 2010; Steglich, Snijders, and West, 2006).

Analyses in SIENA yielded three types of parameters. First, the parameters of the behavior and network *rate functions* indicated the average

1. SIENA is one of the statistical modules of StOCNET (Boer et al., 2006), a family of statistical programs for social-network analysis. The software programs and respective manuals can be downloaded for free at http://stat.gamma.rug.nl/stochnet/. More information is also available on the SIENA homepage (http://stat.gamma.rug.nl/snijders/siena.html), which provides links to many of the references cited here as well as to other studies in which the models implemented in SIENA are used or described.

number of changes in each. Second, parameters with regard to the network represented both structural network effects and changes in the network (network dynamics). In the current study, we controlled for the simultaneous occurrence of the following three structural effects: 1) *reciprocity*, or the extent to which best-friend choices were reciprocated by the other; 2) *transitivity*, or the tendency of individuals to be friends with the friends of their friends (so-called transitive triplets); and 3) an *outdegree* parameter, which indicated the number of outgoing ties and, therefore, the density of the network. Snijders (2001) recommended taking into account these three structural effects to avoid overestimation of other network-related estimates and influence effects. For example, when a friendship is formed between two weapon carriers through a third shared friend (transitivity), leaving out a transitivity estimate for this friendship selection would incorrectly lead it to be attributed to their weapon carrying.

In addition to these structural network effects, we estimated network dynamics that represented selection effects with regard to weapon carrying. The *effect of weapon carrying on friendship nominations given* indicated the extent weapon carrying influenced the number of best-friend nominations given to peers. Conversely, *the effect of weapon carrying on friendship nominations received* indicated the extent weapon carrying affected incoming ties (being nominated as a best friend by peers). These two parameters were needed to test the hypothesis that the influence effect was related to status. Furthermore, because of the inclusion of these weapon-carrying effects on friendship nominations given and received, the parameter *weapon-carrying selection* gave a more reliable estimate of the extent to which individuals tended to form new friendships with those who were similar with regard to the behavior under investigation (weapon carrying). This effect was used to measure the degree to which closeness of two peers on the weapon-carrying scale affected their friendship and represented the selection effect.

The third set of estimates indicated the extent to which behavior (here, weapon carrying) changed across time, referred to as behavior dynamics. Note that SIENA was developed to examine the simultaneous changes in the network as well as in behavior and, therefore, yielded estimates for changes in both networks and behavior. Behavioral dynamics had three parameters. First, the linear-shape effect indicated the overall response toward high or low values on weapon carrying. A negative parameter would indicate that most respondents scored below the mean on the 5-point scale for weapon carrying; a positive parameter would indicate that most respondents scored above the mean.

Second, we included the quadratic-shape effect, which expressed polarization on the weapon-carrying scale. A positive parameter indicated that responses tended to occur on the extreme ends of the scale, whereas a

negative value suggested that responses were unimodally scattered around the group average (see also Snijders, Van de Bunt, and Steglich, 2010). Together, the linear- and quadratic-shape effects can be interpreted as a curvilinear function, which expresses the result of inclinations and constraints for the possible values of weapon carrying independent of peer effects or other explanatory mechanisms.

The third estimate concerning behavioral dynamics was weapon-carrying influence. This parameter indicated the extent to which participants changed their behavior to minimize the average distance from their friends on the weapon-carrying scale. This parameter represents the influence effect.

Finally, the SIENA program allowed for the inclusion of covariates and their effects on either the network dynamics or the behaviors under investigation. To test our hypothesis that, if weapon carrying is influenced by personal factors, then it is not through vulnerability but aggression, we included the effects of aggression and victimization in the model, and estimated the effects of both variables on changes in weapon carrying. The results of all effects are discussed in more detail in the Results section. Estimation of parameters was based on the methods-of-moments algorithm (Snijders, Steglich, and Schweinberger, 2007).

To facilitate the interpretation of the results, we calculated the exponential function of the estimates. For the similarity effects (i.e., weapon-carrying selection and weapon-carrying influence), we first divided the estimates by the number of answer categories on the weapon-carrying scale minus one. As a result, the odds ratios for these effects reflected the effect of a one unit increase or decrease on the weapon-carrying scale. For the covariates aggression and vulnerability, we first multiplied the estimates by the standard deviation before calculating the exponential function. Consequently, these odds ratios indicated the effect of a 1 standard deviation increase or decrease for aggression and vulnerability on weapon carrying. Because the quadratic-shape effect was not linear, we did not calculate an odds ratio for this particular estimate.

RESULTS

DESCRIPTIVE STATISTICS

From table 2, we see that the prevalence of adolescent weapon carrying was 27.4 percent at time 1 and 30.4 percent at time 2. Although the mean level of weapon carrying seemed to increase across time, this trend was not significant [t (134) 1.47, p = .15]. Although the majority of adolescents did not carry a weapon at either time point, a third of the participants from this sample carried a weapon at least at one time point.

Table 2. Five Categories of Prevalence of Weapon Carrying

Prevalence of Weapon Carrying	Time 1 (N = 164)	Time 2 (N = 138)
0	72.6%	69.6%
1	4.9%	5.8%
2–5	10.4%	8.7%
6–9	2.4%	2.2%
10+	9.8%	13.8%
Total	100.0%	100.0%

Correlational analyses revealed that weapon carrying at time 1 was highly correlated with weapon carrying 1 year later, which indicates that weapon carrying was rather stable across time, $r = .63$, $p <. 05$ (see table 3). Furthermore, we examined the correlations of weapon carrying with aggression and victimization. As is shown in table 3, only aggression correlated significantly with weapon carrying ($r = .31$ at time 1 and .36 at time 2, $p < .05$).

Table 3. Correlations Among Weapon Carrying and Peer-Reported Aggression and Vulnerability

	1	2	3	4
1. Weapon carrying time 1	—			
2. Weapon carrying time 2	.63* (135)	—		
3. Aggression time 1	.31* (164)	.36* (138)	—	
4. Victimization time 1	.03 (164)	–.02 (138)	–.02 (167)	—

NOTES: Correlations based on pairwise selection. *N* is given in parentheses.
*$p < .05$.

SELECTION AND INFLUENCE

Structural Network Effects

The results of the SIENA analyses are presented in table 4. Parameter estimates for the three structural network effects (reciprocity, transitivity, and outdegree) were significant. The positive reciprocity parameter [Estimate (Est.) = 1.43, t (156) = 10.75, $p < .001$] indicated that—all else being equal—best-friend nominations were four times more likely to be reciprocated than unilateral [odds ratio (OR) = 4.20]. The significant transitivity effect [Est. = .02, t (156) = 20.33, $p < .001$] pointed toward the existence of transitive triplets, that is, the social mechanism that friends of friends also

are considered friends [OR = 1.02]. This effect was small, but it is necessary to consider that, in a group, the same friendship typically is embedded in multiple transitive triplets. The negative outdegree parameter [Est. = –1.41, t (156) = –21.84, $p < .001$] indicated that participants on average were more likely to nominate less than half of the total network members as friends (i.e., network density is low) (OR = .24). Together, these parameters show, as expected, that the friendship networks were rather closed.

Table 4. SIENA Results for Weapon Carrying (N = 167)

	Est.	SE	t Value[a]	OR	90% CI
Network Effects					
Rate function	41.813	2.511			
Reciprocity	1.434	.133	10.75***	4.20	(3.37, 5.22)
Transitivity	.024	.001	20.33***	1.02	(1.02, 1.03)
Outdegree	–1.411	.065	–21.84***	.24	(.22, .27)
Network Dynamics					
Effect of weapon carrying on friendship nominations received	.117	.033	3.56***	1.12	(1.06, 1.19)
Effect of weapon carrying on friendship nominations given	–.065	.029	–2.25*	.94	(.89, .98)
Weapon carrying selection	.087	.117	.75	1.02	(.97, 1.07)
Behavior Dynamics					
Rate function	11.732	3.204			
Linear shape	–1.100	.173	–6.36***	.33	(.25, .44)
Quadratic shape[b]	.582	.090	6.43***		
Weapon carrying influence	3.316	1.864	1.78*	2.29	(1.06, 4.93)
Aggression time 1	2.270	1.370	1.66*	1.17	(1.00, 1.37)
Victimization time 1	–.246	1.187	–.21	.98	(.84, 1.15)

ABBREVIATIONS: Est. = Estimate; OR = odds ratio; SE = standard error.

[a] The t values are based on the parameter estimate divided by the standard error. They were not calculated for the rate function because these parameters indicate the extent to which changes have occurred in the network and behavior, respectively. Testing these effects using a t test score implies that the null hypothesis would be that no changes occurred in either the network or the behaviors, which is evidently not the case in our data.

[b] Because the quadratic effect was not linear, we did not calculate an odds ratio for this particular estimate.

*$p < .05$; **$p < .01$; ***$p < .001$ (one-tailed).

Network Dynamics for Weapon Carrying

Analyses of the network dynamics indicated that weapon carrying positively affected the number of incoming nominations, as indicated by the effect of weapon carrying on friendship nominations received [Est. = .12, t (156) = 3.56, $p < .001$]. Conversely, the significant negative effect for friendship nominations given [Est. = –.07, t (156) = –2.25, $p < .05$] revealed that weapon carrying tended to decrease the number of nominations given. Specifically, an increase of one unit on the weapon-carrying scale increased the probability of being chosen as a friend versus not being chosen by 1.12 (or +12 percent), whereas it decreased the overall probability

of nominating peers as best friend by .94 (or –6 percent). Thus, the more adolescents were involved in weapon carrying, the more best-friend nominations they received from peers, but the less they themselves nominated peers as best friend 1 year later. These two effects together support our hypothesis that status effects were involved; weapon carrying increased the number of best friend nominations received, which suggests that weapon carrying was attractive for affiliation, whereas weapon carriers themselves were more selective in giving best-friend nominations. Finally, we found no evidence that weapon carriers tended to select each other as friends [Est. = .09, t (156) = .75, p = .23]. Thus, similarity in weapon carrying among befriended peers cannot be attributed to selection.

Behavioral Dynamics in Weapon Carrying

With regard to the behavioral dynamics, we found a negative linear-shape effect [Est. = –1.10, t (156) = –6.36, $p < .001$; OR = .33], which reflects that weapon carrying was a rather uncommon behavior; that is, most respondents scored below the mean on our scale for weapon carrying. The positive quadratic-shape effect [Est. = .58, t (156) = 6.43, $p < .001$] indicates the polarized nature of weapon carrying. Respondents tended to be extreme rather than moderate (i.e., a respondent either never carried a weapon or carried one often). Furthermore, we found the expected influence effect [Est. = 3.32, t (156) = 1.78, $p < .05$], which suggests that adolescents tended to alter their weapon carrying to resemble more closely the weapon-carrying behavior of their friends. Participants were 2.29 times more likely to make a move toward their friends' weapon-carrying average than not to change their weapon carrying. Taken together, these findings show that adolescents tend to imitate friends who carry weapons. Finally, with regard to personal characteristics, we found that the correlational results were confirmed in this analysis as well; aggression contributed to weapon carrying [Est. = 2.27, t (156) = 1.66, $p < .05$] 1 year later; victimization had no effect [Est. = –.25, t (156) = –.21, $p < .42$].

SUPPLEMENTARY ANALYSES

To test the robustness of our findings, we conducted several additional analyses. First, we tested the same model using three best-friend nominations from a separate limited-choice questionnaire instead of unlimited nominations. The use of a limited-nomination questionnaire, in contrast with the unlimited-choice instrument used in the previous analyses, could identify more explicitly peers who are truly best friends as opposed to more distant friends. This closeness, in turn, might particularly affect the influence processes (see, for example, Card and Hodges, 2006 for evidence that limited-choice friendships are more similar on a target for aggression

measure than unlimited-choice friendships). To this end, we also analyzed the same model using three best-friend nominations. These additional analyses revealed a peer-influence effect comparable with that found using the analyses with unlimited nominations.

We also included an interaction term between reciprocity and influence to see if friendship influence was moderated by whether best-friend nominations were reciprocated. No significant interaction occurred between reciprocity and friendship influence. We also examined differences in grades by including the main effect for grade as well as interaction terms between grade and the friendship influence effect. The results indicated no significant effect of grade and its interaction with friendship influence. Additionally, we tested whether adolescents who received a high number of best-friend nominations were more likely to carry weapons, which was not the case. Finally, to see whether the nonsignificant finding for vulnerability could be attributed to the use of peer-reported victimization, we also correlated weapon carrying with self-reported victimization (which might better capture self-perceived vulnerability than external reports of victimization; see Card and Hodges, 2008). No significant association was found between self-reported victimization and weapon carrying at either time 1 ($r = -.04$, $p = .66$) or time 2 ($r = -.14$, $p = .12$).

DISCUSSION

The central aim of this study was to examine peer influence on weapon carrying by adolescents. Prior research has shown that adolescent weapon carrying is related concurrently to the weapon carrying of friends (Bailey, Flewelling, and Rosenbaum, 1997; Harris Study, 1993; MORI, 2003; Myers et al., 1997). From these findings, it has been argued that weapon carrying is influenced by peers. However, an alternative explanation of these prior findings is that similarity in weapon carrying is instead the result of a selection process, in which weapon carriers tend to select each other as friends (and noncarriers select other noncarriers as friends). This explanation implies that behavior stays similar, but friends change; explanations based on peer influence indicate the reverse pattern (friends stay similar, but behavior changes). Ruling out selection as an alternative explanation requires longitudinal data on both friendship networks and behaviors (i.e., weapon carrying), and statistical techniques that enable these processes to be modeled simultaneously. Both requirements were met in this study. This study is the first to test whether similarity in weapon carrying among adolescents indeed should be attributed to peer influence, as suggested by the findings of prior research, or is instead a consequence of peer selection.

Our primary hypothesis was that weapon carrying among befriended peers is subject to friendship influence rather than to a selection process in which weapon carriers select each other as friends. We arrived at this hypothesis on the basis of a theory in regard to the influence of goals (Lindenberg, 2001, 2006) on affiliation processes. Adolescents are likely to try to combine the achievement of status with the realization of friendship (affection). When higher status peers carry weapons, low-status adolescents can impress them by daring to carry weapons too, which suggests that weapon carrying, once accepted, is likely to become a status symbol.

This reasoning favors an influence effect and goes against a direct-selection effect, which states that those who carry weapons flock together. The results of our study showed that peers indeed influenced the weapon carrying of adolescents; no support was found for the selection mechanism. Additional support for our hypothesized influence source, the status effect, came from findings that weapon carrying increased the number of best-friend nominations received and decreased the number of best-friend nominations given. Furthermore, it seemed that these processes occurred when the significant structural network effects of reciprocity, transitivity, and outdegree were controlled for. The importance of including these structural network effects is twofold. Controlling for these network effects results in a more reliable selection effect estimation by ruling out structural network conditions known to affect friendship selection. Consequently, the influence effect is more reliable when a true selection effect is controlled for, which is not affected by structural network conditions, as a competing mechanism for similarity in friendship relations.

It sometimes has been argued in the literature that weapon carrying is a defensive measure taken by those who are vulnerable and fear the aggression of others (Arria, Borges, and Anthony, 1997; Durant et al., 1999; Kingery, Pruitt, and Heuberger, 1996; McNabb et al., 1996; Rudatsikira et al., 2007). This argument runs counter to our expectations about status, so we explicitly evaluated vulnerability (operationalized as victimization) and aggression. Vulnerability might be a legitimate rationalization to carry weapons, but in our reasoning, it is not likely to be the mechanism that drives weapon carrying among adolescents. Instead, we expected that if a personal aspect influences this tendency, then aggressiveness is a more likely candidate. By using peer nominations on victimization as an indicator of vulnerability, we minimized the likelihood that the answers would rationalize weapon carrying. The results support the status process. They show that aggressiveness is associated with weapon carrying, whereas vulnerability is not.

Weapon carrying, however, might be an indirect response to threats in the environment. Research has shown that having witnessed and being exposed to violence, such as shootings or stabbings, is related to higher

levels of violence perpetration and increased chances of being a member of a gang (Bingenheimer, Brennan, and Earls, 2005; McNulty and Bellair, 2003). Members of ethnic minorities more often face such disadvantaged community factors that magnify the risk of becoming a victim of violence, which in turn could evoke weapon carrying as a defensive response.

Together, the findings of our study point to a complex interplay among the attractiveness of weapon carriers for affiliation, peer influence, and individual aggression. This threefold effect is alarming. In concert, these findings imply that weapon carrying can spread easily among young adolescents through modeling and imitation. The peer influence processes described in our study suggest that weapon carrying is more likely to increase in friendship relations with initial weapon carriers. This pattern in part may be because friends who already own weapons can advise others on where to get them (Callahan and Rivara, 1992; Kingery, Pruitt, and Heuberger, 1996). Here, peer influence, susceptibility to risky behaviors, and opportunities for illegal behavior are intertwined closely and provide an important, but particularly risky, platform to imitate weapon carrying. This finding might apply particularly to adolescents who spend their time with peers when authority figures are absent (Osgood and Anderson, 2004).

It should not be forgotten, however, that even in this high-risk sample, approximately 70 percent of the adolescents never carried a gun, knife, or other weapon. Still, 30 percent of the adolescents occasionally carried a weapon, and a small portion (10 percent) carried a weapon often. Despite this relatively low number, these adolescents do form a serious threat to the safety of their peers and, as we have seen, contribute to the increase of this problem. Prevention programs should consider that weapon carrying seems to be part of the interlacing of status and friendship formation among peers who tend to be aggressive.

Compared with findings in population-based samples, the prevalence of weapon carrying in our sample was rather high (e.g., Arria, Borges, and Anthony, 1997; Kingery, Coggeshall, and Alford, 1999; Williams et al., 2002). The question then is to what extent conclusions about the association between weapon carrying and status apply to this specific sample of high-risk youth or hold more universally. In general, adolescents become more inclined to engage in risky behavior during adolescence (Steinberg et al., 2008), which in turn contributes to status among peers (Allen, Weissberg, and Hawkins, 1989; Dijkstra et al., 2009). In this regard, weapon carrying fits this notion of being subject to status processes among adolescents.

However, adolescent involvement in risky behaviors often is limited to petty crimes and relatively innocent forms of rule-breaking behavior that seem part of adolescents' strive for autonomy (Moffitt, 1993). As such,

weapon carrying deviates from this perspective by being more risky than the general rule-breaking behavior of adolescents. Therefore, weapon carrying might be particularly subject to status processes in subcultures that adhere to masculine norms that emphasize toughness, daring, and gaining respect (Anderson, 1999; Warr, 2002), as well as among adolescents who are more inclined to engage in dangerous illegal behaviors, such as drug trade (Anderson, 1999). Future research might build on our research by examining to what extent similar mechanisms apply to population-based samples and to what extent normative judgments from specific subcultures affect the likelihood of weapon carrying among adolescents.

LIMITATIONS

Several limitations of this study should be considered. First, our sample was a high-risk sample of male, low-SES, Hispanic youths. Other factors often associated with male weapon carrying are related to being a boy and to low SES but warrant explicit consideration, such as delinquency, family background, school failure, and early initiation of sexual activity (Bailey, Flewelling, and Rosenbaum, 1997; Barlas and Egan, 2006; Callahan and Rivara, 1992; Durant et al., 1995; Estell et al., 2003; Kulig et al., 1998; Steinman and Zimmerman, 2003; Webster, Gainer, and Champion, 1993). This consideration was not possible in our study and points to fruitful questions for future research.

Second, we did not have information about whether respondents were members of a gang. This behavior could be the case for some of our predominantly low-SES Hispanic sample because these youngsters seem to have a heightened risk of gang membership (McNulty and Bellair, 2003). For adolescents in gangs, friendships within a small network of deviant peers and weapon carrying might be part of a deviant lifestyle that easily coincides with other forms of delinquency, such as being arrested and selling drugs (Myers et al., 1997; Steinman and Zimmerman, 2003). To what extent gang members who carry weapons differ from weapon carriers who do not belong to a gang is a question open for future research.

A third limitation is that we focused only on male participants. As a consequence, we did not capture female adolescents in the networks under investigation. Because girls are far less likely to carry weapons than boys (Bailey, Flewelling, and Rosenbaum, 1997; Kulig et al., 1998; Pickett et al., 2005; Rudatsikira et al., 2007; Steinman and Zimmerman, 2003; Valois et al., 1995), leaving out girls might not directly affect the results with regard to weapon carrying. However, girls might play an indirect role in weapon carrying in peer networks. It could be argued that status enhancement becomes more salient for adolescents in mixed-gender peer groups to establish cross-gender relations (Dijkstra et al., 2010b; Mayeux, Sandstrom, and Cillessen, 2008; Pellegrini and Bartini, 2001).

Fourth, the networks considered in our study were based on friendship relations at grade level. Therefore, participants could not nominate lower and higher grade-school friends or outside-school friendships by design. Although the school context is an important area for friendship formation (Blythe, Hill, and Thiel, 1982; Coleman, 1961), we could not capture selection and influence processes with regard to friends outside the grade level. As such, we missed a potentially influential part of an adolescent's world, also with regard to delinquency (Kiesner, Poulin, and Nicotra, 2003). Furthermore, the networks we analyzed were not complete. Participants only were included when information was available for at least one time point. The extent to which this point influenced the results is difficult to say. One could speculate that the results might even be more pronounced if more participants had been included in the sample for whom information was available on both network dynamics and behavioral dynamics (here, weapon carrying).

Despite these limitations, the findings of this study substantially advance our understanding of the roles of peer influence and selection processes on adolescent weapon carrying. In sum, to the best of our knowledge, this study is the first in which peer influence effects were unraveled from selection effects on weapon carrying using sophisticated statistical modeling and in which the roles of personal aggression and vulnerability also were considered. The findings indicate that adolescent weapon carrying indeed is influenced by peers as well as by prior aggression. Moreover, weapon carrying is related to status processes, which is evidenced by the fact that it decreased the number of best-friend nominations given and increased the number of nominations received from peers. These findings indicate that weapon carrying emerges from a complex interplay among the attractiveness of weapon carriers for affiliation, peer influence in friendship networks, and individual aggression.

REFERENCES

Adler, Patricia A., and Peter Adler. 1998. *Peer Power Preadolescent Culture and Identity*. New Brunswick, NJ: Rutgers University Press.

Akers, Ronald L. 1985. *Deviant Behavior: A Social Learning Approach*. Florence, KY: Wadsworth.

Akers, Ronald L., Marvin D. Krohn, Lonn Lanza-Kaduce, and Marcia Radosevich. 1979. Social learning and deviant-behavior: A specific test of a general theory. *American Sociological Review* 44:636–55.

Allen, Joseph P., Roger P. Weissberg, and Jacquelyn A. Hawkins. 1989. The relation between values and social competence in early adolescence. *Developmental Psychology* 25:458–64.

Anderson, Elijah. 1999. *Code of the Street. Decency, Violence, and the Moral Life of the Inner City*. London, UK: Norton.

Arria, Amelia, Guilherme Borges, and James C. Anthony. 1997. Fears and other suspected risk factors for carrying lethal weapons among urban youths of middle-school age. *Archives of Pediatrics & Adolescent Medicine* 151:555–60.

Aseltine, Robert H. 1995. A reconsideration of parental and peer influences on adolescent deviance. *Journal of Health and Social Behavior* 36:103–21.

Ash, Peter, Arthur L. Kellermann, Dawna Fuqua-Whitley, and Arlene Johnson. 1996. Gun acquisition and use by juvenile offenders. *Journal of the American Medical Association* 275:1754–8.

Bailey, Susan L., Robert L. Flewelling, and Dennis P. Rosenbaum. 1997. Characteristics of students who bring weapons to school. *Journal of Adolescent Health* 20:261–70.

Barlas, Joanna, and Vincent Egan. 2006. Weapons carrying in British teenagers: The role of personality, delinquency, sensational interests, and mating effort. *Journal of Forensic Psychiatry and Psychology* 17:53–72.

Bingenheimer, Jeffrey B., Robert T. Brennan, and Felton Earls. 2005. Firearms, violence, and self-protection—response. *Science* 309:1675–6.

Black, Maureen M., and Izabel B. Ricardo. 1994. Drug-use, drug trafficking, and weapon carrying among low-income, African-American, early adolescent boys. *Pediatrics* 93:1065–72.

Blythe, Dale A., John P. Hill, and Karen S. Thiel. 1982. Early adolescents significant others: grade and gender differences in perceived relationships with familial and nonfamilial adults and young people. *Journal of Youth and Adolescence* 11:425–50.

Boer, Peter, Mark Huisman, Tom A. B. Snijders, Christian E. G. Steglich, Lotte H. Y. Wichers, and Evelien P. H. Zeggelink. 2006. StOCHNET: An open software system for the advanced statistical analyses of social networks, [1.7]. Groningen, The Netherlands: ICS/Science Plus.

Bukowski, William M., Lorrie K. Sippola, and Andrew F. Newcomb. 2000. Variations in patterns of attraction to same- and other-sex peers during early adolescence. *Developmental Psychology* 36:147–54.

Burgess, Robert L., and Ronald L. Akers. 1966. Differential association-reinforcement theory of criminal behavior. *Social Problems* 14:128–47.

Burk, William J., Christian E. G. Steglich, and Tom A. B. Snijders. 2007. Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors. *International Journal of Behavioral Development* 31:397–404.

Byrne, Donna. 1971. *The Attraction Paradigm*. New York: Academic Press.

Callahan, Charles M., and Frederick P. Rivara. 1992. Urban high-school youth and handguns: a school-based survey. *Journal of the American Medical Association* 267:3038–42.

Card, Noel A., and Ernest V. E. Hodges. 2006. Shared targets for aggression by early adolescent friends. *Developmental Psychology* 42:1327–38.

Card, Noel A., and Ernest V. E. Hodges. 2008. Peer victimization among schoolchildren: Correlations, causes, consequences, and considerations in assessment and intervention. *School Psychology Quarterly* 23: 451–61.

Centers for Disease Control and Prevention (CDC). 1999. Youth risk behavior surveillance. *Morbidity and Mortality Weekly Report* 49:1–96.

Cialdini, Robert B., and Kenneth D. Richardson. 1980. Two indirect tactics of image management: basking and blasting. *Journal of Personality and Social Psychology* 39:406–15.

Cohen, Geoffrey L., and Mitchell J. Prinstein. 2006. Peer contagion of aggression and health risk behavior among adolescent males: An experimental investigation of effects on public conduct and private attitudes. *Child Development* 77:967–83.

Coie, John D., Kenneth A. Dodge, and Janis D. Kupersmidt. 1990. Peer group behavior and social status. In *Peer Rejection in Childhood*, eds. Steven R. Asher and John D. Coie. New York: Cambridge University Press.

Coleman, James S. 1961. *The Adolescent Society. The Social Life of the Teenager and Its Impact on Education*. New York: Free Press.

Corsaro, William A., and Donna Eder. 1990. Childrens' peer cultures. *Annual Review of Sociology* 16:197–220.

Davis, James A. 1970. Clustering and hierarchy in interpersonal relations: testing 2 graph theoretical models on 742 sociomatrices. *American Sociological Review* 35:843–51.

Dijkstra, Jan K., Antonius H. N. Cillessen, Siegwart Lindenberg, and René Veenstra. 2010a. Basking in reflected glory and its limits: Why adolescents hang out with popular peers. *Journal of Research on Adolescence*. In press. doi:10.1177/0272431609350926.

Dijkstra, Jan K., Antonius H. N. Cillessen, Siegwart Lindenberg, and René Veenstra. 2010b. Same-gender and cross-gender likeability: Associations with popularity and status enhancement. The TRAILS study. *Journal of Early Adolescence*. In press.

Dijkstra, Jan K., Siegwart Lindenberg, and René Veenstra. 2007. Same-gender and cross-gender peer acceptance and peer rejection and their relation to bullying and helping among preadolescents: Comparing predictions from gender-homophily and goal-framing approaches. *Developmental Psychology* 43:1377–89.

Dijkstra, Jan K., Siegwart Lindenberg, Frank C. Verhulst, Johan Ormel, and René Veenstra. 2009. The relation between popularity and aggressive, destructive, and normbreaking behaviors: Moderating effects of athletic abilities, physical attractiveness, and prosociality. *Journal of Research on Adolescence* 19:401–13.

Durant, Robert H., Alan G. Getts, Chris Cadenhead, and Elizabeth R. Woods. 1995. The association between weapon carrying and the use of violence among adolescents living in and around public housing. *Journal of Adolescent Health* 17:376–80.

Durant, Robert H., Daniel P. Krowchuk, Shelley Kreiter, Sara H. Sinal, and Charles R. Woods. 1999. Weapon carrying on school property among middle school students. *Archives of Pediatrics and Adolescent Medicine* 153:21–6.

Eder, Donna. 1985. The cycle of popularity: interpersonal-relations among female adolescents. *Sociology of Education* 58:154–65.

Estell, David B., Thomas W. Farmer, Beverly D. Cairns, and Jason T. Clemmer. 2003. Self-report weapon possession in school and patterns of early adolescent adjustment in rural African American youth. *Journal of Clinical Child and Adolescent Psychology* 32:442–52.

Glueck, Sheldon, and Eleanor Glueck. 1950. *Unraveling Juvenile Delinquency*. Cambridge, MA: Harvard University Press.

Goldstein, Sara E., Amy Young, and Carol Boyd. 2008. Relational aggression at school: Associations with school safety and social climate. *Journal of Youth and Adolescence* 37:641–54.

Gottfredson, Michael R., and Travis Hirschi. 1990. *A General Theory of Crime*. Stanford, CA: Stanford University Press.

Harris Study. 1993. A survey of experiences, perceptions, and apprehensions about guns among young people in America. Harvard School of Public Health: Chicago, IL: Joyce Grant Foundation.

Haynie, Dana L. 2001. Delinquent peers revisited: Does network structure matter? *American Journal of Sociology* 106:1013–57.

Haynie, Dana L. 2002. Friendship networks and delinquency: The relative nature of peer delinquency. *Journal of Quantitative Criminology* 18:99–134.

Huisman, Mark, and Christian E. G. Steglich. 2008. Treatment of non-response in longitudinal network studies. *Social Networks* 30:297–308.

Kandel, Denise B. 1978. Homophily, selection, and socialization in adolescent friendships. *American Journal of Sociology* 84:427–36.

Kiesner, Jeff, Francois Poulin, and Eraldo Nicotra. 2003. Peer relations across contexts: Individual-network homophily and network inclusion in and after school. *Child Development* 74:1328–43.

Kingery, Paul M., Mark B. Coggeshall, and Aaron A. Alford. 1999. Weapon carrying by youth: Risk factors and prevention. *Education and Urban Society* 31:309–33.

Kingery, Paul M., Buster E. Pruitt, and Greg Heuberger. 1996. A profile of rural Texas adolescents who carry handguns to school. *Journal of School Health* 66:18–22.

Kochanek, Kenneth D., and Bettie L. Hudson. 1992. Advanced report of final mortality statistics. *Monthly Vital Statistics Report* 43.

Krohn, Marvin D., Alan J. Lizotte, Terence P. Thornberry, Carolyn Smith, and David McDowall. 1996. Reciprocal causal relationships among drug use, peers, and beliefs: A five-wave panel model. *Journal of Drug Issues* 26:405–28.

Kulig, John, Jeanette Valentine, John Griffith, and Robin Ruthazer. 1998. Predictive model of weapon carrying among urban high school students: Results and validation. *Journal of Adolescent Health* 22:312–9.

Lindenberg, Siegwart. 1996. Continuities in the theory of social production functions. In *Verklarende Sociologie; Opstellen Voor Reinhart Wippler*, eds. Harry Ganzeboom and Siegwart M. Lindenberg. Amsterdam, The Netherlands: Thesis Publications.

Lindenberg, Siegwart. 2001. Social rationality versus rational egoism. In *Handbook of Sociological Theory*, ed. Jonathan H. Turner. New York: Kluwer.

Lindenberg, Siegwart. 2006. Prosocial behavior, solidarity, and framing processes. In *Solidarity and Prosocial Behavior: An Integration of Sociological and Psychological Perspectives*, eds. Detlef Fetchenhauer, Andreas Flache, Abram P. Buunk, and Siegwart Lindenberg. New York: Springer.

Luthar, Suniya S., and Thomas J. McMahon. 1996. Peer reputation among inner-city adolescents: Structure and correlates. *Journal of Research on Adolescence* 6:581–603.

Martin, Sandra L., Laura S. Sadowski, Niki U. Cotten, and Donna R. McCarraher. 1996. Response of African-American adolescents in North Carolina to gun carrying by school mates. *Journal of School Health* 66:23–6.

Matsueda, Ross. L., and Kathleen Anderson. 1998. The dynamics of delinquent peers and delinquent behavior. *Criminology* 36:269–308.

Mayeux, Lara, Marlene J. Sandstrom, and Antonius H. N. Cillessen. 2008. Is being popular a risky proposition? *Journal of Research on Adolescence* 18:49–74.

McNabb, Scott J. N., Thomas A. Farley, Kenneth E. Powell, Henry R. Rolka, and John M. Horan. 1996. Correlates of gun carrying among adolescents in south Louisiana. *American Journal of Preventive Medicine* 12:96–102.

McNulty, Thomas L., and Paul E. Bellair. 2003. Explaining racial and ethnic differences in serious adolescent violent behavior. *Criminology* 41:709–48.

Merton, Robert K. 1938. Social structure and anomie. *American Sociological Review* 3:672–82.

Moffitt, Terrie E. 1993. Adolescence-limited and life-course-persistent antisocial-behavior: a developmental taxonomy. *Psychological Review* 100:674–701.

MORI Research. 2003. Glasgow young people's survey 2003 for Glasgow City Council, Strathclyde Police and Glasgow Alliance. Scotland.

Myers, Gail P., Gene A. McGrady, Clementine Marrow, and Charles W. Mueller. 1997. Weapon carrying among black adolescents: A social network perspective. *American Journal of Public Health* 87:1038–40.

Ormel, Johan, Siegwart Lindenberg, Nardi Steverink, and Michael Vonkorff. 1997. Quality of life and social production functions: A framework for understanding health effects. *Social Science & Medicine* 45:1051–63.

Osgood, D. Wayne, and Amy L. Anderson. 2004. Unstructured socializing and rates of delinquency. *Criminology* 42:519–49.

Pellegrini, Anthony D., and Maria Bartini. 2001. Dominance in early adolescent boys: Affiliative and aggressive dimensions and possible functions. *Merrill-Palmer Quarterly Journal of Developmental Psychology* 47:142–63.

Pickett, William, Wendy Craig, Yossi Harel, John Cunningham, Kelly Simpson, Michal Molcho, Joanna Mazur, Suzanne Dostaler, Mary D. Overpeck, and Candace E. Currie. 2005. Cross-national study of fighting and weapon carrying as determinants of adolescent injury. *Pediatrics* 116:855–63.

Price, James H., Sharon M. Desmond, and Daisy Smith. 1991. A preliminary investigation of inner-city adolescents perceptions of guns. *Journal of School Health* 61:255–9.

Rountree, Pamela W. 2000. Weapons at school: Are the predictors generalizable across context? *Sociological Spectrum* 20:291–324.

Rudatsikira, Emmanue, Pramil Singh, Jayakaran Job, and Synnove Knutsen. 2007. Variables associated with weapon-carrying among young adolescents in southern California. *Journal of Adolescent Health* 40:470–3.

Sheley, Joseph F. 1994. Drugs and guns among inner-city high school students. *Journal of Drug Education* 24:303–21.

Short, James F., and Fred L. Strodtbeck. 1963. The response of gang leaders to status threats: an observation on group process and delinquent behavior. *American Journal of Sociology* 68:571–9.

Simon, Thomas R., Jean L. Richardson, Clyde W. Dent, Chi P. Chou, and Brian R. Flay. 1998. Prospective psychosocial, interpersonal, and behavioral predictors of handgun carrying among adolescents. *American Journal of Public Health* 88:960–3.

Snijders, Tom A. B. 2001. The statistical evaluation of social network dynamics. In *Sociological Methodology*, eds. Michael E. Sobel and Mark P. Becker. Oxford, UK: Basil Blackwell.

Snijders, Tom A. B. 2005. Models for longitudinal network data. In *Models and Methods in Social Network Analysis*, eds. Peter Carrington, John Scott, and Stanley Wasserman. New York: Cambridge Press.

Snijders, Tom A. B., Christian E.G. Steglich, and Michael Schweinberger. 2007. Modeling the co-evolution of networks and behavior. In *Longitudinal Models in the Behavioral and Related Sciences*, eds. Kees Van Montfort, Johan Oud, and Albert Satorra. Mahwah, NJ: Lawrence Erlbaum.

Snijders, Tom A. B., Christian E. G. Steglich, Michael Schweinberger, and Mark Huisman. 2007. Manual for SIENA version 3. Oxford, UK: University of Oxford, Department of Statistics. http://stat.gamma.rug.nl/stocnet.

Snijders, Tom A. B., Gerhard G. Van de Bunt, and Christian E.G. Steglich. 2010. Introduction to stochastic actor-based models for network dynamics. *Social Networks*. In press. http://dx.doi.org/10.1016/j.socnet.2009.09.004.

Sorenson, Susan B., and Katherine A. Vittes. 2004. Adolescents and firearms: A California statewide survey. *American Journal of Public Health* 94:852–8.

Steglich, Christian E. G., Tom A. B. Snijders, and Michael Pearson. 2010. Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*. In press.

Steglich, Christian E. G., Tom A. B. Snijders, and Patrick West. 2006. An illustrative analyses of the co-evolution of adolescents' friendship networks, taste in music, and alcohol consumption. *Methodology* 2:48–56.

Steinberg, Laurence, Dustin Albert, Elizabeth Cauffman, Marie Banich, Sandra Graham, and Jennifer Woolard. 2008. Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. *Developmental Psychology* 44:1764–78.

Steinberg, Laurence, Sanford M. Dornbusch, and B. Bradford Brown. 1992. Ethnic differences in adolescent achievement: An ecological perspective. *American Psychologist* 47:723–9.

Steinman, Kenneth J., and Marc A. Zimmerman. 2003. Episodic and persistent gun-carrying among urban African-American adolescents. *Journal of Adolescent Health* 32:356–64.

Sutherland, Edwin H. 1947. *Principles of Criminology*. Philadelphia, PA: Lippincott.

Valente, Thomas W. 2003. Social network influences on adolescent substance use: An introduction. *Connections* 25:11–6.

Valois, Robert F., and Robert E. McKeown. 1998. Frequency and correlates of fighting and carrying weapons among public school adolescents. *American Journal of Health Behavior* 22:8–17.

Valois, Robert F., Robert E. McKeown, Carol Z. Garrison, and Murray L. Vincent. 1995. Correlates of aggressive and violent behaviors among public high-school adolescents. *Journal of Adolescent Health* 16:26–34.

Vaughan, Robert D., James F. McCarthy, Bruce Armstrong, Heather J. Walter, Pamela D. Waterman, and Lorraine Tiezzi. 1996. Carrying and using weapons: A survey of minority junior high school students in New York City. *American Journal of Public Health* 86:568–72.

Warr, Mark. 2002. *Companions in Crime*. New York: Cambridge University Press.

Webster, Daniel W., Patricia S. Gainer, and Howard R. Champion. 1993. Weapon carrying among inner-city junior high school students: defensive behavior vs aggressive delinquency. *American Journal of Public Health* 83:1604–8.

Williams, Sunyna S., Peter F. Mulhall, Janet S. Reis, and John O. DeVille. 2002. Adolescents carrying handguns and taking them to school: Psychosocial correlates among public school students in Illinois. *Journal of Adolescence* 25:551–67.

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