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Sibling Contagion for Drinking in Adolescence: A Micro Process Framework

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Abstract

Siblings represent an important social influence on alcohol use in adolescence. That said, there is a need for studies that examine potential mechanisms by which siblings exert an influence on the likelihood of drinking in adolescence. This paper illustrates a method that utilizes videotaped interaction between sibling dyads along with a micro social coding system that captures rule break behavior between siblings. Sibling interaction was observed in sibling pairs participating in the Iowa Youth and Families Project (IYFP) at baseline; younger sibling use of alcohol was tracked for 3 additional annual assessments. Exposure to older sibling rule break at baseline was associated with later use of alcohol by younger siblings across the 3 annual assessments. Micro social methods hold promise for uncovering processes that underlie sibling contagion for alcohol use in adolescence.

Introduction

The importance of sibling influence on risky behaviors has long been recognized by developmentalists (Patterson, 1986) and is of considerable interest to both researchers and clinicians (see Kramer & Bank, 2005). Siblings contribute to the family environment as critical echoes of parental influence and provide a unique interpersonal influence during childhood and especially adolescence (Reiss et al., 2000). The importance of siblings derives from the extensive proximal and continual contact in childhood and adolescence, the strong emotional nature of the sibling relationship, and the eventual linkage with peer relationships especially during adolescence (Dunn, 2005). Indeed, prior conceptions of sibling influences as being of relatively minor importance as compared to parent and peer effects have been replaced by recognition of the strong empirical links between siblings' risky behaviors in adolescence, which often provides comparable predictive power to the effects observed for parents and peers (Avenevoli & Merikangas, 2003; Kokkevi et al., 2007a,b; Pomeroy et al., 2005; Slomkowski et al., 2005; Vink et al., 2003).

Recent studies have demonstrated that sibling influences may be especially salient for alcohol use in adolescence (Kokkevi et al., 2007a,b; Poelen et al., 2007; Scholte et al, 2007; Trim et al., 2006; Van Der Vorst et al., 2007). Sibling similarity for alcohol use increases inversely with age gap, such that siblings close in age show the most synchronous levels of use (Scholte et al., 2007; Trim et al., 2006). Although there have been suggestions that sibling similarity is greater for same-sex pairs (Trim et al., 2006), there is also evidence that sex composition does

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not moderate sibling similarity for alcohol consumption (Van Der Vorst et al., 2007). Co-sibling drinking has been shown to be more predictive of alcohol use in adolescence than parental drinking (Scholte et al., 2007), and heavy drinking by a sibling has recently been shown to convey a risk of similar magnitude to peer heavy drinking (Kokkevi et al., 2007a,b). Overall, after taking into account a number of psychosocial correlates of adolescent alcohol use, co-sibling drinking has emerged as one of the key predictors of heavy drinking in adolescence (Kokkevi et al., 2007b).

The overall implication from this body of work is that siblings represent an important socializing influence on adolescent drinking. Consistent with this, significant shared environmental effects on adolescent alcohol use have been found in twin studies (Buster & Rogers, 2000; McGue et al., 2001; Rose et al., 2001; Viken et al., 1999) as well as twin-sibling (Cleveland & Wiebe, 2003; Rende et al., 2005a) and sibling/twin/adoption paradigms (Rhee et al., 2003). Given the evidence for shared environmental effects derived from sibling-based genetically-informative designs, behavior geneticists have proposed that siblings may directly influence each other and as such serve as one important source of the shared environmental influence on adolescent alcohol use (Hopfer et al., 2003; Rhee et al., 2003; Rose, 1998). In support of this proposition, Rende et al. (2005) utilized a twin/sibling design to demonstrate that sibling relationship quality—specifically high levels of sibling connectedness—significantly moderates the shared environmental effect on adolescent drinking, which they interpreted as evidence for social contagion between siblings.

Given the convergence from clinical, developmental, and behavioral genetic research that sibling effects on adolescent drinking are substantial, the key issue is to determine the mechanisms underlying the social contagion process between siblings (Dunn, 2005). Family process researchers have emphasized the importance of examining observable real-time interactions to provide insight into the dynamics of sibling influences (Bank et al., 2004; Conger & Rueter, 1996; Conger et al., 1997; Reiss et al., 2000), particularly as sibling interaction has been shown to be primarily reflective of shared environmental rather than genetic processes (Reiss et al., 2000). One promising approach has focused on the role of "rule-breaking" behavior between siblings as a core process of deviancy training which conveys risk for a range of problem behaviors including substance use (Bank et al., 2004; Bullock & Dishion, 2002; Snyder et al., 2005; Stormshak et al., 2004). The construct of rule-breaking synthesizes complementary perspectives on sibling deviancy training which have emphasized both coercive (negative reinforcement) and cooperative/coparticipatory (positive reinforcement) processes (Bank et al., 2004; Rende et al., 2005; Slomkowski et al., 2001, 2005; Snyder et al., 2005; Stormshak et al., 2004) by operationalizing specific interactive behaviors between siblings that may promote the likelihood of risktaking behavior in general and thus also illicit use of substances, including alcohol.

In this paper we introduce The Social Interaction between Siblings Process Code (SIBS-PC; Shebloski, Heylen, Conger, & Slomkowski, 2002), a micro process observational coding system designed to measure characteristics of sibling interactions that predict the development of problem behavior. The SIBS-PC is based on the Peer Process Code (PPC) developed by Dishion and Andrews (see Andrews & Dishion, 1994), the Sibling Interaction Code (Bank, 1993) and on the Social Interaction between Siblings (SIBS) interview developed by Slomkowski et al. (1997). Elements of the PPC micro-social code and of the SIBS interview, designed to assess the sibling interactions of antisocial youth, were combined to create an efficient method of capturing verbal and physical behaviors and affect between siblings that may contribute to the onset and escalation of rule-breaking behaviors over time.

Utilizing data from the Iowa Youth and Family Project (IYFP), we examine the utility of real-time sibling rule-breaking behavior as captured by the SIBS as a predictor of adolescent

drinking. To illustrate the potential of micro process data, we focus on the following unresolved issues pertaining to the construct of sibling contagion for drinking. First, we explore the extent to which exposure to older sibling rule-breaking behavior would predict not only contemporaneous drinking in a younger sibling, but also later drinking by a younger sibling as they make the transition into adolescence. Such relatively long term effects of exposure to older sibling problem behavior has been shown to operate for delinquency (Slomkowski et al., 2001) and tobacco use (Bricker et al., 2007). Our particular interest here is to test a sibling social learning "exposure" model as has been proposed for other forms of illicit substance use such as tobacco (Bricker et al., 2007). In this regard, we hypothesized that older sibling rulebreaking behavior would be predictive of younger sibling drinking after controlling for younger sibling rule-breaking behavior. Second, again following the tenets of an exposure or contagion model, we hypothesized that older sibling rule break would be predictive of drinking persistence in younger siblings, as assessed over 4 annual assessments. Demonstration of sibling effects on drinking persistence in younger siblings would enhance the clinical implications of an exposure or contagion model. Third, we examine potential gender composition effects. As noted earlier, the effects of gender composition on sibling similarity for alcohol use has been mixed, although there is evidence that sibling effects on delinquency are much stronger for same versus opposite- sex sibling pairs (Slomkowski et al., 2001). Fourth, we examined if the associations between rule break and younger sibling drinking varied as a function of the older sibling's use of alcohol. Via exploration of these issues, we hope to illustrate the potential yield of micro process data for illuminating mechanisms of sibling influence that could serve as empirically-based targets for prevention and intervention studies.

Methods

Sample

The study population was 451 rural Midwestern youth and their families residing in Iowa. The sampling frame were all 7th grade students living in eight adjacent rural counties in north central Iowa attending either public or private school in the Fall of 1989. Counties were selected due to their demographic characteristics which made their economy dependent on or related to agricultural production. The specific sampling frame was implemented in order to examine the impact of economic hardship on families in the rural Midwest. The sample selection method included contacting families (via US mail, followed by phone contact) and inviting them to participate in the study. Families with a 7th grade child with two biological parents living in the home and a close age sibling (within 4 years) were eligible for the study. All families were white European Americans, as was reflective of the communities at that time from which the sample was drawn. Of those contacted, 79% participated at wave 1 (1989). There were no significant differences in demographic characteristics between those that chose to participate and those that did not. This sample of families is referred to as the Iowa Youth and Families Project (IYFP); see Conger and Elder (1994) for more detailed information on the sample and procedures.

Procedures

Data Collection—Data was collected yearly beginning in 1989 through 1993. Families were visited twice each year, approximately 2 weeks apart, and each visit lasted approximately 2 hours. During the first visit family members filled out questionnaires regarding family and individual circumstances, relationship qualities and interactions. During the second visit families participated in four structured interaction tasks that were video-taped in the family's home. The first two interaction tasks involved all four family members who were participating in the study, the third task involved the two siblings, and the fourth task involved the marital couple. Only data from Task 3, the siblings, is used in these analyses.

Interaction Tasks—The observations for this project were from a semi-structured interaction task (Task 3 in the study). During Task 3, which lasted 15 minutes, siblings answered and discussed a set of question cards. Siblings took turns reading the question cards which asked siblings to discuss their relationship in terms of quality (Are we close? Are we friends? What was the last fun thing we did together?), similarities or differences, perceptions of parental treatment (How does Mom treat us differently? What about Dad?), and sibling social lives (friends, school, problems, etc.). All interaction tasks were video-taped for subsequent coding. Concurrently, parents filled out questionnaires in another part of the house, out of hearing range of the sibling discussion task.

Coding Procedures

Microsocial Ratings with SIBS-PC—Coding of sibling interactions was based on the Social Interaction between Siblings Process Code (SIBS-PC) developed by Shebloski, Heylen, Conger & Slomkowski (2002). The purpose of the code is to highlight social processes that contribute to the development of antisocial and prosocial behaviors, especially in terms of understanding continuity or discontinuity in siblings' behavioral outcomes such as delinquency, tobacco use, and other problem behaviors. The SIBS-PC is a five-category event-based behavioral coding system focused on rule adherence that focuses on five codes (actor, rule adherence, reinforcement, directives, and affect). However, if at anytime one of the five codes (actor, rule adherence, reinforcement, directives or affect) changed, a new set of codes for each category was recorded. For example, in response to a question, "what do we like to do together", a sibling states that he likes to get drunk. This would be coded as an antisocial rule break (and affective codes would also be assigned based on the actor's emotional affect). The sibling's response would also be coded for reinforcement and affect. In addition, there were codes for directives and subsequent compliance to get at coercive behaviors exchanged between the siblings.

The focus of this paper is the construct of rule breaking behavior. Rule adherence behaviors were coded as either rule follow or rule breaks (with a qualifier code for rule break being mild or antisocial). Rule follow codes reflected behavior that was verbal or non-verbal behavior, and was appropriate to the interaction task or other social situations where rules typically guide behaviors. A rule break was a behavior that was inappropriate for the task (and/or most social situations). Examples of mild rule breaks would be answering a telephone, playful hits or punches (more aggressive physical slaps, hits or kicks are coded as antisocial rule breaks), intentional whispering, showing off for the camera, etc. Antisocial rule breaks were behaviors or talk about cheating, derogatory name calling, physical aggression, discussing instances of disobeying parents, substance use, swearing, and other dishonest, disruptive, or illegal behaviors.

After reviewing the videotaped interaction in its entirety, each coder watched the first 5-minute sequence of the sibling interaction; coding was done in real-time with the code being entered on the computer keypad. The videotaped was paused and the first segment was checked for problems or errors. This sequence was repeated for the second and third 5-minute sequence until the videotaped interaction was completed. The length of interactions varied slightly depending on if the siblings talked beyond the 15 min time span or the interviewer did not return immediately to end the interaction task. For this reason, only the first 15 minutes of the videotaped interaction were used for the analyses. Coders received approximately 12 weeks of training and passed regular reliability checks during the 6 month coding process.

Interobserver Agreement—Sixteen percent of tapes were randomly selected to be coded twice in order to check interobserver agreement. Coders were not aware of which tapes were calibration tapes (primary coder) and which tapes were reliability tapes (secondary coder).

Primary coders were randomly assigned and secondary coders were matched with every other coder in order to ensure that all coders were equally evaluated for reliability. Interobserver agreement was calculated by using both percent agreement and Cohen's Kappa (1960); Cohen's Kappa ranged from .87 to .94 across codes. Coders were informed of whether their agreements were above or below 90%. When agreement was below 90%, or if above 90% but review of the matrices revealed a systematic difference in codes, coders met to discuss differences and come to consensus on the appropriate code. Coders discussed interactions that were difficult to decide with the project supervisors during the weekly coding meetings. All corrections were made to the original calibration tape. These corrected codes were utilized in all subsequent analysis.

Agreements were calculated using the Actor plus one additional category for all four categories. As coding speed could account for some differences in coding, a time-window of 6 seconds is allowed around each code; meaning that if two coders reported similar codes within 6 seconds for the category under consideration, the codes were judged to match.

Alcohol use—Alcohol use was assessed in a similar fashion with three questions designed to measure any use as well as frequency of alcohol use such as drinking beer, wine, or hard liquor. At each wave, younger siblings reported how often he or she used each type of alcohol during the past year using a 4-point scale (never, 1–2 times, 3–11 times, 1–3 times per month, 3 or more times per week). Given the non-continuous nature of the response choice, categorical variables were created to represent use versus nonuse at each wave, which also permitted presentation of number of waves of drinking as an outcome variable (coded as 0, 1, 2, and 3 +). All participants were under the legal drinking age of 21 at the time of the assessment, therefore this is considered an illegal behavior.

Results

The fundamental questions we ask in this paper are as follows: 1) Does exposure to older sibling rule break (mild, antisocial) at study baseline predict patterns of drinking over 4 annual waves of assessment? 2) Are the observed associations independent of younger sibling rule break at baseline? 3) Are there significant effects of sibling gender composition on these associations?

Exposure to Older Sibling Rule Break

Following an exposure model, we examine the effects of exposure to older sibling rule break at the first wave of assessment. Before presenting results, we summarize a first key finding: no significant associations were observed between older sibling mild rule break and younger sibling drinking. Given this, we focus only on older sibling antisocial rule break.

Older sibling antisocial rule break was somewhat normative in the first wave of assessment: 55.9% of the older siblings were coded as having performed at least 1 observable antisocial break while interacting with their younger sibling. This distribution provided a logical split—rule breaking older siblings versus non-rule breaking older siblings—for examining drinking patterns in younger siblings. We note here that exploratory analyses that distinguished between lower and higher levels (ranging from 1% to approximately 20% of all coded turns in the observed interaction at Wave 1) of older sibling antisocial rule break did not reveal any significant findings (these results are available upon request).

Older sibling antisocial rule break at Wave 1 was predictive of younger sibling alcohol use at a trend level at Wave 1 [*OR*=1.54 (0.94–2.54), *p*=.09], Wave 2 [*OR*=1.47 (0.93–2.35), *p*=.10], and Wave 3 [*OR*=1.51 (0.98–2.33]. Older sibling antisocial rule break at Wave 1 was significantly predictive of younger sibling drinking at Wave 4 [*OR*=1.70 (1.12–2.57), *p*=.02]. A related issue pertains to the number of waves in which younger siblings reported drinking,

as an indicator of persistence of drinking over time. Table 1 presents descriptive data on younger siblings' persistence of drinking—represented as number of waves in which drinking was endorsed—as a function of older sibling antisocial rule break at Wave 1. There was an overall effect of older sibling antisocial rule break [χ_2 (3)=12.2, p=.01] on younger sibling persistence of drinking. Inspection of Table 1 reveals two important effects: (1) younger siblings not exposed to older sibling antisocial rule break were less likely (55.7%) to drink at any wave as compared to those exposed to older sibling rule break (39.4%); and (2) younger siblings exposed to older sibling rule break were more likely (25.5%) to endorse drinking at 3 + waves than younger siblings who were not exposed to older sibling rule break (18.0%).

We next consider the effects of younger sibling antisocial rule break at Wave 1. Sibling pairs were highly concordant for antisocial rule break: 45% of the sibling pairs were both coded as having performed an antisocial rule break; 36% of the sibling pairs did not perform an antisocial rule break; and 19% of the sibling pairs were discordant (only 1 of the siblings were coded as performing an antisocial rule break). Despite this high level of concordance between siblings for rule break, younger sibling drinking persistence was not significantly associated with younger sibling antisocial rule break. As shown in Table 1, the pattern of results was however similar to that found for older sibling antisocial rule break.

We utilized logistic regression models to address two exploratory issues. First, we examined if the linkage between older sibling antisocial rule break and younger sibling drinking differed by gender composition of the sibling pairs. No significant effects of gender composition were found in logistic regression models that modeled the interaction between gender composition (brother-brother, sister-sister, mixed-sex) and older sibling antisocial rule break. Descriptively, the pattern of findings was similar across both same- and opposite-sex sibling pairs. Second, we examined if the association between older sibling rule break and younger sibling drinking remained significant after controlling for younger sibling rule break. Third, we examined the possibility that the associations between older sibling rule break and younger sibling drinking reflected effects of older sibling drinking. We did not detect significant interactive effects with older sibling use of alcohol at Wave A, as the linkage between older sibling rule break and younger sibling drinking persistence was similar for both non-drinking and drinking older siblings. We consider these analyses to be quite exploratory, however, given the sample size and baseline of adolescent drinking.

Discussion

This study builds upon a large literature that documents sibling influences on adolescent risky behaviors, including alcohol use, as well as a smaller literature that has utilized capturing sibling interaction in real time using semi-structured videotaped paradigms. Our first point for discussion is that our findings suggest that micro process methodologies hold much promise for illuminating the social processes between siblings that may underlie sibling contagion for substance use. For example, prior studies that have demonstrated sibling effects on alcohol use in adolescence have typically relied upon self-reported dimensions of the sibling relationship, such as warmthsupport, hostility-coercion, or sibling social connectedness. While these studies have implied that specific interactive behaviors between siblings may convey risk for illicit drinking, they have not been positioned to identify the key social processes. In this paper we have built upon prior work flagging rule breaking behavior as one core mechanism underlying social influence between siblings (Bank et al., 2004; Bullock & Dishion, 2002; Snyder et al., 2005; Stormshak et al., 2004). Our findings converge with prior studies and suggest that rule breaking behavior may play an important role consistent with a contagion or exposure model of substance use risk (Rende et al., 2005; Bricker et al., 2007), especially in terms of providing exposure to a general pattern of rule breaking that would generalize to use of alcohol. Thus, our extension of the Peer Process Code (Andrews & Dishion, 1993) to the study of siblings

revealed that siblings engage in similar rule breaking processes that have been observed for friend dyads.

Exposure to an older sibling's rule breaking behavior was shown to predict younger sibling drinking across 4 annual assessments. In particular, older sibling rule break at the first wave of assessment was predictive of younger sibling drinking 3 years later, as well as the number of waves that younger siblings reported drinking. These findings not only support self-report studies that argue for the importance of sibling influence on adolescent drinking, but provide a particular mechanism for the social processes between siblings that are influential predictors of initiating and maintaining drinking from early to middle adolescence. The predictive power of older sibling rule break after controlling for younger sibling rule break provides especially important support of the contagion/exposure model.

In future studies, it would be important to determine if younger and older siblings increase their use of antisocial rule breaking behaviors over time and if this escalation corresponds to convergence for increasingly unhealthy patterns of drinking during adolescence. Indeed, it is interesting to note that antisocial rule breaking was not uncommon at the first wave of assessment. Although we could not detect significant influences of the frequency of antisocial rule break, it may be that the clinical significance becomes more apparent over time as younger siblings make the transition from early to later adolescence. Finally, we have not considered the role of genetics and gene-environment interplay in models of sibling contagion. A genetically- informative design would be necessary to broach this issue. Here we do note that prior work using self-report data on sibling relationship quality suggests an important role for sibling dynamics as a social influence on adolescent drinking which is independent of genetic similarity and reflective of shared environmental influence (Rende et al., 2005). We speculate that rule breaking behavior is one of the processes that would underlie this shared environmental effect; however a genetically- informative design would be needed to test this speculation.

One of the key yields of micro process studies is identification of social targets for both intervention and prevention studies. The now impressive literature on sibling effects on a wide range of risky behaviors suggests that sibling interaction should be a modifiable risk factor but few studies identify specific interactive behaviors that should receive focus. The convergence of our findings with other micro process studies (Bank et al., 2004; Bullock & Dishion, 2002; Snyder et al., 2005; Stormshak et al., 2004) suggest that the dynamics underlying rule breaking behavior—particularly antisocial rule breaking behavior—would serve as an empirically supported target for intervention as well as prevention. In this regard the utility of the high-risk sibling design should be considered, as both interventive (i.e., focused on an older sibling who has initiated drinking) and preventive (i.e., a younger sibling who has not yet initiated drinking) goals can be tested with efficiency (see Brontman et al., 2005).

There are a few key issues that would be important to address in future studies. First, we did not find strong evidence of gender composition effects, which is not inconsistent with recent sibling studies of alcohol use (Van der Vorst et al., 2007). That said, gender composition effects may be more apparent by in-depth analyses of the patterns of interaction afforded by micro social data. Second, it would be important to place antisocial rule breaking behavior as a function of parenting behaviors. There is both theoretical and empirical support for the idea that antisocial rule breaking behavior emerges as part of a broader family dynamic resulting from ineffective parenting styles, and we would hypothesize that corresponding patterns of escalating rule break and drinking throughout adolescence would be linked with parenting. A similar perspective should be considered in terms of linkage with peer influences, particularly given the importance of mutual friendships in sibling contagion models. Future sibling studies that can generate more comprehensive models incorporating parental and peer influences

would go a long way in demonstrating the unique positioning of siblings as a fundamental source of connection between the family environment and the peer environment, especially during the critical juncture of adolescence.

It must be noted that the Iowa sample is primarily White, and of European-American descent, therefore generalization to other types of adolescent populations may be limited. Results from this sample have been replicated in more diverse samples giving us added confidence about the generalizability of the findings (e.g., Conger, Wallace, Sun, Simons, McLoyd, & Brody, 2002; Solantus, Leinonen, & Punamaki, 2004). That said, replication and expansion of these findings in more ethnically-diverse families will be important.

Overall, the findings of this paper support prior contentions that micro process data can yield important insights on sibling social interaction that are relevant for etiology, prevention, and treatment. In this paper, we generated a summary indicator of a key interactive process—antisocial rule break—from intensive event based micro process coding and demonstrated the predictive utility of this measure. That said, other insights may be gleaned by use of the sequential nature of the data, both within-wave and across-wave (see Dishion et al., 2004). The levels of insight that may accrue from applying multiple levels of analysis of micro process data have the potential to substantially sharpen the focus of future preventive and interventive strategies aimed to reduce the likelihood of initiating and escalating risky behaviors during the risky period of adolescent development.

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References

Andrews, DW.; Dishion, TJ. The microsocial structure underpinnings of adolescent problem behavior. In: Ketterlinus, RD.; Lamb, ME., editors. Adolescent problem behaviors: Issues and Research. Hillsdale, NJ: Erlbaum; 1994. p. 187-207.

Bank, L. Sibling Interaction Process Code. Oregon Social Learning Center; Eugene: 1993. Unpublished coding manual

Bank, L.; Dishion, T.; Skinner, M.; Patterson, GR. Method variance in structural equation modeling: Living with “glop”. In: Patterson, GR., editor. Depression and aggression in family interactions. Hillsdale, NJ: Lawrence Erlbaum; 1990. p. 247-279.

Bank, L.; Patterson, GR.; Reid, J. Negative sibling interaction patterns as predictors of later adjustment problems in adolescent and youth adult males. In: Brody, GH., editor. Sibling relationships: Their causes and consequences. New York: Ablex Publishing; 1996. p. 197-229.

Bank L, Burraston B, Snyder J. Sibling conflict and ineffective parenting as predictors of adolescent boys’ antisocial behavior and peer difficulties: additive and interactional effects. Journal of Research on Adolescence 2004;14:99–125.

Blozis SA, Conger KJ, Harring JR. Nonlinear latent curve models for multivariate longitudinal data. International Journal of Behavioral Development 2007;31:340–346.

Bullock BM, Dishion TJ. Sibling collusion and problem behavior in early adolescence: Toward a process model for family mutuality. Journal of Abnormal Child Psychology 2002;30:143–153. [PubMed: 12002395]

Buster MA, Rodgers JL. Genetic and environmental influences on alcohol use: DF analysis of NLSY kinship data. Journal of Biosocial Sciences 2000;32:177–189.

Cleveland HH, Wiebe RP. The moderation of genetic and shared environmental influences on adolescent drinking by levels of parental drinking. Journal of Studies on Alcohol 2003;64:182–194. [PubMed: 12713191]

Cohen J. A coefficient of agreement for nominal scales. Educational and Psychological measurement 1960;20:37–46.

Conger, KJ.; Conger, RD.; Elder, GH, Jr. Sibling relations during hard times. In: Conger, RD.; Elder, GH., Jr, editors. Families in troubled times: Adapting to change in rural America. Hillsdale, NJ: Aldine de Gruyter; 1994.

Conger RD, Wallace LE, Sun Y, Simons RL, McLoyd VC, Brody GH. Economic pressure in African American families: A replication and extension of the family stress model. Developmental Psychology 2002;38:179–193. [PubMed: 11881755]

Conger, RD.; Elder, GH., Jr, editors. Families in troubled times: Adapting to change in rural America. Hillsdale, NJ: Aldine de Gruyter; 1994.

Dishion, T. The Peer Process Code. Oregon Social Learning Center; Eugene: 1990. Unpublished coding manual

Dishion TJ, Andrews DW, Crosby L. Antisocial boys and their friends in early adolescence: Relationships characteristics, quality, and interactional processes. Child Development 1995;66:139–151. [PubMed: 7497821]

Dishion, TJ.; Kavanaugh, K. Intervening in adolescent problem behavior: A familycentered approach. New York: Guilford Press; 2003.

Dunn J. Commentary: Siblings in their families. Journal of Family Psychology 2005;19:654–657. [PubMed: 16402881]

East PL, Khoo ST. Longitudinal pathways linking family factors and sibling relationship qualities to adolescent substance use and sexual risk behaviors. Journal of Family Psychology 2005;19:571–580. [PubMed: 16402872]

Elliott, DS.; Huizenga, D.; Ageton, S. Explaining delinquency and drug use. Beverly Hills, CA: Sage; 1985.

Forbes, C.; Vuchinich, S.; Kneedler, B. Assessing families with the Family Problem Solving Code. In: Kerig, PK.; Lindahl, KM., editors. Family observational coding systems: resources for systemic research. Mahwah, NJ: Erlbaum; 2001. p. 59-75.

Gwet K. Kappa statistic is not satisfactory for assessing the extent of agreement between raters. Statistical Methods for Inter-rater Reliability Assessment 2002;1:1–6.

Hopfer CJ, Crowley TJ, Hewitt JK. Review of twin and adoption studies of adolescent substance use. Journal of the American Academy of Child and Adolescent Psychiatry 2003;42:710–719. [PubMed: 12921479]

Kokkevi AE, Arapaki AE, Richardson C, Florescu S, Kuzman M, Stergar E. Further investigation of psychological and environmental correlates of substance use in adolescence in six European countries. Drug and Alcohol Dependence 2007;88:308–312. [PubMed: 17113243]

Kokkevi AE, Richardson C, Florescu S, Kuzman M, Stergar E. Psychosocial correlates of substance use in adolescence: a cross-national study in six European countries. Drug and Alcohol Dependence 2007;86:67–74. [PubMed: 16837140]

Kramer, L. Experimental interventions in sibling relationships. In: Conger, RD.; Lorenz, FO.; Wickrama, KAS., editors. Continuity and change in family relations: Theory, methods, and empirical findings. Mahwah, NJ: Erlbaum; 2004. p. 345-380.

Kramer L, Bank L. Sibling relationship contributions to individual and family wellbeing: Introduction to the special issue. Journal of Family Psychology 2005;19:483–485. [PubMed: 16402862]

McGue M, Elkins I, Iocono WG. Genetic and environmental influences on adolescent substance use and abuse. American Journal of Medical Genetics 2000;96:671–677. [PubMed: 11054776]

McGue M, Iacono WG, Legrand LN, Elkins I. Origins and consequences of age at first drink: II. Familial risk and heritability. Alcoholism: Clinical and Experimental Research 2001;25:1166–1173.

Melby, JN.; Conger, RD. The Iowa Family Interaction Rating Scale (IFIRS). In: Kerig, PK.; Lindahl, KM., editors. Family observational coding systems: resources for systemic research. Mahwah, NJ: Erlbaum; 2001. p. 33-58.

Patterson, GR. The contribution of siblings to training for fighting: A microsocial analysis. In: Olweus, D.; Block, J.; Radke-Yarrow, M., editors. Development of antisocial and prosocial behavior: Research, theories and issues. Orlando, FL: Academic; 1986. p. 235-261.

Poelen EA, Engles RC, Van Der Vorst H, Scholte RH, Vermulst AA. Best friends and alcohol consumption in adolescence: a within-family analysis. Drug and Alcohol Dependence 2007;88:163–173. [PubMed: 17127016]

Pomeroy EA, Gibbons FX, Gerrard M, Cleveland MJ, Brody GH, Wills TA. Families and risk: prospective analyses of familial and social influences on adolescent substance use. Journal of Family Psychology 2005;19:560–570. [PubMed: 16402871]

Reiss, D.; Neiderhiser, JM.; Heatherington, EM.; Plomin, R. The relationship code: Deciphering genetic and social influences on adolescent development. Cambridge, MA: Harvard University Press; 2000.

Rende R, Slomkowski C, Lloyd-Richardson E, Niaura R. Sibling effects on substance use in adolescence: social contagion and genetic relatedness. Journal of Family Psychology 2005;19:611–618. [PubMed: 16402876]

Rhee SH, Hewitt JK, Young SE, Corley RP, Crowley TJ, Stallings MC. Genetic and environmental influences on substance use initiation, use, and problem use in adolescents. Archives of General Psychiatry 2003;60:1256–1264. [PubMed: 14662558]

Rose RJ. A developmental behavior-genetic perspective on alcoholism risk. Alcohol Health and Research World 1998;22:131–143. [PubMed: 15706788]

Rose RJ, Dick DM, Viken RJ, Pulkkinen L, Kaprio J. Drinking or abstaining at age 14? A genetic epidemiological study. Alcoholism: Clinical and Experimental Research 2001;25:1594–1604.

Scholte RH, Poelen EA, Willemsen G, Boomsma DI, Engels RC. Relative risks of adolescent and young adult alcohol use: The role of drinking fathers, mothers, siblings, and friends. Addictive Behavior. 2007 epub ahead of print.

Shebloski, B.; Heylen, E.; Conger, KJ.; Slomkowski, C. The Social Interactions between Siblings Process Code (SIBS-PC). Davis, CA: University of California; 2002. Unpublished coding manual

Shortt JW, Capaldi DM, Dishion TJ, Bank L, Owen LD. The role of adolescent friends, romantic partners, and siblings in the emergence of the adult antisocial lifestyle. Journal of Family Psychology 2003;17 (4):521–533. [PubMed: 14640802]

Slomkowski C, Rende R, Conger KJ, Simons RL, Conger RD. Sisters, brothers, and delinquency: Evaluating the social influence during early and middle adolescence. Child Development 2001;72:271–283. [PubMed: 11280484]

Slomkowski C, Rende R, Novak S, Lloyd-Richardson E, Niaura R. Sibling effects on smoking in adolescence: Evidence for social influence from a genetically-informative design. Addiction 2005;100:430–438. [PubMed: 15784052]

Slomkowski C, Wasserman G, Schaffer D, Rende R. A new instrument to assess sibling relationships in antisocial youth: The social interaction between siblings (SIBS) interview: A research note. Journal of Child Psychology and Psychiatry 1997;38(2):253–256. [PubMed: 9232471]

Snyder J, Bank L, Burraston B. The consequences of antisocial behavior in older male siblings for younger brothers and sisters. Journal of Family Psychology, special issue 2005;19:643–653.

Solantus T, Leinonen J, Punamaki RL. Children's mental health in times of economic recession: Replication and extension of the family economic stress model in Finland. Developmental Psychology 2004;40:412–429. [PubMed: 15122967]

Stormshak EA, Comeau CA, Shepard SA. The relative contribution of sibling deviance and peer deviance in the prediction of substance use across middle childhood. Journal of Abnormal Child Psychology 2004;32:635–649. [PubMed: 15648530]

Trim RS, Leuthe E, Chassin L. Sibling influence on alcohol use in a young adult, high-risk sample. Journal of Studies of Alcohol 2006;67:391–398.

van der Valk JC, van den Oord E, Verhulst FC, Boomsma DI. Using parent ratings to study the etiology of 3 year-old twins' problem behavior: different views of rater bias? Journal of Child Psychology and Psychiatry 2001;42:921–931. [PubMed: 11693587]

Van Der Vorst H, Engles RC, Meeus W, Dekovic M, Van Leeuwe J. Similarities and bi-directional influences regarding alcohol consumption in adolescent sibling pairs. Addictive Behavior 2007;32:1814–1825.

Viken RJ, Kaprio J, Koskenvuo M, Rose RJ. Longitudinal analyses of the determinants of drinking and drinking to intoxication in adolescent twins. Behavior Genetics 1999;29:455–461. [PubMed: 10857250]

Table 1

Younger Sibling Drinking Across Waves as a Function of Older and Younger Sibling Antisocial Rule Break.

	Percentage of Younger Siblings with Number of Waves of Endorsed Drinking			
	0	**1**	**2**	**3+**
Older Sib Rule Break				
No	55.7%	12.0%	14.4%	18.0%
Yes	39.4%	21.2%	13.9%	25.5%
Younger Sib Rule Break				
No	52.0%	14.3%	14.9%	18.9%
Yes	42.0%	19.5%	13.5%	25.0%