

## Peer Influences on Risk Behavior: An Analysis of the Effects of a Close Friend

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Cross-sectional research suggests that peer influence has a moderate to strong impact on adolescent risk behavior. Such estimates may be inflated owing to third-variable confounds representing either friendship selection effects or the operation of parallel events. Approximately 1,700 peer dyads in Grades 7 to 11 were studied over a 1-year period to estimate the influence of closest friends on sexual activity and binge drinking. Analyses suggested that peer influence was small but reliable when both selection effects and parallel events were taken into account. Peer influence varied as a function of individual–peer similarity and maternal relations but not in accord with other theoretical predictions. It is suggested that the magnitude of peer effects in previous research may be overestimated in many contexts.

Literally thousands of studies have examined peer influence in adolescence. The body of evidence suggests that one of the most powerful and consistent predictors of adolescent risk behavior is whether an individual has friends who also engage in that behavior. Such associations have led many social scientists to conclude that peers exert considerable influence on adolescents. For example, in her recent review of behavior genetic studies, Harris (1998)

analyzed parental and peer influences on adolescent behavior and concluded that about 50% of the variance in adolescent personality is genetic in origin and the remaining 50% primarily reflects the influence of peers. Other studies have compared the influence of different types of peers and have concluded that best friends are one of the most potent sources of influence, more potent than friends in general, general friendship networks, or broad-based peer networks (Berndt, 1996; Cohen, 1983; Morgan & Grube, 1991; but see Bearman & Brückner, 1999).

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Such conclusions may not be warranted. The majority of studies of adolescent peer influence simply ask participants how many friends have performed a risk behavior and then correlate this value with the target's own risk behavior. A statistically significant correlation between the measures is assumed to reflect peer influence (Berndt, 1996). Variants of this strategy ask whether the person's closest friend has performed a risk behavior and then correlate this value with risk behavior. Critics have noted that the association between one's own behavior and reports of the behavior of friends cannot be taken as unambiguous evidence for peer influence (Bauman & Ennet, 1996; Billy & Udry, 1985; Cairns, Leung, & Cairns, 1995). Studies suggest that adolescents may be inaccurate in characterizing the behavior and attitudes of their friends (Bauman & Fisher, 1986; Donohew et al., 1999; Kandel, 1996; Wilcox & Udry, 1986). This research suggests that congruence between adolescent and peer behavioral measures may reflect response artifacts due to projection processes on the part of the adolescent (see Anderson & Lindsay, 1998; Bauman & Ennet, 1996; Whitley, 1998).

A second criticism of the traditional research paradigm is that the dynamics of peer influence are confounded with selection effects (Bauman & Ennet, 1996; Billy, Rodgers, & Udry, 1984; Kandel, 1978, 1996): Adolescents choose friends on the basis of a set of common values, common personality dynamics, and common life orientations. These values and orientations can encourage

or discourage risk behavior in their own right. The individual with an initial set of values and orientations that predispose him or her toward risk could well engage in risk behavior no matter who his or her peers are. It just so happens that the peers are people who have similar values and orientations (owing to friendship selection criteria), and hence there is a co-occurrence of risk behavior.

Researchers have argued that selection effects can be addressed by using longitudinal designs to document concomitant changes in behavior over time between peers and the target individual (Berndt, 1996). The reasoning is that once the friendships have formed, selection effects have taken place, and so any future co-occurrence of behavior is likely the result of peer influence. However, the personal qualities that influence friendship selection might still result in behavioral convergence over time, even after friends have been chosen. As an example, two adolescents may be more likely to become friends if they are physically developing at about the same rate. This shared attribute produces concomitant changes in hormones in the future, which can then lead to the future co-occurrence of sexual activity. We refer to such confounds as the occurrence of *parallel events*.

In sum, there is evidence that adolescents' risk behaviors are associated with the behaviors of their close friends, but it is not clear that such associations reflect peer influence. The associations instead may reflect measurement artifacts, friendship selection, or the operation of parallel events. In the present study we applied methods to control for these mechanisms to gain a sense of the magnitude of influence that close friends may exert on adolescent health-risk behavior.

### Strategies for Inferring Peer Influence

At least three strategies can be used to estimate peer influence. The first strategy is to obtain self-reports by adolescents of the extent to which their behavior is the result of peer pressure or motivated by concerns of what their friends think (e.g., Keefe, 1994; Steinberg & Silverberg, 1986; Urberg, Shyu, & Liang, 1990). This strategy is unsatisfactory, because adolescents may overestimate the extent to which they are being pressured from others as a way of justifying their decisions and past behavior (Suls, Wan, & Sanders, 1988). It also seems likely that questions about peer influence are sensitive only to direct coercion and that adolescents will lack insight into the subtle ways in which they are influenced by others (Berndt, 1996; Vorauer & Miller, 1997).

A second strategy is to place the construct of peer influence into a larger nomological network to determine whether the target-friend associations act in accordance with theoretical expectations vis-à-vis that network. For example, if individuals emulate the behavior of peers when they identify with them, one might expect target-friend associations to be greater when the friend is liked a great deal than when the friend is liked less (Buunk & Gibbons, 1997). Similarly, a friend should have more influence if she or he is the target's only friend, rather than one of a large number of friends (Berndt, 1996). Failure to find relationships such as these would raise doubts that adolescent-peer associations reflect social influence.

A third strategy involves measuring selection and confounding variables and then imposing statistical controls on those variables to eliminate ambiguity of interpretation. This strategy provides perspectives on the magnitude of peer influence by assessing the

extent to which target-friend associations remain intact after confounds have been controlled. Of course, there is no way of knowing whether all confounding influences have been controlled, and so this strategy cannot unequivocally demonstrate that the remaining effects are due to peer influence. Nevertheless, this approach can determine the extent to which target-friend associations are accounted for by the most likely and foreseeable confounds.

The present study used the latter two strategies. We placed peer influence within a larger nomological network to test predictions about the magnitude of peer associations. We also statistically controlled for a range of parallel-event confounds to determine whether theory-consistent patterns remain intact after such confounds are taken into account. In addition, we addressed measurement artifacts by assessing the behavior of close friends directly, rather than relying on reports of peer behavior by the target individual. In the next section, we introduce the nomological network and then review the potential confounds.

### A Nomological Network for Peer Influence: Identification

Our framework is premised on the notion that adolescents are more influenced by the actions of a friend to the extent that they *identify* with that friend. The notion that identification increases peer influence is shared by many theories of social influence, most notably social learning theory (Bandura, 1982) and social comparison theory (see Buunk & Gibbons, 1997; Suls & Wheeler, 2000). Because little research has tested mediators and moderators of peer influence, we define identification broadly so that it can speak to either of these theoretical frameworks. By identification, we mean that a friend can be seen as a relevant standard for self-evaluation, as a meaningful role model, or as a fellow member of an important social category (see Blanton, 2001). In this study, we investigated two general classes of variables that influence identification and thus the magnitude of peer influence.

The first class of theoretical variables reflect the *closeness* of the relationship. This is operationalized in three ways. The first two operationalizations are based on Aron, Aron, and Smollan's (1992) two facets of interpersonal closeness: *behaving close* and *feeling close*. A target-friend dyad is viewed as behaving close if members spend a great deal of time together. It is defined as feeling close if both individuals (as opposed to just one) nominate each other as the closest friend. The third and final operationalization is derived from the social comparison literature. Social comparison research indicates that people are more likely to compare themselves with others to the extent that they are *similar* (Festinger, 1954; see Blanton, 2001; Wood, 1989). This suggests that peer influence also should be greater when two peers are similar. Because friends share a great deal of similarity to one another on many dimensions, the present study focused on similarity with regard to past behavior. Two friends are viewed as similar to the degree that they have engaged in similar levels of health-risk behavior in the past.

The second class of variables related to identification focus on the larger social network in which friendships are embedded and the competing sources of influence that might moderate the effects of one's closest friend. Our reasoning is that identification with a friend should be greatest to the extent that this one friend has little "outside competition" from others. For instance, we predicted that the influence of a close friend would be diminished to the extent

that target individuals had many other friends available to them (see Berndt, 1996). Parents also represent an alternative guide to behavior, and so we predicted that adolescents would be less susceptible to peer influence when they had positive relations with their parents (see Dishion, 1990; Miller, 1998; Steinberg & Silverberg, 1986).

In sum, we predicted that associations between target and peer behavior would increase when adolescents identified with a friend, as indicated by (a) greater time spent together, (b) reciprocal friendship nomination, (c) similar levels of prior risk behavior, (d) smaller friendship networks, and (e) less satisfying relationships with parents. Confirmation of the proposed relationships would increase confidence that observed associations between the behavior of adolescents and their friends derive from social influence mechanisms—not from confounds due to selection or parallel events.

### Confounding Parallel Events

As further assurance that relations reflect peer influence, six potential confounds reflecting possible parallel events are measured and controlled. For pedagogical purposes, we discuss how the variables might result in confounded associations for sexual activity (one of the health-risk behaviors that we studied), but the logic is readily extended to other risk behaviors. The first confound is *physical development*. Adolescents who mature at roughly the same rate as their peers are likely to undergo hormonal changes at about the same time. To the extent that hormonal factors have an impact on sexual activity (Halpern & Udry, 1999; Smith, Udry, & Morris, 1985; Udry, 1994), sexual intercourse will co-occur for an adolescent and his or her peers. A second confound is the presence of a *romantic relationship* with an opposite-sex partner, which tends to increase the likelihood of sexual activity (Dittus & Jaccard, 2000). Common contextual influences may dispose two similarly aged friends to orient toward opposite-sex relationships at roughly similar time points, and to the extent this is true, sexual intercourse will co-occur for them. A third confound is *academic achievement*. Higher levels of academic achievement are associated with lower levels of sexual activity (Stevens-Simon & McAnarney, 1996). To the extent that school performance changes in a similar fashion for target and peer, sexual activity will be more likely to co-occur.

Three additional confounds relate to parent-child relationships. The first is the *quality of the parental relationship*. Research suggests that the quality of the parent-adolescent relationship impacts sexual activity, with poorer relations leading to more sexual intercourse (Jaccard, Dittus, & Gordon, 1996). There is a tendency for adolescent satisfaction with the maternal relationship to decrease with age (Jaccard & Dittus, 1990). If dyad members are similarly aged, then it is possible that they may experience comparable levels of increased dissatisfaction with their parents over time. To the extent this is true, sexual activity will be more likely to co-occur over time. Another parent-based confound is *parental control*. In general, parents tend to become less vigilant about monitoring their children as the adolescent approaches adulthood. To the extent that such decreases in parental monitoring occur contemporaneously among friends over time, sexual activity may co-occur as well (Miller, 1998). The final variable is *parental disapproval of the target behavior*. Research has shown that par-

ents tend to become less disapproving of their adolescent engaging in sexual intercourse as adolescents become older (Jaccard & Dittus, 1990). Sexual activity may co-occur for an adolescent and a close friend over time because both individuals perceive decreased disapproval for sexual activity on the part of their parents.<sup>1</sup>

To summarize, in the current study we evaluate the magnitude of peer influence by close friends after measurement artifacts have been removed, after selection effects are controlled, after confounds due to parallel events are controlled, and in the context of a nomological network that tests whether peer associations vary in a theoretically coherent fashion. We use data from the National Longitudinal Study of Adolescent Health (Add Health) and focus on both sexual behavior and binge drinking (Bearman, Jones, & Udry, 1997). This permits us to replicate peer-based analyses in two risk behavior domains. Of interest in both sets of analyses is whether risk behaviors between two time points for a target individual are associated with risk behaviors of his or her same-sex friend during that same time interval.

### Method

#### *Respondents*

The analysis used the Add Health database collected by Bearman et al. (1997).<sup>2</sup> The Add Health database is a school-based sample of 20,745 adolescents in Grades 7 through 12 who reside in the United States. The sampling frame selected a stratified random sample of 80 high schools in the United States. For each school, a set of “feeder” schools was identified that included 7th graders who sent their graduates to the high school. This resulted in a pair of schools in each of 80 communities. Because some high schools spanned Grades 7 to 12, they functioned as their own feeder school, and the “pair” was a single school. There were 134 discrete schools in the study.

An initial in-school self-administered questionnaire was given to students in Grades 7 to 12 in all schools during a class period. This questionnaire was completed by more than 90,000 adolescents. All students who completed the in-school questionnaire as well as those who were listed on the school roster were used as a sampling frame to specify a random sample of 12,105 adolescents, stratified by gender and grade, who were later interviewed in their homes. Approximately 200 adolescents were selected from each of the 80 pairs of schools. Because Add Health was designed to elucidate adolescent social networks, there were 16 schools from which all enrolled students were selected for the in-home interviews. These were two large schools (with a total combined enrollment of over 3,300) and 14 small schools (with enrollment of fewer than 300). This sample is called the “saturation sample” and was used for the present study. Data were collected at two points in time separated by an approximately 1-year time interval. All respondents nominated up to five same-sex friends and five opposite-sex friends, and it was possible to link the data between a given adolescent and his or her nominations in the context of the

<sup>1</sup> For some of the parallel event variables noted above, it is possible that indirect peer effects are operating. For example, a peer whose relationship with his or her parents is deteriorating and who starts to do poorly in school may contribute to poor relations and poorer school performance on the part of the target individual. These behaviors, in turn, may make both individuals more prone to engage in sex, resulting in an association between target-peer behavior change. When this indirect peer influence on parental relationships and school performance is held constant, the target-peer association in sexual behavior change becomes trivial. We discuss this dynamic in later sections.

<sup>2</sup> This database is described in detail at [www.cpc.unc.edu/addhealth](http://www.cpc.unc.edu/addhealth).

saturated sample. The present study focused on individuals who (a) were in the saturated sample, (b) nominated at least one same-sex friend in their school, (c) were in Grades 7 through 11, and (d) were interviewed at both times of assessment. The adolescents also were restricted to include only those who had never married. There were 1,692 individuals who met the above criteria. Attrition was relatively low. Of those whom the research team intended to reinterview, about 80% were reinterviewed. There was no evidence for attrition bias when explored using a range of demographics measured at Wave 1.

### Procedure

The majority of the interviews were conducted in the respondents' homes. All data were recorded on laptop computers. For less sensitive sections, the interviewer read the questions and entered the respondent's answers. For more sensitive sections, the respondent listened to prerecorded questions through earphones and entered the answers directly (through audio computer-assisted self-interviewing). The topics covered in the interviews were diverse, including health status, health facility utilization, nutrition, peer networks, decision-making processes, family composition and dynamics, educational aspirations and expectations, employment experience, the ordering of events in the formation of romantic partnerships, substance use, and criminal activities. All of the measures described below were obtained at both waves of the survey.

### Measures

*Nominations and peer linking.* Each study participant was asked to list the names of five same-sex friends. For each nomination, five questions were asked to determine how close the respondent was to the friend: "Did you go to [name]'s house during the past seven days?"; "Did you meet [name] after school to hang out or go somewhere during the past seven days?"; "Did you spend time with [name] during the past weekend?"; "Did you talk to [name] about a problem during the past seven days?"; and "Did you talk to [name] on the telephone during the past seven days?" These five items each were scored 0 for *no* and 1 for *yes* and then summed to yield a score from 0 to 5. The closest friend was operationalized as the nominee who received the highest score on this closeness index and who also attended the respondent's school (hence, our focus was on same-sex friends within one's school). In the case of a tie for two or more nominees, the friend who was mentioned first was selected as the closest friend. The data from the study participant and the friend were then linked together into a single dyad. Each dyad had a set of variables reflecting the nominator's status on variables of interest as well as that of the nominee's status on the same variables. All measures described below were available for both the target individual and his or her peer.

The above represents a behavioral approach to defining one's closest friend. A second strategy is to use the individual's self-nominated closest friend. Respondents were asked to list their closest friend first when completing the above friend nominations, so it was possible to identify one's best friend using the self-nomination technique in addition to the behavioral technique. Of the individuals who were identified as closest friends using the behavioral approach, 65% also were identified as best friends using self-nominations. We decided to use the behavioral approach for defining a best friend for the reported analyses. Thus, if a target individual tended to go to the house of a friend more than to the homes of his or her other friends, spent the most time with that friend, talked about his or her problems to that friend more than to other friends, called that friend on the phone more than other friends, and hung out with that friend more than with others, then operationally, that friend was considered the individual's best friend. We repeated all analyses using the self-nominated closest friend in place of the behavior-derived best friend, and the results of the analyses paralleled those reported here. In addition, we took into account reciprocal nominations when defining friendships but did so in the form of moderator analyses, as described in the Results section.

*Adolescent satisfaction with maternal relationship.* The extent to which adolescents were satisfied with their relationship with their mothers was measured with the following item: "Overall, I am satisfied with my relationship with my mother." This statement was responded to on a 5-point *agree-disagree* scale and scored from 1 to 5 such that higher numbers indicated greater agreement. This single-item measure has been found to be highly correlated with more complex multi-item measures of relationship satisfaction and has been used successfully in our research program in numerous empirical studies (Jaccard & Dittus, 1990; Jaccard et al., 1996).

*Adolescent perceptions of parental control.* The extent to which adolescents perceive their parents as controlling was assessed with seven items focused on the degree to which adolescents are permitted to make their own decisions regarding certain behaviors. Items were responded to with yes or no; a composite measure of perceived parental control was derived by averaging across the seven items, such that a higher score indicated a greater degree of parental control. Each of the seven items began with the phrase "Do your parents let you make your own decisions about . . . ?" The items were "the time you must be home on weekend nights," "the people you hang around with," "what you wear," "how much television you watch," "which television programs you watch," "what time you go to bed on weeknights," and "what you eat." The alpha for this measure was .78 at Wave 1 and .74 at Wave 2.

*Physical development.* Adolescent respondents were asked to describe the extent of their physical maturity by responding to a number of statements (four items for boys; three for girls). An overall index of physical development was formed within gender by first standardizing the responses to a given item and then averaging the responses across the items. For a boy, the items focused on how much hair had grown under his arms, how much hair had grown on his face, to what degree his voice was lower than it had been in grade school, and overall how advanced his physical development was compared with other boys his age. For a girl, the items measured to what degree her breasts had developed, how curved her body had become, and overall how advanced her physical development was compared with other girls her age. Measures based on this approach have been used in numerous studies on physical development (Morris & Udry, 1980; Udry, Talbert, & Morris, 1986) and typically have been found to be highly correlated with more detailed measures based on direct physical observations. The actual items used are available in codebooks on the Add Health website.

*Adolescent perceptions of mothers' attitudes about sex.* Adolescent respondents were asked to indicate their perceptions of their mothers' attitudes toward their engaging in sexual activity and toward their using contraception. The item measuring perception of mothers' disapproval of sexual intercourse was "How would your mother feel about your having sex at this time in your life?" Responses ranged from 1 to 5, from *strongly approve* to *strongly disapprove*. Scores were assigned such that higher scores indicated greater disapproval. The item measuring perception of mothers' approval of the use of birth control was "How would your mother feel about your using birth control at this time in your life?" This was scored from 1 to 5, with higher scores indicating greater approval. These measures have been used successfully in past research and have been shown to have construct validity (Jaccard et al., 1996). The item on birth control has some ambiguity with respect to low scores, because a low score can result from either disapproval of sex in general or simply disapproval of birth control. This conceptual ambiguity, however, does not create problems for the use of the measure as a control for the occurrence of a parallel event over time.

*Academic achievement.* Academic achievement was measured in terms of a self-report of grades during the last grading period. Reports were made using letter grades (A, B, C, and D or lower) and were reported separately for English or language arts, mathematics, history or social studies, and science. An overall grade point average was assigned by averaging re-

sponses to these items, where 1 indicated a D or lower and 4 indicated an A.

*Involvement in an opposite-sex relationship.* Each individual was asked to provide the first and last initials of “each person you have had a special romantic relationship with in the last 18 months.” Additional questions probed whether any of the mentioned partners was a current partner of the adolescent and whether the nominated person was of the opposite or same sex (for our respondents, all partners were of the opposite sex). This variable was scored dichotomously, with a 1 indicating the adolescent was currently in a relationship and a 0 indicating the adolescent was not.

*Behavioral outcomes.* In terms of sexual behavior, an index of whether the adolescent had engaged in sexual intercourse between the two waves of assessment was derived from responses to the following question, asked at both the first and second interviews: “Have you ever had sexual intercourse? When we say sexual intercourse, we mean when a male inserts his penis into a female’s vagina.” If the respondent reported that he or she had never engaged in sexual intercourse at Wave 1 but then reported that he or she had engaged in sexual intercourse at Wave 2, then that respondent was scored as having engaged in sexual intercourse since Wave 1. In addition, dates provided in response to the question “In what month and year did you have sexual intercourse most recently?” at Wave 2 were used to determine whether sexual intercourse had occurred since the last interview for adolescents who were already sexually active as of Wave 1. Binge drinking was measured by asking individuals, “Over the past twelve months, on how many days did you drink five or more drinks in a row?” This was followed by a rating scale with the following response categories: 1 = *never*, 2 = *one or two days in the past 12 months*, 3 = *once a month or less (3–12 times in the past 12 months)*, 4 = *two or three days a month*, 5 = *one or two days a week*, 6 = *three to five days a week*, 7 = *every day or almost every day*. The focus on five or more drinks on a single occasion is the traditional standard for defining binge drinking, although it represents a somewhat heavier drinking pattern for females as opposed to males because of height, weight, and metabolism differences (Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994).

*Peer similarity on the surrounding dimension.* A measure of peer similarity on the surrounding dimension for binge drinking was defined as whether the individual had ever engaged in the consumption of alcohol. Specifically, each individual was asked, “Do you ever drink beer, wine, or liquor when you are not with your parents or other adults in your family?” If the target individual and the peer gave the same response to this item, they were classified as being similar on the surrounding dimension. For sexual behavior, the indicator of similarity was whether the target and the individual had ever engaged in sexual intercourse. If both individuals had engaged in sexual intercourse or if neither individual had, then they were classified as similar on the surrounding dimension.

## Results

### *Analytic Strategy*

Strategies for the analysis of concomitant change are controversial, and no one approach is best. In the present research, the analysis is complicated by the need to test for interaction effects and by the fact that one of the outcomes is dichotomous. We analyzed the data first using traditional regression strategies for panel data. The data have two sources of dependency that further complicate this analysis. First, respondents were selected from 16 different schools, and it is possible that school effects introduce residual dependencies for students from the same school (i.e., students from the same school may be more alike than students from different schools). Second, because data for targets and peers are linked on the basis of nominations, it is possible for a person’s

data to appear more than once in the data set, once as the target individual and then additional times depending on whether the person is nominated as a best friend. Strategies for dealing with “clustering” effects due to common schools and other sources of residual dependencies have evolved in the statistical literature on complex survey sampling. Two general approaches are used. In one, dependencies are viewed as nuisances whose adverse influence on inferential tests need to be eliminated. In the other, dependencies are thought to be of theoretical interest and formally modeled and described (Lehtonen & Pahkinen, 1996). We adopted the former perspective.

We used the generalized linear model approach of McCullagh and Nelder (1989) using the method of generalized estimating equations (GEE) introduced by Zeger and Liang (1986) and extended to clustered data in the SUDAAN computer package (see Shah, Barnwell, & Bieler, 1997, pp. 4–11). These methods can be thought of as traditional multiple regression and logistic regression models but with adjustments to accommodate bias in standard errors caused by clustering and residual dependencies of unknown form. We defined each school as a primary sampling unit (PSU) from a single stratum and then identified target–peer dyads within a school as replicates within a PSU, with each replicate having an equal probability of being selected. We then used the SUDAAN computer program to calculate parameter estimates and to perform significance tests using robust variants of GEE algorithms.

In all of our analyses (unless otherwise noted), we included gender, maternal education of the target person, maternal education of the peer, ethnicity of the target person, and grade of the target person as covariates. Grade level is highly correlated with chronological age ( $r = .89$ ), and so it controls for age as well. There is theoretical justification for preferring grade to age as an index of the broader developmental context in which the adolescent is embedded. Ethnicity of the peer and grade of the peer were not included because these were highly collinear with their target counterparts (e.g., most friends are the same age and ethnicity). In his research on peer effects, Udry reported several gender and ethnic differences in the effects of peer-related variables (e.g., Billy et al., 1984; Billy & Udry, 1985; Smith et al., 1985). Interaction effects with these covariates were explored accordingly.

Special analytic issues arise because adolescent friendships often are not long lived. Fifty-three percent of the sample failed to nominate their closest friend from Wave 1 as one of their friends (closest or otherwise) at Wave 2. If analyses focused only on individuals whose friendships persisted over the 1-year interval between waves, then the resulting dyads would be atypical, thereby undermining the external validity of the analyses. In addition, it is unclear from the nomination data when the friendship was terminated. It could have been 1 week prior to the Wave 2 nominations, or it could have been 51 weeks prior. Billy and Udry (1985) found that friendship deselection processes cannot account for associations between target and peer behavior in the sexual domain. Bearman and Brückner (1999) noted that when friends are replaced, they tend to be replaced with someone who is similar to the original friend (see also Billy & Udry, 1985). Thus, the peer behavior as measured at Wave 2 of the closest friend nominated at Wave 1 can be construed as a proxy of the behavior of the target’s current closest friend at Wave 2. These considerations led us to conduct analyses on adolescent–peer dyads established at Wave 1

irrespective of whether the friendship was still intact at Wave 2. However, the stability of the relationship was dummy coded, and differential effects due to stability status were evaluated in all analyses through the use of product terms (Jaccard, Turrisi, & Wan, 1991).<sup>3</sup>

Preliminary analyses using the full set of assessed variables were tested for multivariate outliers using leverage statistics (Cook & Weisberg, 1986). An outlier was defined as an individual having a leverage score four times larger than the mean leverage score in the sample. No outliers were detected. Where possible and consistent with the recommendations of the recent American Psychological Association task force on data analysis (Wilkinson, 1999), we report confidence intervals for model parameters as a way of conveying both statistical significance and an appreciation of sampling error.

### Initial Analyses

*Descriptive statistics.* Table 1 contains descriptive statistics for sexual activity and binge drinking behavior. At Wave 1, 65% of the sample were virgins. Thirty-nine percent of the respondents engaged in sexual intercourse between the first and second waves of the interview. At Wave 1, 72% of the sample had not engaged in binge drinking during the past 12 months, whereas 28% had engaged in it one or more times. By the time of Wave 2, binge drinking had increased at all scale points, as reflected by the binge drinking measure. The behavioral profiles of the sample were similar to the profile of the larger Add Health sample, suggesting that the sample is not unrepresentative or biased in this respect.

Table 1 also contains comparisons of the risk behaviors on key demographic variables. Sexual activity tended to increase with age. Binge drinking showed a statistically significant change from 8th to 9th grade but then tended to level off through the rest of high school. At Wave 1, boys were more sexually active and were binge drinking more frequently than girls. Smaller percentages of Latinos and European Americans were sexually active than African

Americans, and African Americans and Latinos reported binge drinking less frequently than European Americans.

Exhaustive analyses failed to reveal significant tendencies for the demographic variables in Table 2 to moderate the magnitude of peer influence effects reported later. Given this fact and the lack of strong theory guiding the prediction of such moderation, we do not present demographic moderator analyses below. However, we present analyses that include demographic variables as covariates, consistent with the analytic strategy outlined above. We also did not find evidence for higher order interactions with the demographic covariates, but care must be exercised in interpreting such trends because of small cell sample sizes and power issues.

*Peer selection and peer influence.* Pearson correlations between selected target-peer variables at Wave 1 are presented in Table 2. These correlations are uncorrected for covariates and indicate that individuals and their friends tend to exhibit commonalities on the measured dimensions. These correlations could be the result of friendship selection effects, past peer influence, or some common cause that creates spurious relationships between the variables. They indicate that individuals who engaged in sex tended to have friends who engaged in sex and that individuals who engaged in higher levels of binge drinking tended to have friends who engaged in higher levels of binge drinking. These results are consistent with traditional cross-sectional analyses of "peer effects," but they differ by virtue of the fact that the peer measure is derived directly from the peer rather than through a report of peer behavior from the target individual.

At Wave 1, target-peer correlations for the indicators of confounding and parallel events were statistically significant ( $p < .05$ ). These results suggested that adolescents and close friends shared common tendencies in terms of (a) the quality of their relationship with their mother, (b) their academic achievement, (c) their perceptions of maternal disapproval of them engaging in sex, (d) their physical development, (e) whether they are involved in a romantic relationship, and (f) their perceptions of parental control. With four of these covariates (relationship satisfaction with the mother, perception of maternal disapproval of sex, involvement in a romantic relationship, and perceived parental control), the target-peer correlations tended to be nontrivially stronger for girls than for boys. This suggests that selection and peer effects may have been stronger for the adolescent girls than for the boys.

*Simple indices of across-time concomitant change.* To provide a general sense of concomitant change in behavior over time for target individuals and their friends, we applied simple descriptive statistical and graphical procedures to the data. For sexual activity,

Table 1  
*Descriptive Statistics and Risk Behavior*

Variable	N	Percentage reporting sex at Wave 1	Percentage reporting sex between waves	Mean binge drinking
<b>Grade</b>				
Wave 1 7th graders	148	4.1 <sub>a</sub>	11.0 <sub>a</sub>	1.07 <sub>a</sub>
Wave 1 8th graders	151	14.0 <sub>a</sub>	16.6 <sub>a</sub>	1.25 <sub>a</sub>
Wave 1 9th graders	233	27.3 <sub>b</sub>	32.3 <sub>b</sub>	1.70 <sub>b</sub>
Wave 1 10th graders	588	36.3 <sub>c</sub>	40.1 <sub>c</sub>	1.79 <sub>b</sub>
Wave 1 11th graders	568	50.5 <sub>d</sub>	53.5 <sub>d</sub>	1.81 <sub>b</sub>
<b>Gender</b>				
Male	837	38.6 <sub>a</sub>	38.5 <sub>a</sub>	1.82 <sub>a</sub>
Female	851	31.2 <sub>b</sub>	38.2 <sub>a</sub>	1.53 <sub>b</sub>
<b>Ethnicity</b>				
African American	218	47.2 <sub>a</sub>	49.2 <sub>a</sub>	1.28 <sub>a</sub>
Latino	250	29.3 <sub>b</sub>	30.7 <sub>b</sub>	1.50 <sub>a</sub>
European American	891	32.2 <sub>b</sub>	36.0 <sub>b</sub>	1.75 <sub>b</sub>
Other	305	39.5 <sub>a</sub>	45.3 <sub>a</sub>	1.90 <sub>b</sub>
Total sample	1,692	35.2	34.8	1.67

*Note.* Values in a column within a variable category (e.g., grade) with different subscripts differ at  $p < .05$ .

<sup>3</sup> By including interaction terms with dyad stability, we are essentially exploring whether the change dynamics are different for dyads that remain intact versus those that do not. If peer influence is truly operating, one would expect these interactions to be pervasive. The advantage of using this approach as compared with doing split-sample analyses on the subgroups separately is that (a) the latter approach yields more stable estimates of error terms and (b) the latter approach directly compares the parameters of change in one group with the parameters of change in the other group. In later analyses, it is important to keep in mind the distinction between the stability of the friendship (whether the friendship dissolved over time) and friendship reciprocity (whether, at Wave 1, the linked peer and the target individual were best friends with each other or whether the best friend designation was only for the target to peer versus vice versa).

Table 2  
Zero-Order Correlations Between Target Individual and Same-Gender Closest Friend

Target and peer variable	Total sample	Boys	Girls
Relationship satisfaction with mother	.09	-.01 <sup>b</sup>	.15
Grade point average	.42	.37	.44
Perception of maternal disapproval of sex	.24	.11 <sup>a</sup>	.32
Physical development	.11	.14	.08 <sup>a</sup>
In a romantic relationship	.17	.11	.23
Perceived parental control	.12	.05 <sup>b</sup>	.19
Grade	.85	.83	.87
Ever had sexual intercourse	.37	.34	.40
Binge drinking	.30	.31	.25

Note. All correlations are statistically significant at  $p < .05$  unless otherwise noted. Sample sizes vary slightly for a given correlation owing to missing data.

<sup>a</sup>  $p < .10$ . <sup>b</sup>  $p > .10$ .

of those target individuals whose closest friend engaged in sexual activity across the two waves, 56% also engaged in sexual intercourse across the waves. By contrast, for those target individuals whose closest friend did not engage in sexual activity across the waves, only 24% engaged in sexual intercourse across the waves. The probability of engaging in sexual intercourse across waves on the part of the target individual was thus more than two times higher if the friend had sexual intercourse than if the friend did not. If these two probabilities (.56 and .24) are expressed in terms of the traditional index of odds, the respective values are  $.56/(1 - .56) = 1.27$  and  $.24/(1 - .24) = 0.32$ , and the odds ratio is  $1.27/0.32 = 3.97$ . The odds of engaging in sexual intercourse

across waves are thus about 4 times higher when the peer has engaged in sexual intercourse across waves than when the peer has not done so. In later sections, we characterize the differential tendencies using odds rather than probabilities because of our reliance on logistic regression, which lends itself to the characterization of effects in terms of odds and odds ratios.

For binge drinking, the association between changes in peer behavior and changes in target behavior is characterized using a smoothed scatterplot in Figure 1. The  $x$ -axis is the difference score between binge drinking reported at Wave 2 and binge drinking reported at Wave 1 for the peer. Negative scores indicate a change on the part of the peer toward less binge drinking, and positive scores indicate a change toward more binge drinking. The  $y$ -axis represents changes in binge drinking on the part of the target individual, again with negative scores indicating changes toward less binge drinking and positive scores indicating changes toward more binge drinking. The plotted data points represent the mean target individual change scores at each level of the peer change score (hence, it is a smoothed scatterplot). Although a positive linear trend is evident in these data, each of the mean values characterized by a data point has considerable variability about it, as reflected by the fact that the two sets of difference scores are correlated only .09. The slope of the line in Figure 1 is relatively flat given the different scaling metrics used on the two axes, and there is no evidence of high levels of concomitant change.

#### Analysis of Sexual Activity Across Waves

In this section, we first report estimates of peer effects controlling for selection. We next report results when parallel events are

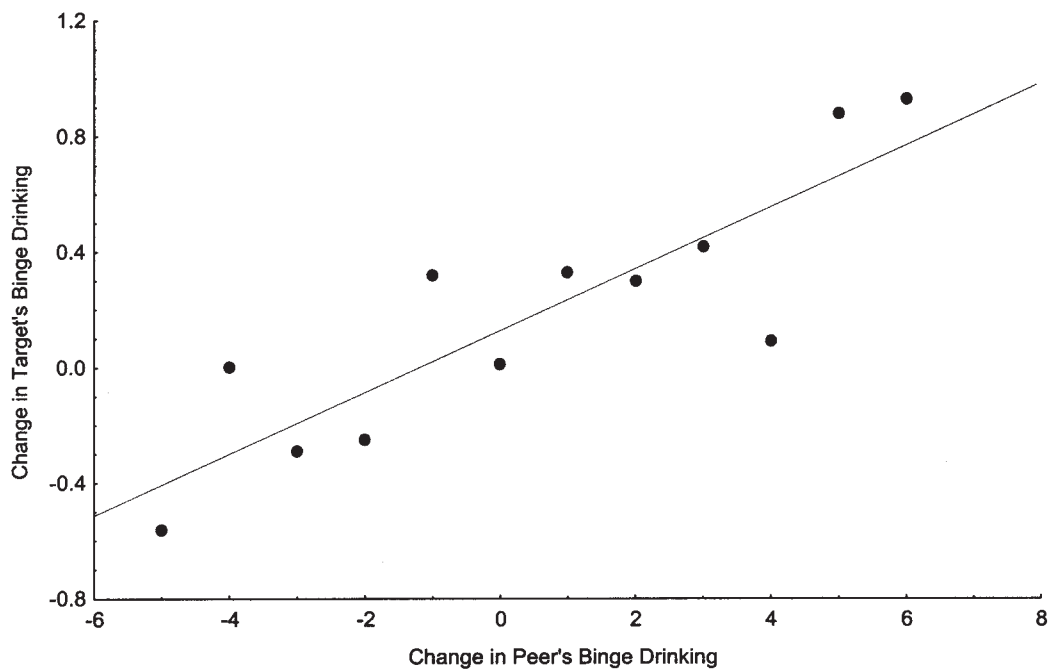


Figure 1. Smoothed scatterplot of target's mean changes in binge drinking as a function of peer changes in binge drinking.

controlled and then the results for the behavior of target–peer associations within the broader identity nomological network.

*Concomitant changes in target–peer behavior over time, controlling for selection effects.* To determine whether a target’s sexual behavior over time was associated with peer sexual behavior over time, a logistic regression was performed, regressing whether the target individual had engaged in sex between the time periods onto the following predictors: (a) whether the peer had engaged in sex between the time periods, (b) indices of past sexual activity as reflected by the virgin status of both the target and the peer at Wave 1 (so as to control for friendship selection effects based on the previous sexual histories of the target and peer), and (c) the demographic covariates. The exponent of the logistic coefficient for the peer predictor reflecting peer sexual activity between waves was 2.11 (95% confidence interval [CI] = 1.63 to 2.73), suggesting that the odds of an adolescent engaging in sex between the two waves of assessment were about twice as high if the same-sex closest friend of the adolescent engaged in sex across waves as compared with the case where the same-sex friend did not engage in sex across waves, after controlling for the covariates. This contrasts with the 4 to 1 ratio from the previous section where selection effects and covariates were not statistically controlled. Table 3 shows the relevant odds ratios and 95% CIs for the three primary predictors focused on sexual activity. Interaction analyses were performed to test whether the effects of the across-time peer predictor varied as a function of the target’s virgin status as well as each of the other covariates in the equations. These analyses yielded no statistically significant interaction effects.

*Control for parallel events.* The logistic regression model tested above was augmented with additional predictors to control for concomitant changes in the quality of the relationship with the mother across time, concomitant changes in grade-point average, concomitant changes in perceived maternal disapproval of sex, concomitant changes in physical development, concomitant changes in parental control, and concomitant changes in romantic relationship status. Using maternal disapproval of sexual activity to illustrate the logic of the analysis, we regressed the target’s sexual behavior across time onto the predictors described in the previous section, as well as the target individual’s perception of his or her mother’s disapproval as measured at Wave 1 and Wave 2 and the peer’s perception of his or her mother’s disapproval at Wave 1 and Wave 2. This analysis tests for the effect of peer sexual activity across time while controlling for target and peer maternal disapproval of sex at both Wave 1 and Wave 2. It thus controls for confounds with peer influence due to concomitant changes in maternal disapproval of sexual intercourse. When predictors for all of the parallel events were included in the prediction

equation, the exponent of the logistic coefficient for peer sexual behavior between waves was 1.65 (95% CI = 1.01 to 2.68). The peer effect across time remained statistically significant ( $p < .045$ ), but the point estimate was somewhat weaker in magnitude than before: The predicted odds of an adolescent engaging in sex between the two waves of assessment were about one and two thirds higher if the same-sex closest friend of the adolescent engaged in sex across waves as compared with the case where the same-sex friend did not engage in sex across waves, holding constant all other variables in the equation.

*Analysis of nomological network.* The identification framework states that the amount of peer influence will vary as a function of five variables: reciprocity of nominations, time spent together, similarity on the behavioral dimension, number of close friends, and adolescent satisfaction with the maternal relationship. This implies a statistical interaction between each of these variables and the measure of peer sexual activity across waves when predicting sexual activity of the target respondent. Interaction effects for these variables as well as the stability of the target–peer relationship across time were tested using product terms (Jaccard et al., 1991). None of the conceptually mandated variables yielded statistically significant interaction effects, although there was a statistically significant interaction between the peer predictor and the stability of the friendship over time (exponent of logistic coefficient for the product term = 3.38, 95% CI = 1.60 to 7.15,  $p < .01$ ). When the friendship was stable between waves, the predicted odds ratio for the peer predictor was 3.59 (95% CI = 2.28 to 5.64), whereas when the friendship was unstable, the predicted odds ratio was 1.06 (95% CI = 0.63 to 1.80). Thus, the peer effect was statistically significantly stronger when the friendship persisted across time than when it did not. Although such a result is consistent with what one would expect from the perspective of true peer influence effects, the failure to observe interactions with the other variables offers little support for the hypothesized identification mechanisms.

In sum, the analysis of sexual activity yielded results that were consistent with peer influence after friendship selection effects were statistically controlled, as well as when a wide range of parallel events were statistically controlled. The effect size was small but consistent. However, the analysis of predictors of the degree of peer influence in the context of a broader theoretical network of peer effects yielded limited support for peer influence.

*Analysis of Binge Drinking*

As with sexual activity, we report estimates of peer effects controlling for selection effects, then analyses that control for

Table 3  
*Odds Ratios and Unstandardized Regression Coefficients for Predictors in the Logistic Regression and the Linear Regression*

Predictor variable	Sexual behavior odds ratio	95% CI	Binge drinking regression coefficient	95% CI
Target behavior at Wave 1	10.15	7.74 to 13.31	0.48	0.43 to 0.53
Peer behavior at Wave 1	1.15	0.86 to 1.55	0.07	–0.01 to 0.15
Peer behavior at Wave 2	2.11	1.63 to 2.73	0.12	0.10 to 0.14

Note. CI = confidence interval.



parallel events, and then we evaluate the behavior of target–peer associations within the broader identity nomological network.

*Concomitant changes in target–peer behavior over time, controlling for selection effects.* To determine whether a target’s binge drinking behavior over time was associated with peer binge drinking behavior over time, a regression analysis was performed regressing the amount of binge drinking that the target individual reported at Wave 2 onto the following predictors: (a) the amount of binge drinking that the peer reported at Wave 2, (b) indices of the frequency of binge drinking at Wave 1 for both the target and the peer (to control for friendship selection effects by controlling previous binge drinking histories of the target and peer), and (c) the demographic covariates. The squared multiple correlation for the analysis was .31 ( $p < .01$ ). The unstandardized regression coefficient for the peer predictor at Wave 2 was 0.12 (95% CI = 0.10 to 0.14,  $p < .05$ ), suggesting that changes in the target’s binge drinking behavior over time are associated with changes in the binge drinking behavior of his or her closest friend over time, holding constant friendship selection effects. The effect, however, is somewhat small: A 1-unit change on the binge drinking scale for the peer across time is associated with a 0.12-unit change on that scale for the target individual. Table 3 contains the relevant unstandardized regression coefficients and 95% confidence intervals for the three primary predictors focused on binge drinking. If the confidence interval does not include the value of zero, then the regression coefficient is statistically significant in traditional null hypothesis testing.

*Control for parallel events.* The regression model tested above was augmented with additional predictors to control for concomitant changes in the quality of the relationship with the mother across time, concomitant changes in grade point average, concomitant changes in physical development, concomitant changes in parental control, and concomitant changes in romantic relationship status, using a structure parallel to that of the previously reported logistic regressions. When predictors for all of the parallel events were included in the equation, the unstandardized regression coefficient for peer binge drinking at Wave 2 was 0.07 (95% CI = 0.05 to 0.09). The peer effect across time remained statistically significant ( $p < .01$ ), but the point estimate was weaker in magnitude, such that a 1-unit change on the binge drinking scale for the peer across time was associated with a 0.07-unit change for the target individual.

*Analysis of nomological network.* The five conceptually relevant predictors of peer influence as well as the stability of the target–peer relationship across time were tested for statistical interaction with the index of peer binge drinking at Wave 2. Three of the five conceptually mandated variables yielded statistically significant interaction effects. First, there was a statistically significant interaction with whether the friendship was reciprocated by the peer and peer binge drinking at Wave 2 (unstandardized regression coefficient for the product term =  $-0.09$ , 95% CI =  $-0.17$  to  $-0.02$ ,  $p < .03$ ). When the friendship relationship was reciprocated by the peer, the unstandardized coefficient for the peer Wave 2 predictor was 0.05 (95% CI = 0.01 to 0.09), whereas when the friendship relationship was not reciprocated by the peer, the unstandardized coefficient for the peer Wave 2 predictor was 0.14 (95% CI = 0.10 to 0.18). This was opposite to predictions. Second, a statistically significant interaction effect was observed with the behavioral similarity between target and peer and peer

binge drinking at Wave 2 (unstandardized regression coefficient for the product term = 0.15, 95% CI = 0.06 to 0.25,  $p < .006$ ). When the target and peer had a similar behavioral history with respect to having experimented with or having not experimented with alcohol, the unstandardized coefficient for the peer Wave 2 predictor was 0.18 (95% CI = 0.01 to 0.09). When the experimentation history was dissimilar, the unstandardized coefficient for the peer Wave 2 predictor was 0.03 (95% CI =  $-0.02$  to 0.08,  $p > .05$ ). This was consistent with predictions, because the effect of the peer was stronger when peer and target were similar as opposed to dissimilar on the surrounding behavioral dimension. Third, a statistically significant interaction effect was observed with the adolescent’s satisfaction with his or her maternal relationship and peer binge drinking at Wave 2 (unstandardized regression coefficient for the product term =  $-0.04$ , 95% CI =  $-0.06$  to  $-0.02$ ,  $p < .01$ ). As satisfaction with the maternal relationship increased, the effect of peer binge drinking at Wave 2 tended to decrease. For example, when adolescent satisfaction with the maternal relationship was at its neutral point on the satisfaction scale, the unstandardized regression coefficient for the peer Wave 2 predictor was 0.16 (95% CI = 0.13 to 0.19). When adolescent satisfaction with the maternal relationship was at its highest point on the satisfaction scale, the unstandardized regression coefficient for the peer Wave 2 predictor was 0.09 (95% CI = 0.07 to 0.11). This trend was consistent with predictions, as it suggested weaker peer influence when parental satisfaction was high.

In addition to these theoretically mandated analyses, we tested whether the stability of the friendship interacted with peer effects in the prediction of binge drinking behavior. There was a statistically significant interaction with the stability of the friendship over time (product term coefficient =  $-0.07$ , 95% CI =  $-0.13$  to  $-0.01$ ,  $p < .03$ ). When the friendship was stable between waves, the unstandardized regression coefficient for the peer Wave 2 binge drinking predictor was 0.07 (95% CI = 0.05 to 0.09), whereas when the friendship was unstable, the unstandardized regression coefficient was 0.15 (95% CI = 0.13 to 0.17). This result was counter to predictions, as it suggested weaker peer influence when friendships persisted across time.

Although two of the four identification-based effects were contrary to predictions, these were weaker in magnitude than the two that were consistent with predictions. When a modified Bonferroni control for experimentwise error based on the Holm procedure discussed in Jaccard (1998) was applied to the interaction tests, only the theory-consistent interactions for behavioral similarity and maternal relationship satisfaction remained statistically significant ( $p < .05$ ).

### *Randomly Selected Peers*

Additional perspectives on the potential artifactual bases of target–peer effects can be garnered by examining whether there is a peer effect on the target individual behavior when data from a randomly selected individual are substituted for the data of the individual’s true close friend. If it is truly the close friend who is having an effect on the target individual rather than a common environmental confound or a parallel event affecting both individuals at similar times, then one would not expect to find a “friend” effect when the close friend is randomly selected and has a low probability of meaningful contact with the target individual. We

paired data from each target individual with data from another randomly selected individual who was in the same grade, of the same gender, and in the same school as the target individual. We then regressed the target individual's behavior between the two waves of assessment onto the behavior of the randomly selected peer. For sexual activity, there was a marginally statistically significant effect for predicting the sexual behavior between waves of the target individual and that of the random peer ( $p < .09$ ). The exponent of the logistic coefficient was 1.68 (95% CI = 0.92 to 3.09), suggesting that the target individual is about one and two thirds more likely to have had sex between waves if a random peer also has had sex between waves. For binge drinking, the effect for the random peer was statistically significant ( $p < .05$ ), with the unstandardized regression coefficient for the random peer at Wave 2 being 0.11 (95% CI = 0.01 to 0.21). For every 1-unit increase in the random peer's binge drinking, the target individual's binge drinking increased by 0.11 units on the binge drinking scale.

We added the random peer variables to the basic prediction equations to determine whether the close friend's scores predicted changes in behavior over and above that of the random peer. For sexual activity, the exponent of the logistic coefficient for the friend remained statistically significant ( $p < .01$ ) in both the analysis that did not control for parallel events (exponent of coefficient = 2.07, 95% CI = 1.58 to 2.71) and the analysis that did so (exponent of coefficient = 1.69, 95% CI = 1.05 to 2.72). The same was true for binge drinking. With this behavior, the unstandardized regression coefficient for the friend remained statistically significant ( $p < .01$ ) in both the analysis that did not control for parallel events (coefficient = 0.11, 95% CI = 0.09 to 0.13) and the analysis that did so (coefficient = 0.06, 95% CI = 0.05 to 0.07). These data are consistent with the proposition that friend effects are present independent of the parallel event effects that are represented by a randomly paired same-sex classmate of comparable age.

## Discussion

### *The Magnitude of Peer Influence*

Numerous studies have examined the relationship between an adolescent's behavior and the behavior of peers as a means of indexing peer influence, but most studies have not taken into account other factors that can contribute to such associations. After controlling for measurement artifacts, selection effects, and confounded parallel events, we observed consistent associations between changes in adolescent behavior and changes in peer behavior, but the effects were not strong. The estimated average effect of the adolescent's closest friend on the adolescent's binge drinking behavior corresponded to a shift of 0.07 rating scale units for every 1 full unit shift in the binge drinking behavior of the peer. For sexual activity, the odds of the target individual engaging in sexual intercourse across time were about 1.65 times larger when the target's closest friend had engaged in sexual intercourse across time as compared with when the target's closest friend had not. These effects, though meaningful, are somewhat weak. Overall, our data do not support the notion of pervasive peer influence on the part of one's closest friend with respect to adolescent health-risk behavior. This is especially true when one also considers that the associations thought to be reflective of peer influence did not

vary in accord with what one would expect within a broader nomological network of influence vis-à-vis identification mechanisms.<sup>4</sup>

We do not doubt that adolescent peer and social networks exert considerable impact on a wide range of behaviors, such as musical interests, clothing preference, and extracurricular activities. However, when it comes to risk behaviors such as sexual intercourse and binge drinking, which ultimately involve fundamental value systems of adolescents and their families, the influence of a close friend and other peers may be less important than commonly has been assumed. Granted, even small peer effects can be important as they accumulate over time, but this is true of other effects as well (e.g., parenting influences). The effects we observed are congruent with the idea that peer influence is just one of a number of factors that contribute to adolescent risk behavior. Regardless of the ultimate size of peer effects, it is clear that simple cross-sectional associations between peer and target behaviors yield larger estimates of peer influence than can be justified by a more critical analysis, such as ours.

Although small but consistent peer effects seemed evident in the data, there were other features of the results that raise questions about whether the observed associations were indeed the result of peer influence. It was disconcerting that the peer effects did not consistently vary for either risk behavior in accord with what one would expect on the basis of fundamental theories of identification processes, such as the reciprocity of nominations, time spent together, similarity on the behavioral dimension, number of friends, and adolescent satisfaction with the maternal relationship. This raises the possibility that the observed peer effects are not a result of identification processes but rather reflect some unspecified parallel event or confound. Our results, of course, must be interpreted with caution owing to the dangers of accepting the null hypothesis, but they should give one pause about the true source of the observed peer effects. It also was somewhat disconcerting that the behavior of a randomly selected peer revealed associations with the risk behavior of the target individual. This suggests the presence of a cohort effect, though the data also revealed an independent effect of one's close friend when the behavior of the random peer was controlled.

### *Moderators of Peer Influence*

Despite the above, there were features of the analysis that were interesting and that were consistent with identification mechanisms. Most notable was that peer effects for binge drinking manifested themselves in a theoretically meaningful fashion with respect to target-peer similarity on the surrounding behavioral dimensions as well as satisfaction with the maternal relationship. Specifically, peer effects were more likely to be manifest when the target and peer shared similar behavioral histories, a result that is consistent with social comparison theories (see Blanton, 2001). Moreover, peer effects were more likely to be found when the

<sup>4</sup> Lack of effects always must be interpreted relative to statistical power. Power was reasonable for all of our analyses. For example, to detect an effect for a single predictor that accounts for 1% unique variance in a multiple regression analysis with 15 predictors and a population  $R^2$  of .35, for a two-tailed alpha of .05 and a sample size of 1,700, the statistical power is greater than .99.

target was dissatisfied with the maternal relationship, a result suggesting that adolescents identify more with their peers when parental bonds are strained.

Before one concludes that target–peer associations do or do not reflect peer influence, future research should expand the list of theoretical mediators and moderators and, more important, isolate and directly measure the underlying theoretical mechanisms. To better isolate identification mechanisms, for instance, it might be informative to incorporate measures of changes in the self-concept and changes in the social images associated with the risk behavior (see Blanton & Christie, 2003; Gibbons & Gerrard, 1997). Alternatively, research might consider mechanisms that follow from theoretical frameworks other than identification. For instance, research could adopt a social learning perspective (Bandura, 1982) and test whether changes in knowledge and self-efficacy mediate observed peer effects. Or, research could adopt a situational perspective (Snyder, 1983) and test whether high-risk peers expose targets to higher risk environments, resulting in greater risk behavior by the target.

### *Confounded Variance*

We analyzed peer influence from multiple perspectives, none of which are without weakness. For our regression strategy with covariates, it could be argued that so many covariates were included in our models that the peer variables had little hope of manifesting influence. We would argue that the choice of covariates was based on carefully reasoned competitors to peer influence. Nevertheless, it is possible that some of the parallel events (e.g., changes in academic performance) may have incorporated aspects of peer influence and that we did not take into account important indirect effects of peers. This would result in an underestimation of peer influence because our modeling strategy modeled only direct (unmediated) effects, not indirect effects. The empirical evidence for nontrivial indirect effects was equivocal. For example, when we calculated peer influence effect sizes omitting the control of parallel events when such dynamics might be operating, the resulting effect sizes for peer influence were close in magnitude to those that we observed with such controls.

Even if one questions the covariate strategy, we evaluated peer effects from other perspectives as well. For example, we explored hypotheses about moderated effects in a larger nomological network, and we tested whether adding a random peer created the appearance of peer effects. Although no one approach is flawless, the overall picture that emerges from the multiple perspectives we took reinforces a similar message: Peer effects with respect to sexual activity and binge drinking may not be as pervasive as some have assumed.

### *Qualifications and Future Challenges*

There are important qualifications to our analysis of peer influence. Perhaps the most important qualification is that we have focused only on one type of peer effect, namely, the impact of same-sex closest friends who attend the same school as the target adolescent. More pervasive effects might be observed for broadly defined peer networks or for peers who have a qualitatively different relationship to the adolescent. It is important to note, however, that past research suggesting effects of broader peer networks

also have failed to control for selection effects and parallel events. These variables are just as important to control for broader peer networks as for more focused peer influences. Other forms of peer influence include perceived behavioral base rates and needs for acceptance with respect to broadly defined peer groups.

Other qualifications result from statistical and design limitations of the study. First, the effect sizes we observed may be biased by measurement error. The direction of bias is not tractable, and the true effects could be somewhat higher or somewhat lower than what we observed. Second, our effect size estimates are based on a model of peer influence that assumes trivial reciprocal influence, and such estimates could change if other more complex systems of influence are modeled.<sup>5</sup> Indeed, to the extent that reciprocal effects are present, the current estimates may be inflated that much more. Third, as noted earlier, some of the parallel events we considered may have incorporated peer influence, and results must be interpreted in light of this.

Additional qualifications arise from methodological constraints associated with data collection. The research relied on a school-based sample that is not representative of the U.S. population, and generalizations are restricted accordingly. The research also relied on self-reports of behavior, which are always a cause for concern. In addition, some of the constructs were represented by a single item. The use of single items can introduce bias in parameter estimates due to measurement error. If a construct is not adequately represented by a measure, then that construct may not be controlled fully in the statistical analyses.

It is also possible that weakened peer effects were observed because the current study used a measure of peer behavior rather than a measure assessing targets' perceptions of peer behavior. It is possible that some of the underlying mechanisms that govern peer influence derive from perceptions of peer behavior rather than peer behavior per se. One rationale for such an approach derives from symbolic interaction perspectives, which emphasize the subjective interpretation of one's environment over the environment (Blumer, 1969; see also Iannotti & Bush, 1992; Jussim & Osgood, 1989; Wilks, Callan, & Austin, 1989). As a final concern, we point out a challenge facing future research simply due to the nature of adolescent friendships. Our study highlights the fact that adolescent friendships tend to be short lived. Only about 50% of the target individuals' closest friends at Wave 1 were mentioned as members of the friendship network 1 year later. Adolescents change friends rapidly, and so the opportunity for any given friend to impact the behavior of a target individual is limited. As a result, future research that addresses peer effects must recognize and incorporate into its theorizing the dynamic nature of peer networks and accommodate the short histories that tend to characterize adolescent friendships.

<sup>5</sup> There are many forms that models of reciprocal causation can take. One model is that of peer accommodation, where each member of the dyad alters his or her behavior in a direction that is more congruent with that of the other member—that is, the individuals converge to a point in between their initial levels of risk behavior. We tested several models of reciprocal influence in the present data and found little support for them. Details of the analyses can be obtained from James Jaccard.

### Concluding Comments

The present study suggests that longitudinal associations between targets and friends with respect to alcohol and sexual activity are small but robust. It is unclear whether these associations reflect peer influence, and future research should continue in the tradition of the current study to disentangle peer influence from the confounds that plague this literature. Such research should test theoretically derived relationships between adolescents and peers, while controlling for selection effects, parallel events, and method variance. Studies that replicate cross-sectional, zero-order correlations between the behavior of adolescents and the behavior of their peers are of limited utility. Such findings yield little insight into the underlying mechanisms by which peer effects occur, and they probably lead to inflated estimates of the importance of peers.

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