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Delinquency as a Consequence of Misperception: Overestimation of Friends' Delinquent Behavior and Mechanisms of Social Influence

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This article examines how actors' perceptions of other people's behavior may be exaggerated and how this inaccuracy may influence behavior. More specifically, we apply these issues to improve our understanding of the correlation between delinquency of friends and individual delinquency. This relationship is one of the most replicated findings in the social sciences. However, research has not distinguished misperceptions of friends' behavior from actual behavior of friends, leaving two empirical questions unanswered. First, why do youth overestimate their friends' level of delinquency? Second, does overestimation of friends' delinquency influence one's own delinquency? We examine these questions using data from two waves of the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR) School Project. These data include self-reports by school friends of their own delinquent behavior, as well as respondents' estimates of their friends' behavior, making them uniquely equipped to calculate how much respondents exaggerate the behavior of their school friends and to investigate the determinants and consequences of this overestimation. Findings indicate that youth who engage in delinquency, have attitudes supporting delinquency, and experience peer pressure are more likely to exaggerate the prevalence of delinquency in their friendship network. Also, overestimating friends' delinquency leads to more delinquency in a subsequent wave, net of actual delinquency of friends and individual and situational characteristics. Overestimating friends' delinquency has the strongest effect on individuals who value social approval, are unpopular in their school, and experience peer pressure from their friends. We conclude by discussing avenues for future research. Keywords: delinquency; peers; measurement; social influence; cognitive bias.

Understanding the processes and mechanisms that lead individuals to orient their own behavior to the behavior and norms of others is a fundamental goal of sociological research (Weber [1921] 1968). Perceptions of others' behavior and the norms of social groups lie at the core of this orienting process. As a result, the social sciences have directed substantial attention toward understanding how perceptions about others influence action and how these actions produce macro properties (e.g., Homans 1958; Mead 1934; see also Hedstrom and Bearman 2009). Examples include racial preferences and residential segregation (Schelling 1978), collective behavior (Granovetter 1978), enforcement of unpopular norms (Centola, Willer, and Macy 2005), and conformity in markets (Bikhchandani, Hirshleifer, and Welch 1998). While the particular causal mechanisms examined in these studies vary, they all share the premise that there is considerable social influence on behavior, brought about by the perceived behavior of others.

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These outcomes are dependent, however, on the accuracy of individuals' perceptions. Individuals rarely have complete information about what others think and do, and when individuals form perceptions about the behavior of others and about group norms, a variety of mistakes and cognitive biases can occur, leading to misperceptions about reality. Regardless of their accuracy, however, perceptions about others may still exert strong influences on behavior (Akers 2009; Snyder and Swann 1978). Such a notion is captured by a classic dictum in sociology known as the Thomas Theorem: "if men define situations as real, they become real in their consequences" (Thomas and Thomas 1928:572). This theorem, pointing at the mechanism of "self-fulfilling prophecies" (Merton [1948] 1968), has been investigated in many studies in sociology and social psychology (see, for example, Biggs 2009; Jussim 1986, 2012).

In this article, we examine the consequences of inaccurate perceptions regarding delinquent behavior in adolescent friendship networks. Friends and peer groups play a central role in explanations of crime and delinquency that postulate *social influence* as a proximate cause of behavior. A rich theoretical literature proposes several mechanisms of social influence, including transmission of values and beliefs that legitimate delinquent behavior and learning techniques for committing delinquency (Sutherland 1947); social learning processes in which deviant behavior is reinforced through direct experience or behavioral modeling (Akers 1973, 1994); development of norms that are opposed to conventional society (Anderson 1999; Cohen 1955); situational inducements that arise in unsupervised peer groups (Briar and Piliavin 1965; Osgood et al. 1996); and group mechanisms deriving from the importance that adolescents attach to being loyal, avoiding ridicule, and obtaining status in the group (Warr 2002).

The ubiquity of social influence as an explanation of delinquency stems largely from the finding that having delinquent friends is a strong predictor of delinquency (Warr 2002). The correlation between self-reported delinquent friends and self-reported delinquent behavior is one of the most replicated findings in criminology. In prior research, the predominant focus has centered on disentangling the causal ordering behind the correlation. That is, do individuals who engage in delinquency select similar friends or do friends indeed influence the behavior of individuals (e.g., Matsueda and Anderson 1998; Reed and Rose 1998)? However, less attention has been devoted to testing the proposed theoretical mechanisms leading to this correlation. As a result, the exact mechanisms responsible for social influence have received much less attention (some exceptions are Bruinsma 1992; Paternoster et al. 2012; Reed and Rose 1998; Warr and Stafford 1991).

This lack of empirical precision in the study of social influence partially results from a failure to separate perceptions of friends' delinquency from the actual level of delinquent behavior committed by one's friends. Traditionally, delinquency of one's friends has been measured perceptually, by asking the respondent to report about their friends (e.g., Agnew 1991; Matsueda and Anderson 1998; Reed and Rose 1998; Warr and Stafford 1991). But recent research using social network methods has called into question the utility of perceptual measures (e.g., Baerveldt et al. 2004; Boman et al. 2012; Haynie 2001, 2002; Weerman and Smeenk 2005; Young et al. 2011). These studies reveal that adolescents often misestimate the delinquency of their friends, leading to inflated estimates of the correlation between one's own behavior and the behavior of one's friends when perceptual measures are used (Haynie and Osgood 2005; Meldrum, Young, and Weerman 2009; Prinstein and Wang 2005; Weerman and Smeenk 2005). Unfortunately, however, no study has distinguished between the effect of real or correctly perceived delinquency of friends and the effect of misperceived delinquency on one's own behavior. It may be that overestimation of friends' delinquency increases one's own delinquency, independently from the actual behavior of friends, but whether this is the case remains an unanswered empirical question.

In the current study, we focus explicitly on the processes of social influence leading to and resulting from overestimating peer delinquency. We build on a large body of literature describing cognitive biases that generate inaccurate beliefs about the prevalence of behavior among others (Campbell 1986; Marks and Miller 1987; Miller and McFarland 1987; Prentice and

Miller 1993, 1996; Ross, Greene, and House 1977) to explore two research questions. First, we examine the individual characteristics of adolescents and the structural characteristics of social networks that are associated with overestimating friends' delinquency. Second, we analyze how overestimating friends' delinquency, in conjunction with mechanisms of social influence that have been the focus of considerable attention in the adolescence literature (e.g., peer pressure, popularity, and the importance of social approval), affect later delinquency.

We investigate these questions by using social network data from 1,046 youths from the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR) School Project. These data include self-reports by school friends of their own delinquent behavior as well as the respondents' estimates of their friends' behavior. As a result, the data are uniquely equipped to investigate the respondent's overestimation of friends' behavior together with the actual levels of friends' delinquency and to model the unique effect of overestimation on delinquency. Furthermore, these data are longitudinal, which allow us to estimate the effects of overestimating friends' delinquency on later delinquency. We control for several variables that have been related to delinquency in the past (see, for example, Ellis, Beaver, and Wright 2009; Thornberry and Krohn 2003) and that may confound the effects of exaggerated perceptions of peer delinquency. In particular, we control for social control and additional peer-related variables informed by major criminological perspectives (social control, social learning, and routine activities theory). In the next section we review cognitive biases that may lead to overestimation of friends' delinquency and integrate the existing delinquency literature into this discussion. We then describe social influence mechanisms from the adolescence literature, which may moderate the relationship between overestimating friends' delinquency and personal delinquency.

Biases Producing Overestimation of Friends' Delinquency

An abundance of research, spanning multiple disciplines, documents the sensitivity of human information processing to cognitive biases. A litany of biases has been identified that involve decision making, subjective probability and beliefs, mental errors, and social behavior. In this section, we review two cognitive biases that have been shown to produce biased perceptions about others' behavior and deduce hypotheses from each cognitive bias with respect to how they may lead to overestimating the delinquency of one's friends.

False Consensus and Projection

Nearly a half-century of research documents the tendency for individuals to exaggerate the extent to which personal beliefs, opinions, abilities, and behaviors are shared by others (see Marks and Miller 1987 for a review). Lee Ross, David Greene, and Pamela House (1977) coined the term "false consensus" to describe the situation in which an observer projects their own characteristics onto others, leading the individual to exaggerate the extent of agreement in a setting. The level of consensus may be "exaggerated" because people do not have sufficient information about others and simply rely on their own behavior (Holmes 1978). Or, because people do not want to depart from others, especially when undesirable traits or behaviors are involved.[1]

Multiple studies have found that individuals project their own behaviors and attitudes onto others (Byrne and Blaylock 1963; Newcomb 1961; Ross et al. 1977). Projection has been documented for behaviors such as smoking (Sherman et al. 1983) and alcohol consumption (Marks, Graham, and Hansen 1992), as well as attitudes and opinions on various topics (Campbell 1986; Zuckerman, Mann, and Bernieri 1982). With respect to delinquency, several studies show

1. Multiple mechanisms have been proposed to explain why this exaggeration occurs. For example, projection might occur as a defense mechanism to reduce anxiety concerning the possession of undesirable traits. Mixed evidence, however, has been found to support this argument (see Holmes 1978; Suls and Wan 1987). Our intention is not to examine how projection occurs, but how projection leads to overestimation of delinquency.

that individuals who engage in delinquent behavior are more likely to attribute similar behavior to their friends compared to those who do not engage in such behavior (Boman et al. 2012; Prinstein and Wang 2005). Following this research, we hypothesize that:

Hypothesis 1: Individuals who engage in delinquency and have attitudes supporting delinquency are more likely to overestimate the delinquency of their friends.

False Uniqueness and Pluralistic Ignorance

In addition to bias that results from falsely attributing similarity to others, research has also documented a tendency for individuals to incorrectly believe that they differ from others. "False uniqueness" is an error of attribution (Jones and Harris 1967; Jones and Nisbett 1972; Ross 1977), which may occur on a general scale (e.g., most people believe that they can drive better than most others), but also within a particular situation. False uniqueness that occurs in a group setting (Kitts 2003) is an extensively studied phenomenon known as "pluralistic ignorance." This is "the situation in which virtually all members of a group privately reject group norms yet believe that virtually all other group members accept them" (Miller and McFarland 1987:298; see also Allport 1924).

David Matza's classic book *Delinquency and Drift* (1964) is among the first studies that noted pluralistic ignorance. Through in-person interviews of incarcerated youth, Matza found that delinquent behavior among adolescents often results from a "shared misunderstanding" of others' attitudes towards delinquency. Although individuals did not personally endorse delinquency, they believed that their friends did endorse such behavior. Kate Carey and associates (2006) refer to this as a "self-other difference," and have shown that the estimation of a norm can be biased by the perception of uniqueness. Several other studies have documented false uniqueness effects specific to delinquency (Breznitz 1975; Buffalo and Rodgers 1971; Warr and Stafford 1991). For example, M. D. Buffalo and Joseph W. Rodgers (1971) found that respondents believed that their friends endorsed delinquent values and norms as solutions to several situations, whereas the respondents themselves did not endorse the same values and norms. More recently, a number of studies have found that college students tend to overestimate the extent to which students drink heavily and endorse drinking heavily (Bourgeois and Bowen 2001; Martens, et al. 2006; Neighbors, et al. 2006; Turrisi et al. 2007).

In addition, research indicates that overestimating friends' delinquency may be enhanced when friends actively suggest that they endorse rule breaking and risk taking. Individuals may perceive an opinion to be more prevalent because it is heard more often, even though it may represent only a small proportion of the population (Weaver et al. 2007). Thomas J. Dishion and associates (1996) used the term "deviancy training" to describe a form of peer pressure in which adolescents talk positively about rule breaking and risk taking and negatively about abstaining from such behavior. False uniqueness is facilitated when peer pressures exerted in groups offer strong but misleading clues about the behavior of friends. Thus:

Hypothesis 2: Individuals who perceive pressure from their friends to engage in delinquency will be more likely to overestimate the delinquency of their friends.

Effect of Overestimating Friends' Delinquency and Mechanisms of Social Influence

Effect of Overestimation on Delinquency

A classic finding in social psychological research is that, in conditions of uncertainty, the behavior of others may serve as a point of reference for individuals to anchor their decision about appropriate behavior (Asch 1951; Cialdini and Trost 1998; Festinger 1954; Schelling 1978).

Such a condition of uncertainty is characteristic for adolescence, when youth need to develop their own identity, meet new persons, change schools, increase interactions with the opposite sex, experiment with romantic relationships, and cope with physical developments. Since this development increasingly occurs in the absence of parents (see Warr 2006), peers become a reference point for determining appropriate behavior. This is one reason why delinquent behavior is so strongly related to peer delinquency, particularly during adolescence (Warr 2002).

However, how peers behave and what the rules and norms of conduct within friendship groups are may be uncertain, and adolescents may have to rely on what they perceive as their peers' behavior and attitudes. It is reasonable to suspect that exaggerated perceptions of peer deviance may influence behavior in the same way as actual delinquency of friends. For example, adolescents may base their behavior on *perceived* social reinforcements of delinquent behavior, a central mechanism of social learning theory (Akers 1973, 2009). Adolescents may also adapt their behavior to avoid standing out in comparison to perceived social patterns among their friends or to adhere to false believes about what is normative in their group (Carey et al. 2006; Festinger 1954; Matza 1964). They may seek to avoid ridicule by abstaining from behaviors that they believe are rejected by their peers or to achieve status with behaviors that they think are valued by their peers (Warr 2002). Finally, they may correct imbalances in their peer relationships by modifying their behavior to match what they perceive as the level of delinquency of their friends (Heider 1946).

These mechanisms all operate at the cognitive level, and they are based on what adolescents *think* their friends do rather than what they actually do. This may lead individuals to become more delinquent when they exaggerate the delinquency of their friends (or become less delinquent when they are ignorant of friends' actual offending). This implies that adolescents who overestimate their friends' delinquent behavior will have a tendency to adapt their behavior towards what they believe their friends are doing:

Hypothesis 3: Individuals who overestimate the delinquency of their friends are more likely to engage in delinquency.

Moderators of the Effect of Overestimation

The effect of overestimation on behavior may depend on the costs of transgressing perceived norms. Adolescence is a period in life when acceptance from peers is more important than prior developmental stages (Corsaro and Eder 1990) and susceptibility to peer influence increases (Steinberg and Monahan 2007). Youth strive for acceptance and status in their own age group, fearing ridicule and exclusion more than anything else (see Warr 2002). Under such circumstances, some youth may be more inclined than others to avoid these experiences.

First, some adolescents may seek social approval more than others, while others are less concerned about standing out among their peers (Millham and Kellogg 1980; Rudolph, Caldwell, and Conley 2005). Approval of one's actions from others can act as a social reward and has been heavily emphasized as a reason why actors conform to social norms (Festinger 1954; Homans 1958; Horne 2008). Youth who place relatively more importance on social approval, and who are more afraid to be rejected, may not only be more susceptible to the influence of peers in general (see Strickland and Crowne 1962), but also to inflated beliefs about friends' behavior.

Second, some adolescents are more popular among their peers than others because they are more attractive, have greater social competence, or behave in ways that are interesting and appealing to their peers (e.g., Dijkstra et al. 2010; LaFontana and Cillessen 2002). As a result, popular youths may be more confident in their behavior and less threatened by the risk of rejection. On the other hand, individuals with few personal relations may be more strongly influenced by overestimating friends' delinquency because they are seeking popularity and tend to adapt their behavior more strongly than others to gain popularity among their peers.

Finally, pressure from peers to engage in delinquent behavior may signal to the individual that sanctions are forthcoming if they do not conform to their beliefs about peer behavior. This may lead individuals to engage in behaviors that they do not privately endorse. Furthermore, groups of friends may speak positively about rule breaking and offending, and speak negatively or gossip (Eder and Enke 1991) about others who are following the rules. This so-called "deviancy training" referred to above (Dishion et al. 1996) may signal further to adolescents that delinquent behavior is positively valued and abstinence from such behavior is condemned. In short, perceived peer pressure may act to strongly reinforce delinquent behavior and amplify the effects of overestimation on delinquency. Thus:

Hypothesis 4: Individuals who overestimate the prevalence of delinquency in their friendship network are more likely to engage in delinquency the more they value social approval and fitting in, the less popular they are among their peers, and the more they perceive pressure to engage in delinquency from their friends.

Data and Methods

The data used in this study come from the NSCR School Project, a Netherlands-based study that focuses on friendship network formation, personal development, and school interventions in the development of problem behavior and delinquency. The data analyzed here are from the first two annual waves of the longitudinal study, which began in 2002. The sampling procedure was guided by two goals: one, to obtain a relatively "high-risk" sample with a substantial proportion of delinquent respondents; and, two, to achieve enough variation in school contexts and student populations so as to generalize results. To accomplish these goals, schools and students in the lower educational strata of a major Dutch city with inner-city problems were oversampled, and additional students were recruited from schools in smaller cities and towns in the vicinity.

The students from the NSCR School Project are following a lower educational track (in Dutch: *voorbereidend middelbaar beroepsonderwijs* [VMBO], literally meaning preparational middle vocational education). This track lasts four years from ages 12 to 16. About 60 percent of all secondary students follow this type of education in the Netherlands. After VMBO, most students follow another track (*middelbaar beroepsonderwijs* [MBO]), literally middle vocational education) and obtain employment after completion. About 30 percent of students enter the workforce immediately after VMBO. Besides VMBO, about 40 percent of the secondary students in the Netherlands follow higher forms of education; a large part of them go to universities or to higher vocational education schools.

The sample for this analysis consists of 1,046 respondents who participated in Waves 1 and 2 and had valid social network data for both waves. The respondents were recruited in ten secondary schools that participated in the full study in both waves (two more schools participated in the complete study, one participated only in the first wave, the other did not provide complete network data). In total, 1,561 respondents from the ten schools participated in the first wave. In the second wave, 1,156 of these students were recruited again, of whom 1,046 provided usable network information for this study. The sample is divided in two cohorts: students from the first and third grades of the Dutch secondary schools (comparable to seventh and ninth grades in the American school system). Ages range from 11 to 18 years, but due to the cohort design of the study, respondents aged 13 and 15 years dominate (respectively, 32 percent and 25 percent). The majority of respondents (58 percent) live in a metropolitan area, a substantial number (34 percent) live in one of two medium-sized cities (about 120,000 inhabitants) nearby, and some respondents (8 percent) were recruited at a school in a smaller town (about 15,000 inhabitants). As a consequence of selecting a large city, more than one third of the sample consists of respondents with a foreign background, but respondents with Dutch parents are still the majority (63 percent).

Measures

Delinquency. Respondent delinquency was measured using self-reports regarding a variety of offenses measured in the first and second waves. Respondents were asked if they had ever committed an offense and, if so, how often during the reference period, which covered the interval between the last summer holiday prior to the beginning of the school year and the time when the survey was administered (April and May). The measure used in this study comes from the following questions: In the last year, how many times did you: "steal small things from shops worth less than 5 Euros;" "steal things worth more than 5 Euros;" "break or enter to steal something;" "rob someone;" and "hit somebody so hard he or she gets wounded/hurt?" ($\alpha = .689$ and $\alpha = .679$ for Wave 1 and 2, respectively).[2] The responses were recoded into a binary measure that reflects whether or not the respondent reported engaging in each behavior to allow correct comparison with the friends' delinquency variables discussed below. These were then summed to create a count of how many different offenses were committed by the respondent.

Overestimation of Friends' Delinquency. To measure the extent to which individuals overestimate the prevalence of delinquency in their friendship network, we construct a measure based on two indicators of friends' behavior: a direct indicator provided by the respondent's friends themselves and an indirect indicator provided by the respondent. The direct measure of friends' delinquency was constructed using social network questions (comparable with the Add Health Survey method, see Haynie 2001). Respondents were provided with a numbered list of all students in their school who were of the same grade level and asked to identify the students with whom they usually associated (maximum of ten). The direct measure of friends' delinquency was constructed by linking the nominations of school friends with those persons' answers to the five delinquency questions answered by the respondent. The respondent's sent network (individuals nominated by the respondent) was used to calculate the direct measure of friends' delinquency. The number of different offenses committed by each nominated school friend were summed and then divided by the number of nominated school friends to account for different network sizes ($\alpha = .757$). The direct measure of friends' delinquency is therefore the average number of delinquent acts reported by the respondent's friendship network (i.e., those nominated by the respondent as friends).

The indirect measure of friends' delinquency is based on perceptions and followed the conventional method in criminology (e.g., the National Youth Survey; see Elliott, Huizinga, and Ageton 1985). Respondents were asked: In the last year, how many of your friends: "stole small things from shops worth less than 5 Euros;" "stole things worth more than 5 Euros;" "break and entered to steal something;" "robbed someone;" and "hit somebody so hard he or she gets wounded/hurt?" The response categories for each of the questions were: "none," "some," "most or all," coded 1, 2, and 3, respectively and reflect the respondent's *perception* of friends' delinquency for a particular behavior ($\alpha = .727$).

Since the categories for the indirect and direct measures of friends' delinquency are not directly comparable we elected to use an ordinal indicator to construct the overestimation variable to facilitate comparison of the measures. The strategy used to construct the variable is shown in Table 1. Respondents could be assigned a value of −1, 0, or +1 for the overestimation measure. Individuals who reported that "none" of their friends engaged in a particular type of delinquency received a value of 0 if none of their friends reported engaging in delinquency and a value of −1 if the proportion of their friendship network reporting engaging in a particular type of delinquency was greater than zero. Individuals who reported that "some" of the friends engaged in delinquency received a value of 0 if the proportion of their friendship network that reported engaging in delinquency was between .01 and .5; a value of −1 if the proportion of their friendship network that reported engaging in delinquency was greater than .5; and a value of +1 if the proportion of their friendship network that reported engaging in delinquency was 0. Individuals who reported

2. Since the alpha values for these items are below the suggested threshold of .70 (Nunnally 1978), we decomposed the index and conducted the same analyses with the separate items. These results are identical to those presented here, suggesting that the index we present in the text is not producing misleading results.

Table 1 • *Ordinal Coding for Overestimation of Peer Delinquency Measure*

Correct Estimation		
Indirect[a]	*Direct*[b]	*Overestimation*[c]
None	0	0
Some	.01–.5	0
Most or all	> .5	0
Underestimation		
Indirect	*Direct*	*Overestimation*
None	> .0	−1
Some	> .5	−1
Most or all	N/A	N/A
Overestimation		
Indirect	*Direct*	*Overestimation*
None	N/A	N/A
Some	< .5	1
Most or all	0	1

[a]Response category for the respondent's perception of peer delinquency.
[b]Proportion of the respondent's peer group engaging in delinquency.
[c]Value assigned for ordinal measure of overestimation.

that "most or all" of their friends engaged in delinquency received a value of +1 if the proportion of their friendship network that reported engaging in delinquency was less than or equal to .5 and a value of 0 if greater than .5. The ordinal coding constrains any measurement error that may result from the lack of precision of the response categories. That is, among individuals who over-report, under-report, and do not misperceive friends' delinquency, the ordinal coding makes any variation within these groups zero. This procedure was conducted for each type of behavior to create a scale of overestimation from all five items, ranging from −1 (minimal overestimation, or put differently, underestimation) to +1 (maximum overestimation).[3]

Attitudes toward Delinquency. Respondents' attitudes toward delinquency are a central theoretical construct for understanding social influence (Akers 2009; Sutherland 1947) and have been shown to be a consistent predictor of delinquency (Pratt et al. 2010). The attitudes toward delinquency index was created from four items: "it is alright to do something illegal as long as you do not get caught;" "it is alright to lie if it gets you a lot of money;" "breaking and entering rich peoples' homes is not so bad;" and "it is alright to steal if you need money" (α = .698). Higher values represent greater approval of delinquency. We include this measure in our analysis to test the hypothesis that individuals who endorse delinquent behavior are more likely to overestimate the prevalence of delinquency in their friendship network.

Importance of Social Approval. To measure the importance of social approval to the respondent, a single item was used: "It is important that other people don't see me as odd." This item is

3. We explored two alternative approaches for computing overestimation. First, we calculated the simple difference between the direct and indirect measures of friends' delinquency. Second, we created a residual score by taking the residuals from the regression of the direct measure of friends' delinquency on the indirect measure of friends' delinquency and then taking the residuals from the regression of the indirect measure on the direct measure. Then we averaged these residuals to create a residual score. We elected to present the ordinal approach as opposed to one of these other methods for three reasons. First, the two measurements of friends' delinquency are not completely parallel in their categorization so problems that arise from measurement error are not addressed by these two approaches. Second, analyses revealed that the three different misperception measures were highly correlated with the ordinal approach presented in the text (r = .91for the simple difference score approach, r = .89 for the residual score approach). Third, results from models employing these other operationalizations were substantively identical to the results obtained from models using the ordinal approach (i.e., those presented in the text).

used to capture the extent to which the respondent values social approval and fitting in among his/her peers. We used a single item, because an index measuring a "social needs" index with additional items ("I hate it when I am the only one in class who is afraid of something" and "I want to be just like the people I spend time with") lacked internal consistency ($\alpha = .52$).

Popularity among Peers. We use the number of times the individual was nominated as a friend and define individuals who received more nominations as being more popular. This is referred to as the in-degree in the social network literature (Wasserman and Faust 1994) and is commonly used to measure *sociometric* popularity (Coie, Dodge, and Coppotelli 1982; Moody et al. 2011). We use the term "popularity" to maintain consistency with the sociological literature, although it is important to note that some research refers to number of received friendship nominations or nominations as "being liked" as "peer acceptance" (e.g., Kreager 2007), particularly in developmental psychology (see, for example, LaFontana and Cillessen 2002).

Peer Pressure. The extent to which individuals feel coerced or pressured by their friends to engage in particular behaviors is important for understanding delinquency (Dishion et al. 1996; Warr 2002) and may moderate the effect of overestimation on one's behavior. To measure peer pressure an index was created from 5 items: "My friends sometimes make me do things I actually don't want to do;" "My friends would think it's stupid when I don't dare to do something;" "My friends laugh at me when I am afraid of something;" "My friends find it rather funny when I do something that is not allowed;" and "My friends would have respect for me when I dare to break and enter" ($\alpha = .735$).

Social Bonds. Two additional social process variables measuring theoretical constructs from social control theory (Hirschi 1969) were included in the analysis as control variables: parental attachment and commitment to school. The *attachment to parents* index was created from seven items, for example: "I have nice parents," and "I would rather have other parents (reverse coded)" ($\alpha = .797$). The *commitment to school* scale included eight items, for example: "I go to school with pleasure" and "I would rather attend another school (reverse coded)" ($\alpha = .769$). Previous research has confirmed the association of these social bond variables with delinquent behavior (see Kempf 1993).

Additional Peer-Related Variables. The analyses also included three additional peer measures as control variables, "time spent with peers," "network density," and "friends outside of school." The five items for *time spent with peers* measure how much time is spent with friends (e.g., "how often do you spend time with your friends after school" and "how long are you with your friends during weekdays" ($\alpha = .776$). Several studies have reported strong associations between time spent with peers and delinquent behavior (Agnew 1991; Haynie and Osgood 2005; Warr 2006). *Network density* indicates how many mutual relations exist among the respondent's friends, measured by the proportion of social ties in an individual's network relative to the total possible number of ties (Wasserman and Faust 1994). This variable is included because network density may influence dissemination of information in the peer network (see Young et al. 2011), and because network density has been found to moderate the association between delinquent behavior and peer delinquency (Haynie 2002). For the *friends outside of school* measure, respondents were asked to indicate whether the majority of their friends do or do not attend their school. This variable was included to control for potential bias resulting from the fact that friendship nominations were limited to students who attend the same school as each respondent in the current study. It is possible that youths have friends outside school who differ in behavior from their school friends. The "friends outside of school" measure is included to correct for this possibility. Further, we also conducted exploratory analyses investigating whether the regression estimates remain stable when the analysis is limited to respondents with all or almost all of their friends in school: these analyses showed substantively similar results as those presented.

Other Control Variables. Age, sex, and whether the respondent's parents were born in a foreign country (as an indicator of ethnicity) are also included in the models to control for potential confounding effects from these demographic variables. It is often found that age, sex, and ethnicity are related to delinquency, and they may also influence the amount of perceived peer delinquency.

Table 2 • *Descriptive Statistics*

	Mean	*Standard Deviation*	*Min*	*Max*
Male	1.440	.497	1.000	2.000
Age	14.073	1.319	11.000	19.000
Parents foreign born	.377	.484	.000	1.000
Friends outside of school	2.028	.746	1.000	1.000
Attachment to parents	4.583	.527	1.000	5.000
Committment to school	3.640	.778	1.000	5.000
Importance of social approval	3.941	1.304	.000	5.000
Time with friends	2.223	.531	1.000	3.000
Network density	.345	.184	.000	1.000
Popularity	6.121	3.019	.000	19.000
Atttitudes toward delinquency	2.225	.925	1.000	5.000
Peer pressure	2.049	.934	1.000	5.000
Peer delinquency	.169	.224	.000	2.600
Delinquency (time 1)	.292	.659	.000	.000
Delinquency (time 2)	.216	.569	.000	5.000
Overestimation of peer delinquency	.001	.345	−1.000	1.000

Descriptive statistics of variables are listed in Table 2. All variables were standardized prior to estimation to facilitate interpretation of the coefficients.

Missing Data

The Wave 1 sample for this study included 1,561 respondents. At Wave 2, 409 respondents did not participate (26 percent), leaving 1,152 respondents with data for both waves. Finally, 106 respondents did not have sufficient network data to create the overestimation variable (i.e., zero nominated friends or invalid nominations). In sum, 515 cases were excluded from the analysis leaving an effective sample size of 1,046. Difference of means tests for respondents who were not reinterviewed at Wave 2 with respondents who were reinterviewed at Wave 2 are given in Appendix A. Briefly, Appendix A shows that cases who were not reinterviewed were more likely to be older, have foreign-born parents, have friends outside of school, be less committed to school, spend more time with friends, have lower popularity, have attitudes more supportive of delinquency, have more delinquent friends, be more likely to overestimate friends' delinquency, and engage in more delinquency compared to those who were reinterviewed at Wave 2. The implications of these differences for our results are discussed in more detail in the conclusion section. For cases interviewed in both waves that had missing data for survey items, missing data were imputed using Gibbs sampling, a type of Markov chain Monte Carlo (Gelman et al. 2004), which allows the researcher to incorporate the uncertainty in data collection that is ignored by mean imputation (Hoff 2009). The procedure used is described in Appendix B.

Statistical Models

To examine the hypotheses specified above, we begin by focusing on the distribution of overestimation and then examine the variables that influence overestimation of friends' delinquency. An ordinary least squares (OLS) model is used since the overestimation variable is normally distributed.[4] We then investigate the relationship between overestimation of friends' delinquency at Wave 1 and delinquent behavior one year later. Hypothesized interaction effects are analyzed in a subsequent model to examine whether the effect of overestimation on delinquent behavior varies by popularity, the importance of social approval, and peer pressure.

4. Although the variable is normally distributed, the outcome has only 21 possible values, resulting in discontinuous points on the distribution. We assume, however, that the data are drawn from a continuous distribution.

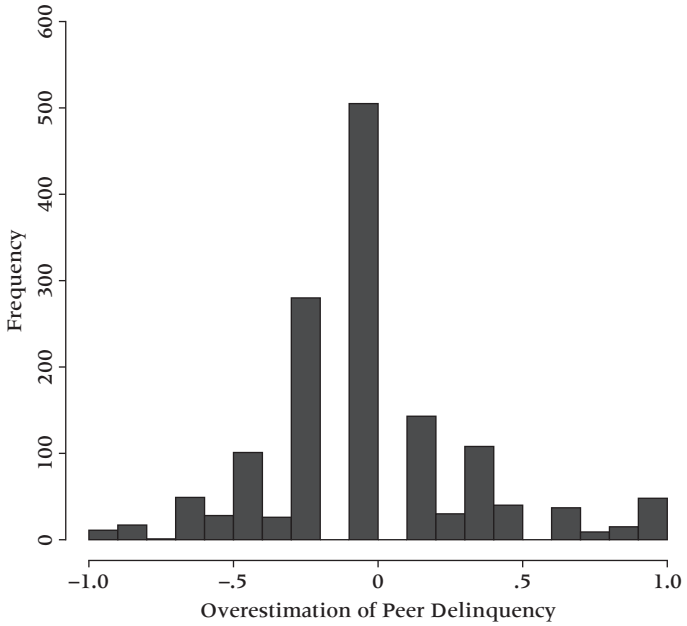

Figure 1 • *Distribution of Overestimation of Peer Delinquency*

Since the measure of self-reported delinquency is a count of delinquent behavior, Poisson regression is the appropriate model because linear regression can produce biased, inefficient, and inconsistent estimates of parameters with count data (Long 1997). A problem with modeling delinquent behavior with Poisson regression is that the distribution is often overdispersed, as is the case here. In the Poisson model, parameter estimates are consistent but inefficient when data are overdispersed (Long 1997). To address this inefficiency, we use a sandwich estimator to calculate robust standard errors using the generalized linear and latent mixed-models (gllamm) function in STATA 11.2 (StataCorp 2009).[5] To address dependence within persons (i.e., the number of delinquent acts at t is not independent of the number of delinquent acts at $t-1$ or $t+1$), a random-intercept model is estimated.

Since respondents are nested within schools we use a multilevel model to account for the shared correlation between respondents within schools. Preliminary analysis of the measure of overestimation showed that a model that allows the intercept to vary across schools does not improve the fit of the model to the data. Instead, we fit a single-level model for the OLS models of overestimation with robust standard errors.

Results

Overestimation of Friends' Delinquency

Figure 1 shows a histogram of the distribution for the overestimation variable and indicates that there are respondents who overestimate the prevalence of delinquency in their peer

5. Researchers often use the negative binomial model to account for overdispersion (i.e., the variance is greater than the mean). However, the multilevel negative binomial model is often less than ideal due to difficulties with parameterization and interpretation (see Rabe-Hesketh and Skrondal 2008).

group (and respondents who underestimate it). Interestingly, 35 percent of the respondents correctly estimated the level of delinquency in their peer group. Approximately 31 percent of the respondents overestimated their peers' delinquency. Lastly, a small group of respondents (10 percent) grossly overstated their peer's delinquency, with overestimation levels between .5 and 1.

Table 3 shows the results of the cross-sectional regression of overestimation of friends' delinquency. Model 1 reports the effect of the control variables on overestimation of friends' delinquency. Model 2 adds attitudes toward delinquency, peer pressure, and peer delinquency, and Model 3 adds self-reported delinquency. The table shows that peer pressure, attitudes supporting delinquency, and delinquency are independently related to overestimation of friends' delinquency.

Table 3 • ***Ordinary Least Squares Regression of Overestimation of Peer Delinquency*** [a]

Variables	*Model 1*	*Model 2*	*Model 3*
Male	.034	−.001	.010
	(.021)	(.020)	(.019)
Age	−.027**	−.010	−.008
	(.009)	(.008)	(.008)
Age squared	−.001	−.002	−.002
	(.007)	(.006)	(.006)
Parents foreign born	.052*	.078***	.063**
	(.022)	(.020)	(.019)
Friends outside of school	.020	.019	.012
	(.015)	(.014)	(.014)
Attachment to parents	.006	.003	−.000
	(.011)	(.010)	(.010)
Commitment to school	−.060***	−.053***	−.037***
	(.011)	(.011)	(.011)
Importance of social approval	.008	.000	.004
	(.010)	(.010)	(.009)
Time with friends	.028*	.025*	.015
	(.011)	(.011)	(.010)
Network density	.005	.001	.006
	(.011)	(.010)	(.010)
Popularity	−.005	−.004	−.006
	(.011)	(.012)	(.011)
Attitudes toward delinquency	—	.055***	.026*
		(.012)	(.012)
Peer pressure	—	.047***	.043***
		(.011)	(.011)
Peer delinquency	—	−.145***	−.151***
		(.010)	(.010)
Self-reported delinquency	—	—	.103***
			(.010)
Constant	.064	.058	.029
	(.131)	(.121)	(.115)
AIC	735	513	418
BIC	749	587	497
Log likelihood	−355	−241	−193
R squared	.041	.231	.291
N = 1,046			

[a]Standard errors corrected for clustering in parentheses.
*$p < .05$ **$p < .01$ ***$p < .001$ (two-tailed tests)

This provides evidence for Hypothesis 1 and replicates previous studies that indicate that individuals who engage in delinquency are more likely to incorrectly attribute such behavior to others (Prinstein and Wang 2005; Weerman and Smeenk 2005). We also found support for Hypothesis 2 in that peer pressure increases overestimation. This finding provides evidence that false uniqueness may occur in social interaction with peers as a consequence of friends actively encouraging rule breaking and risk taking or simply perceiving a behavior to be more prevalent because it is the topic of conversation (Dishion et al. 1996; Weaver et al. 2007).

The effect of peer delinquency on overestimation indicates that individuals in very delinquent peer groups are *less* likely to overestimate the prevalence of such behavior. Though not directly hypothesized, we can speculate that this may occur because frequent delinquency may be more visible and less likely to lead individuals to inaccurate perceptions of peer delinquency. However, it may also reflect a baseline effect in that it is much harder to overestimate when peers are already highly delinquent, while overestimation is the only option when peers engage in little or no delinquency.

Self-Reported Delinquency

Table 4 shows the longitudinal results for the multilevel Poisson regression of delinquency measured at Wave 2. Model 4 includes the control and social process variables, the measure for actual friends' delinquency, self-reported delinquency, and the measure of overestimation. Model 5 shows the multiplicative interaction terms between overestimation of friends' delinquency and other hypothesized variables. For both models, the predictors are measured at Wave 1 and the outcome is measured at Wave 2.

The estimated effects are discussed as the percentage change in the dependent variable (this is calculated with the transformation: $(100 \times [e^{\beta} - 1])$, where β is the estimate). Attitudes toward delinquency, peer pressure, network density, and popularity do not predict delinquency. It appears that social approval has a significant effect on delinquency: for a one standard deviation increase in the importance of social approval, there is a 20 percent increase in delinquency $(100 \times [e^{.179*1} - 1])$. More importantly, friends' actual delinquency, as well as overestimation of friends' delinquency, significantly predicted later delinquent behavior of the respondents. There is a 15 percent and 35 percent increase in self-reported delinquency for a one standard deviation increase in actual friends' delinquency and overestimation of friends' delinquency, respectively. The latter effect provides support for Hypothesis 3 and indicates that inaccurate perceptions of peer delinquency, distorted through cognitive biases such as false consensus or false uniqueness, are important for understanding delinquent behavior.

Moderation Effects

Model 5 in Table 4 shows the multiplicative interaction terms between overestimation of friends' delinquency and popularity, importance of social approval, and peer pressure predicting self-reported delinquency one year later. The coefficients for the interaction terms indicate that overestimation of friends' delinquency has a stronger effect on delinquency for youth who are relatively less popular, more strongly value social approval, and feel more pressure from their peers to engage in behavior. These estimates provide support for Hypothesis 4 and suggest that the social context in which behavior occurs and the social position of the actor, both influence the extent to which exaggerated perceptions influence delinquency. To illustrate the moderating effects, Figure 2 graphs the relationship between overestimation and delinquency across multiple values for popularity (Panel A), importance of social approval (Panel B), and peer pressure (Panel C). These figures indicate that overestimation of friends' delinquency has the strongest effect on delinquency when the respondent is relatively unpopular, values social approval more strongly, and experiences more peer pressure.

Table 4 • ***Multilevel Poisson Regression of Delinquency at Time 2 on Process Variables, Peer Delinquency, and Misperception of Delinquency***[a]

Fixed Effects	*Model 4*	*Model 5*
Male	−.062	−.042
	(.190)	(.189)
Age	−.020	−.024
	(.072)	(.070)
Age squared	−.154*	−.145*
	(.072)	(.071)
Parents foreign born	−.369	−.390
	(.207)	(.215)
Friends outside of school	.155	.156
	(.124)	(.122)
Attachment to parents	−.041	−.020
	(.072)	(.075)
Commitment to school	−.123	−.131
	(.069)	(.072)
Importance of social approval	.179***	.136**
	(.046)	(.042)
Time with friends	.257**	.247**
	(.087)	(.082)
Network density	.006	−.036
	(.068)	(.067)
Popularity	.057	.062
	(.076)	(.073)
Attitudes toward delinquency	.006	.028
	(.091)	(.078)
Peer pressure	.011	.063
	(.060)	(.082)
Peer delinquency	.111*	.147**
	(.053)	(.052)
Self-reported delinquency	.359***	.372***
	(.049)	(.048)
Overestimation of peer delinquency	.197*	.305**
	(.086)	(.112)
Interactions: overestimation of peer delinquency × . . .		
Popularity	—	−.096*
		(.049)
Importance of social approval	—	.148**
		(.047)
Peer pressure	—	.191*
		(.077)
Constant	−1.330	−1.320
	(.966)	(.989)
Random effects		
Standard deviation of intercept	.118	.118
	(.049)	(.049)
AIC	1165	1157
BIC	1254	1241
Log likelihood	−564	−557
N = 1,046		

[a]Robust standard errors in parentheses.
*p < .05 **p < .01 ***p < .001 (two-tailed tests)

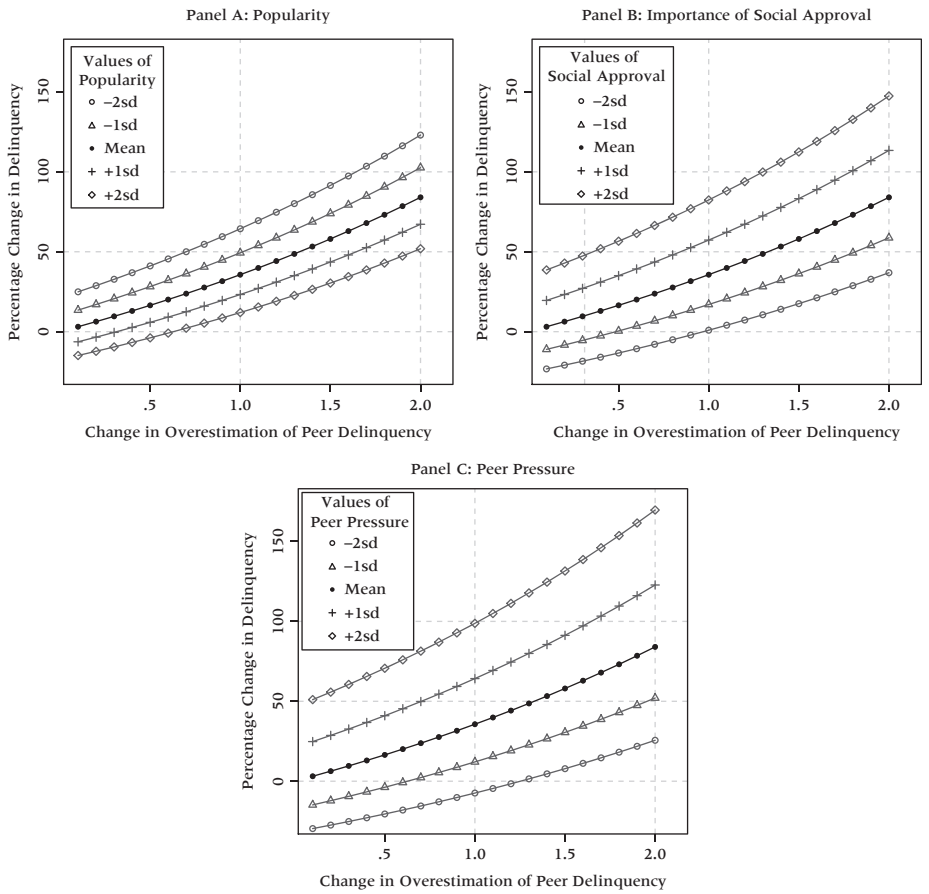

Figure 2 • *Interactions: Overestimation of Peer Delinquency and Popularity, Importance of Social Approval, and Peer Pressure*

Discussion

Substantial research in the social sciences has been devoted to understanding the mechanisms of social influence that lead people to orient their own behavior towards the behavior of others. Scholars have long acknowledged that these mechanisms are not only based on correct observations of other people's actions, but also on perceptions that may be inaccurate, yet still be consequential as if they were real (e.g., Biggs 2009; Jussim 2012; Snyder and Swann 1978; Thomas and Thomas 1928). Empirical research, however, seldom distinguishes actual from perceived behavior or norms.

This study examined how adolescents' perceptions of their friends' delinquency may be exaggerated by cognitive biases and the consequences of this inaccuracy for their own delinquent behavior. We used data from two waves of the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR) School Project, which included self-reports by school friends of their

own delinquent behavior, as well as respondents' estimates of their friends' behavior. These data allowed us to separate the two components of the respondents' perception of friends' delinquency: the part that is correct, capturing the actual level of friends' delinquency, and the part that is incorrect, capturing overestimation. These separate components allowed us to identify the extent to which respondents exaggerated the delinquency of their school friends and the reasons why such exaggerations occurred, and to investigate the consequences of this overestimation on behavior.

The first goal of this study was to examine the characteristics of adolescents and their friendship networks that are related to inflated beliefs about the prevalence of delinquency in their peer group. We found that respondents were more likely to overestimate the extent to which their friends engaged in delinquency if they themselves engaged in delinquency and had attitudes supportive of delinquent behavior. These results parallel findings from previous research showing that individuals may have exaggerated beliefs regarding the prevalence of behavior (Ross et al. 1977), and delinquency in particular (Boman et al. 2012; Prinstein and Wang 2005). Further, the accuracy of the respondent's perceptions is sensitive to features of the social context. Specifically, youth who felt pressure from their friends to engage in delinquency were more likely to overestimate the prevalence of delinquency in their friendship network. This provides further empirical support for the claim that false uniqueness is a cognitive bias leading to overestimation of friends' delinquency (Breznitz 1975; Buffalo and Rodgers 1971; Matza 1964; Warr and Stafford 1991).

Although we did not specify hypotheses regarding the relationship between social approval, popularity, and network density with cognitive biases, it is important to report that they did not predict overestimation of peer delinquency. These findings are consistent with research reported by Young and associates (2011) who found that network density predicted inaccurate reports of peer delinquency but not over- or underestimation. This may be interpreted as evidence that network structure and contextual variables, such as network density and popularity, are mainly important for disseminating information and are therefore related to general misperception of peer behavior, but not necessarily to overestimation of peer delinquency. In contrast, our study has focused on the role of cognitive biases in producing inaccurate information with respect to overestimating peer delinquency. Our findings reinforce the importance of keeping such differences in mind when examining the role of perceptions in social influence.

Overall, the finding that overestimation has identifiable predictors strengthens the claim of prior research that cautions against treating perceptual measures of peer delinquency and actual peer delinquency as synonymous (Gottfredson and Hirschi 1990; Haynie and Osgood 2005; Meldrum et al. 2009; Prinstein and Wang 2005; Weerman and Smeenk 2005; Young et al. 2011). Moreover, these findings question the claim that respondents can provide accurate and unbiased reports of their peers' delinquency (see Warr 2006:37). Overall, the first part of our analysis indicated that overestimation of friends' delinquency is systematic and that perceptions of friends' delinquency may be influenced by one's own behavior and attitudes and by contextual clues that adolescents receive from their friends during social interaction.

The second goal of the study was to analyze how overestimating friends' delinquency, in conjunction with other peer-related variables (e.g., peer pressure, popularity, and the importance of social approval), affects later delinquency. We find that, controlling for past behavior, other social process variables, and actual delinquency of friends, overestimation of friends' delinquency is a strong predictor of self-reported delinquency one year later. Our analyses strengthen the assertion that perceptions play a fundamental role in social influence: "perception is itself important in the peer effect on delinquent behavior. Even if peer behavior is misperceived as more (or less) delinquent than it actually is, the peer influence will still come through that perception" (Akers 2009:119). Furthermore, overestimating friends' delinquency had the strongest effect on

later delinquency for respondents who place a high value on social approval, are unpopular, and experience peer pressure. The implications of these relationships warrant further discussion, as they have not been reported in prior research.

First, the novel findings reported in this study are particularly relevant to the discussion of peers and behavior during adolescence. Multiple studies indicate that forming friendships (Corsaro and Eder 1990) and avoiding social exclusion (Warr 2002) are highly salient during this age period. The present findings cast new light on this body of research by examining the link between the perception of others' actions and subsequent individual behavior. These results indicate that focusing on how actors form inaccurate beliefs about friends' behavior and how these beliefs influence action may be a fruitful pursuit for attaining a better understanding of how social influence mechanisms operate during adolescence.

Second, the variability in the effect of overestimation on delinquency may have important implications for perception-based interventions, such as the *social norms approach* (e.g., Perkins 2006), that seek to reduce problem behavior by providing accurate information about the frequency of behaviors in specific social contexts (e.g., a school). Our findings indicate that such interventions may be more effective for particular individuals under certain conditions. The present study shows that the provision of information as a strategy for reducing delinquency may be most effective for unpopular youth who feel pressured to engage in risky behavior and value social approval from others.

We recognize that our data have several limitations. First, we were only able to analyze 1,046 cases (67 percent) with data from both waves, excluding a nontrivial amount of cases from our analyses. As Appendix A shows, cases who were not reinterviewed were more likely to be older, have foreign-born parents, have friends outside of school, be less committed to school, spend more time with friends, have lower popularity, have attitudes more supportive of delinquency, have more delinquent friends, be more likely to overestimate friends' delinquency, and engage in more delinquency compared to those who were reinterviewed at Wave 2. These differences, for the most part, are small in magnitude, but require discussion nonetheless. Perhaps the most important difference is with respect to overestimation of friends' delinquency and self-reported delinquency. This may have influenced our findings, but we have no reason to believe that they are biased in a systematic way by the selective attrition in our sample. Nevertheless, future research would be needed to replicate our findings with longitudinal data on samples with less attrition.

A second limitation is conceptual in that questions pertaining to individual perceptions of friends' attitudes toward delinquency were unavailable in our data. We were able to explore actors' perceptions of friends' behavior, not their perceptions of whether their friends endorse and sanction delinquency. Future research also should investigate the etiology of individuals' perception of friends' attitudes and reactions, in addition to perceptions of friends' delinquency, and how this process may involve bias. However, we believe that perception of friends' behavior is an inclusive measure because perceptions of collective properties of groups are often based on observed behaviors (Bikhchandani et al. 1998; Cartwright and Patel 2010; Patel and Cartwright 2009).

Third, only one question was used to measure how important social approval was to the respondent. This item was used to capture the extent to which fitting in and being involved in social interaction is important to the respondent. We used a single item, because the additional items in the "social needs" component of the questionnaire (i.e., "I hate it when I am the only one in class who is afraid of something" and "I want to be just like the people I spend time with") lacked internal consistency ($\alpha = .52$). Although imperfect, the lack of convergent validity of the item we use with the other items from this component of the questionnaire suggests that we have, at least partially, correctly operationalized our concept of interest (i.e., importance of social approval). Furthermore, despite only having a single item, we believe the measure reflects the construct under examination because it demonstrates the ability to predict delinquency and

revealed a conditional relationship with overestimation. If the item contains measurement error, we would expect the relationship to be weaker than our models indicate. Nonetheless, researchers should use caution when generalizing these findings.

Fourth, the measurement of friends' delinquency was constrained to the relationships of friends inside the same school grade of respondents. Therefore, friends who were older or younger than the respondents could not be taken into account. Although there is evidence that those who engage in delinquency tend to have older friends (e.g., Warr 2002), respondents usually have the majority of their friends in their own grade, and there is no reason to believe that this limitation has biased the results substantially. Future research can address this issue by using social network data that allow cross-grade nominations.

Fifth, the direct measurement of friends' delinquency used in this study did not capture the effects of friends outside of school. This measure implicitly assumes that friends outside of the school network engage in delinquency at similar rates as the friends nominated in school. This may be an unreasonable assumption. As John Hagan and Bill McCarthy (1998) showed, using the school as the unit of sampling may fail to capture important relationships among individuals, especially for individuals at risk for a variety of delinquent conduct.

It is possible that respondents were (also) reporting about the perceived behavior of friends outside school that may have differed from the actual behavior that was measured for their friends in school. We attempted to account for this with the inclusion of a control variable asking respondents to indicate how many of their friends did not attend their school. Preliminary analyses indicate that the findings reported here are robust when the sample is constrained to those who only nominate friends in school. Nevertheless, future research would benefit from including the network of friends outside of school, although this is difficult to achieve.

Sixth, although we improved upon earlier studies by using social network data to measure actual peer delinquency, we could not utilize recent advances in the modeling of longitudinal social network (e.g., actor-based stochastic actor models [see Weerman 2011]) to further unravel peer influence and selection processes. These models require data on the respondents' perceptions about *each* of his or her nominated peer's delinquency. This limitation may be improved upon in future research where the data permit such analysis.

Despite these limitations, this study contributes to a large literature on the role of friends' behavior and individual action by demonstrating that overestimating the prevalence of friends' delinquency in itself may be a predictor of an individual's delinquency. Although little attention has been given to the role of overestimation as a *cause* of delinquency, this study suggests that it is an important process deserving greater attention. Focusing more precisely on the relationship between perception and mechanisms of social influence may clarify the exact role that friends play in the lives of adolescents and may lead to more effective interventions aimed at deterring delinquent behavior.

Overall, our findings illustrate and support the notion that perceptions and misperceived situations can become real in their consequences. Furthermore, this study suggests that the effects of misperceptions are not the same for everyone. The magnitude of cognitive biases in shaping one's behavior appears to be sensitive to contextual features of the friendship network and one's own position in the network. This implies that further investigation of the circumstances that lead individuals to adapt their behavior towards misperceptions about their social environment may be a fruitful direction for future research.

Appendix A • *Difference of Means Tests for Wave One Variables for Cases Excluded and Included from Analysis*

	Mean for Cases Excluded	*Mean for Cases Included*	*Two-Tailed Significance Level*
Male	1.54	1.55	.54
Age	14.51	13.84	.00
Parents foreign born	.51	.32	.00
Friends outside of school	2.10	1.99	.00
Attachment to parents	4.54	4.60	.06
Committment to school	3.56	3.67	.00
Importance of social approval	3.96	3.93	.53
Time with friends	2.28	2.21	.01
Network density	.35	.34	.63
Popularity	4.01	6.09	.00
Atttitudes toward delinquency	2.33	2.18	.00
Peer pressure	2.09	2.03	.21
Peer delinquency	1.03	.84	.01
Overestimation of peer delinquency	.06	.00	.05
Delinquency	.37	.26	.00

Appendix B • Missing Data and Imputation

A fundamental problem with data collected by self-report is that a portion of the sample may fail to respond. One way to handle cases with incomplete observations is to throw away all subjects with missing data; another is to impute missing values with a population mean or some other fixed value. The first approach is problematic because potentially useful information is being discarded. The second approach is statistically incorrect because it assumes certainty about values of the missing data, which have not been observed. A solution is to integrate over the missing data and using Bayesian statistics, replace missing values by sampling from the posterior distribution (Hoff 2009).

Let Y_{obs} be the $n \times p$ matrix of data and $O = \{o_{i,j}\}$ be an $n \times p$ matrix in which $o_{i,j} = 1$ if $y_{i,j}$ is observed and $o_{i,j} = 0$ if $y_{i,j}$ is missing. Then μ, Σ and $\{y_{i,j} : o_{i,j} = 0\}$ are the unknown quantities, about which we are going to make inference. Posterior distributions are obtained with the following Gibbs sampling scheme:

Given $\Phi(s) = \{\mu(s), \Sigma(s), Y(s)\}$,

1. Compute S_n and μ_n from $Y(s)$;
   a) Sample $\Sigma(s+1) \sim$ inverse-Wishart $(S_n - 1, \nu_0 + n)$;
   b) Sample $\mu(s+1) \sim$ multivariate normal $(\mu_n, 1/(n+\kappa_0)\ \Sigma(s+1))$;
2. For each j {1, . . ., p} in turn and each i such that $o_{i,j} = 0$,
   a) Sample $y_{i,j}(s+1)$ from its full conditional distribution.

By replacing missing values with samples from the posterior distribution, deleting potentially relevant cases and assuming that missing values are fixed is avoided.

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