



NIH PUBLIC ACCESS

## Author Manuscript

*Child Dev.* Author manuscript; available in PMC 2009 November 1.

Published in final edited form as:

*Child Dev.* 2008 ; 79(6): 1777–1791. doi:10.1111/j.1467-8624.2008.01225.x.

## The Social Ecology of Adolescent Alcohol Misuse

Susan T. Ennett, Vangie A. Foshee, Karl E. Bauman, Andrea Hussong, Robert Faris, John Hipp, Li Cai, Robert DuRant, and Heathe Luz McNaughton Reyes

### Abstract

A conceptual framework based on social ecology, social learning, and social control theories guided identification of social contexts, contextual attributes, and joint effects that contribute to development of adolescent alcohol misuse. Modeling of alcohol use, suggested by social learning theory, and indicators of the social bond, suggested by social control theory, were examined in the family, peer, school, and neighborhood contexts. Interactions between alcohol modeling and social bond indicators were tested within and between contexts. Data were from a longitudinal study of 6,544 students, 1,663 of their parents, and the U.S. Census. All contexts were uniquely implicated in development of alcohol misuse from ages 11 through 17 years and most alcohol modeling effects were contingent on attributes of social bonds.

---

A social ecological perspective suggests that multiple social contexts and the interdependencies among contexts must be considered in explaining development of adolescent problem behaviors, such as alcohol misuse. While adolescent alcohol use and misuse have been recognized as shaped by social contexts and processes (e.g., Brook, Nomura, & Cohen, 1989; Perry, Kelder, & Komro, 1993; Petraitis, Flay, & Miller, 1995), research on higher level contexts, such as schools and neighborhoods, is less common than research on peer and family contexts. Comprehensive examination of the multiple contexts comprising the social ecology of adolescent alcohol use is even more limited. Explanation for the lack of social ecological research may rest in the magnitude of conceptual and analytic demands when multiple social contexts that are themselves multidimensional are jointly considered.

We draw on theories of ecology of human development (Bronfenbrenner, 1977; 1979), social learning (Akers, Krohn, Lanza-Kaduce, & Radosevich, 1979; Bandura, 1977; Petraitis et al., 1995), and social control (Hirschi, 1969; Petraitis et al., 1995) to examine development of alcohol misuse in adolescence by specifying a set of social contexts, attributes of those contexts, and interrelations among those attributes to examine. Our purpose is to use these theories to identify a parsimonious set of contextual attributes, while broadly considering the multiple social contexts in which adolescents' lives are embedded, that in interaction with each other could meaningfully explain development of adolescent alcohol misuse.

### Bronfenbrenner's Ecology of Human Development Theory

Bronfenbrenner's theory provides the overarching conceptual framework by establishing a developmental perspective, defining the social contexts for investigation, specifying the need for an inclusive, multidimensional view of these social contexts, and suggesting relationships of the contexts to each other and the developing adolescent. The central precepts of the ecology of human development are that human development takes place

---

Address correspondence to: Susan T. Ennett, Campus Box 7440, Department of Health Behavior and Health Education, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27599. E-mail: [sennett@email.unc.edu](mailto:sennett@email.unc.edu).

within a set of nested and changing environments and that complex relations within and between those nested environments shape behaviors. Bronfenbrenner suggests an approach to examining interrelations among social contexts by positing that “In ecological research, the principal main effects are likely to be interactions” (Bronfenbrenner, 1977, page 518).

Bronfenbrenner defines person-environment interrelations in terms of micro-, meso-, exo-, and macrosystems. The first three systems are relevant to the current investigation because they define social contexts. Microsystems are the principal and immediate socialization contexts in which human development takes place: the family, peer, and school contexts for adolescents. An exosystem comprises more remote social environments, such as neighborhoods, in which microsystems are embedded. The concept of mesosystems is that processes operating in different contexts are not independent of each other. According to Bronfenbrenner, a mesosystem is formed from the interrelations among microsystems; as an example, processes in the family may impinge on relationships in the peer group (Bogenschneider, Wu, Raffaelli, & Tsay, 1998).

## Theoretical Perspectives Relevant to Specifying Contextual Attributes

Despite the conceptual utility of the ecology of human development, Bronfenbrenner does not provide specificity about the particular attributes of social contexts to measure. Social learning and social control theories are helpful here because both theories situate causes of alcohol use and other problem behaviors in the social environment. Moreover, they are the dominant theoretical perspectives in research on adolescent alcohol and other substance use and have substantial empirical support (Petraitis et al., 1995).

Social learning theory emphasizes exposure to alcohol-using role models and social control theory focuses on the constraining function of social bonds. Social learning theory posits that adolescent alcohol use is learned behavior acquired through social interactions and reinforcement and the resulting ratio of exposure to prosocial versus antisocial definitions for drinking (Petraitis et al., 1995). The ubiquitous positive association between adolescent drinking and their friends' drinking (e.g., Bauman & Ennett, 1996) is typically understood as evidence of social learning, as is the relationship between parental alcohol use and drinking in their children (e.g., Richter & Richter, 2001).

Social control theory posits that a tendency toward deviance is universally shared but manifested only when the bond between an individual and society is weakened (Hirschi, 1969; Petraitis et al., 1995). The social bond may be weakened when conventional attachments are attenuated as when parent-adolescent closeness is low or parents do not exercise supervision of their adolescents (e.g., Hops, Duncan, Duncan, & Stoolmiller, 1996; Simons-Morton & Chen, 2005), and in the face of stress, such as in high conflict families (e.g., Aseltine & Gore, 2000; Webb & Baer, 1995). At a higher level, and often understood from the perspective of macro-level social control theory, adolescent deviance may be due to attenuated bonds in socially disorganized neighborhoods (Elliott et al., 1996; Sampson, Raudenbush, & Earls, 1997).

## Conceptual Framework

Figure 1 presents a schematic representation of the conceptual framework guiding the study. Based on the ecology of human development, four social contexts are posited as potentially relevant to development of adolescent alcohol misuse - family, peers, school (microsystems), and neighborhood (exosystem). The arrows between the family, peer, and school contexts indicate interrelations among these microsystem contexts (mesosystems); thus, between family and peers, family and school, and peers and school.

Consistent with Bronfenbrenner's injunction to measure the complexity of social contexts, each context is characterized by a set of four variables. The variables are derived from social learning or social control theory, with each variable tailored to the particular context. Modeling of alcohol use by others (family members, friends, schoolmates, neighbors) is measured as the central construct from social learning theory. From social control theory, closeness to others, social regulation, and stress are measured as indicators of social bonds pertinent to constraining deviant behavior. As an example of the tailoring of these social control variables to the context, closeness is operationalized as parent-child closeness in the family context, feelings of closeness among mutual friends in the peer context, overall level of school bonding among all students in the school context, and neighborhood bonding among neighborhood residents.

All four social contexts are expected to uniquely contribute to adolescent alcohol misuse development. In addition, following from Bronfenbrenner's prediction of the primacy of interactive effects, the social learning and social control variables characterizing the contexts are expected to have interactive effects within the four contexts and between the three microsystem contexts. Specifically, alcohol modeling effects are expected to vary depending on attributes of the social bonds.

## **Empirical Support for Interactive Effects Between Social Learning and Social Control Constructs Between and Within Social Contexts**

Studies of adolescent alcohol or other substance use in which interactions among social learning and social control constructs were examined are surprisingly limited, whether considering studies that simultaneously considered two or more social contexts or that examined only a single social context. When two or more contexts have been included, family-peer relations have been most commonly studied and mediating effects between social learning and social control constructs examined more often than moderating effects. These studies provide evidence that family attributes such as drug models, parent-adolescent attachment quality, parenting style, and family structure buffer negative peer effects (Brook, Whiteman, Gordon, Nomura, & Brook, 1986; Brook, Brook, Gordon, Whiteman, & Cohen, 1990; Farrell & White, 1998; Marshal & Chassin, 2000; Mason, Cauce, Gonzales, & Hiraga, 1994).

Several studies have examined interactive effects of social learning and social control constructs on adolescent alcohol use in the family context, and less often, the peer context. Results are mixed in supporting conditional relationships when effects of the parent-child relationship and parent alcohol use were examined. Some studies found evidence for no interactions between parent-adolescent attachment quality and parental alcohol use (Andrews, Hops, & Duncan, 1997; Kandel & Andrews, 1987) while others reported amplifying effects of lower levels of attachment quality on parental alcohol use and/or buffering effects of higher levels of attachment quality (Andrews, Hops, & Duncan, 1997; Farrell, Barnes, & Banerjee, 1995; Urberg, Goldstein, & Toro, 2005; Zhang, Welte, & Wieczorek, 1997). In the peer context, the relationship between peer and adolescent alcohol use has been shown to be stronger when peer support is high (Urberg et al., 2005). Similarly, in research on adolescent delinquency, delinquency-peer associations may be stronger among closer friends (Giordano, Cernkovich, & Pugh, 1986; Haynie, 2001).

## **Study Hypotheses**

We test the fundamental premises of the ecology of human development that attributes of multiple social contexts will contribute to development of adolescent alcohol misuse and that interrelations within and between contexts, tested through interactions between social

learning and social control constructs, will be important effects. Specifically, we hypothesize that the effects of alcohol use by others will vary depending on closeness, social regulation, and stress, and that the nature of the interactions will vary depending on the context or contexts involved.

Within the family and neighborhood contexts, where adult norms against alcohol misuse are expected, we hypothesize that closeness and social regulation will buffer effects of family and neighbors' alcohol use. Within the peer and school contexts, where the reference is to interactions with other adolescents, closeness and social regulation are hypothesized to amplify effects of friends' and schoolmates' alcohol use. Consistent with these hypotheses, we expect that between-context interactions involving family closeness and social regulation will buffer exposure to alcohol use by friends and schoolmates, while peer closeness and social regulation will amplify exposure to alcohol use by schoolmates. Within and between all contexts, we hypothesize that stress will magnify the effect of alcohol use by others. In keeping with the developmental perspective of the ecological framework, we examine the contribution of these contextual effects to growth in adolescent alcohol misuse by modeling trajectories of alcohol misuse from age 11 to age 17 in a general population sample.

## Method

### Study Overview

The data were from a longitudinal investigation of intrapersonal and contextual factors that influence adolescent alcohol use and other problem behaviors. The study design included four components to enable contextual analyses: a) a census of adolescents identified by school enrollment and surveyed in school every six months for a total of five assessments (waves 1 - 5), b) a simple random sample of parents of the adolescents surveyed annually by telephone for a total of three assessments (waves 1, 3, and 5), c) social network analysis of school networks based on friendship nominations collected in the school surveys, and d) geocoding of all adolescent and parent addresses to allow linkage of the addresses to U.S. Census tracts and block groups. Data collection with adolescents and parents began in Spring 2002 and ended in Spring 2004.

All protocols were reviewed and approved by the institutional review boards at the University of North Carolina at Chapel Hill and Wake Forest University. The boards approved a waiver of written parental consent. Four weeks prior to data collection, parents were informed about the study through a letter sent both by first class mail and home with the child. Parents could refuse their child's participation by returning a postage-paid form or by calling a toll-free number. Written adolescent assent was obtained in school at the time of data collection by trained data collectors.

### Adolescent Sample and Data Collection

Adolescents enrolled in three public school systems in North Carolina were entered into the study when they were 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> graders and completed the study as 8<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup> graders, respectively. The school systems included a total of eight middle schools, two comprehensive K-8 schools, six high schools, and three alternative schools with middle and high school grades. The high schools were not included until wave 2 when the first 8<sup>th</sup> graders transitioned from middle school. Data collection was timed to coincide with the beginning and end of the school year. At each assessment all enrolled students at the targeted grade levels, except for those in self-contained classrooms for Exceptional Children and those with limited English language reading skills, were eligible for the study. Thus, students new to the study enrolled at each wave of data collection; approximately 15% of students were newly enrolled at the beginning of each school year and approximately 3%

were newly enrolled mid-year. Across the five assessments, the samples ranged in size from 5,220 (wave 1) to 5,017 (wave 5) adolescents with 6,891 unique cases across all waves. Response rates at the five waves were 88.4%, 81.3%, 80.9%, 79.1% and 76.0%, respectively. Approximately one-third of students were in each of the three grade cohorts; at wave 1 the distributions were 35.6%, 33.5%, and 30.9% in grades 6, 7, and 8, respectively.

Trained data collectors administered questionnaires on at least two occasions at each school to reduce the effect of absenteeism on the response rate. Adolescents completed the questionnaire in approximately one hour. Names were not written on questionnaires and questionnaires were placed in envelopes without names and sealed before returning them to the data collectors. Teachers stayed in classrooms to help maintain order, but did not answer questions or walk around the classroom.

### Parent Sample and Data Collection

A simple random sample of 1,663 parents of adolescents who completed the wave 1 survey completed a 25-minute telephone interview at waves 1, 3, and 5. All parents completed the interview in English. Unlike for adolescents, new parents did not enter the study after wave 1. By design, in the majority of cases (98.2%) the mother or mother surrogate was the parent interviewed. Response rates at the three waves were 79.8%, 82.5%, and 71.8%, respectively. The parent sample was designed to provide sufficient number of cases within each Census geographic area to allow aggregate measures of neighborhood context from parent responses to questions about their neighborhood.

Based on self-reports, the mean age of parent respondents at wave 1 was 40.50 years ( $SD = 7.23$ ). Approximately 59% self-identified as White, 38% as Black, 1% as Hispanic, and 2% as another race/ethnicity. Approximately two-thirds (64.9%) reported living in a two-parent household. For 45%, the highest education attained was high school graduate or less.

### Social Network Analysis

Social network analysis was conducted on friendships reported by adolescents at each wave of data collection (Ennett et al., 2006). Data collectors provided each student a Student Directory that alphabetically listed all enrolled students along with a unique four-digit peer identification number for each student. Adolescents identified up to their five closest friends, starting with their best friend. Friends not in the directory were identified by "0000." Because most adolescent friendships are with adolescents in the same school and grade, we bounded social networks by school and grade, with the following exceptions. In high schools and alternative schools, networks were bounded by school only because classes and activities were not grade segregated and therefore cross-grade friendships were likely. In the two K-8 schools, networks also were bounded by school because of their small enrollments. We defined the peer context by the adolescent's set of close friends, including those nominated by the adolescent and those who nominated the adolescent as friend. The school context was defined by the school network to which the adolescent belonged and thus included a larger set of peers than close friends.

### Geocoding

The addresses of adolescents and parents at each wave of data collection were sent to a commercial geocoding firm to be matched with U.S. Census tract and block group data in the 2000 Decennial Census. At wave 1, 94.6% of the parent sample was matched to a street address and 5.4% was matched to a ZIP centroid; 94.8% of the adolescent sample was matched to a street address, 3.9% to the ZIP centroid, and less than 1% was not matched. The match rates were similar at other waves of data collection. The geocodes represented 158 Census block groups and 56 tracts, and they covered all of the block groups and tracts in

the three county area as well as some block groups and tracts in contiguous areas where some of the students and parents lived.

We defined the neighborhood context by the U.S. Census block group in which the adolescent lived the first time the adolescent was assessed. Neighborhood assignment was based on block group rather than tract because the smaller size more nearly approximated neighborhoods and comparison of intraclass correlation coefficients for neighborhood measures defined for block groups and census tracts showed greater homogeneity within block groups (not shown).

### Analysis Sample

The analysis sample included all adolescents who participated at any wave of data collection ( $N = 6,891$ ) except for those missing birth date or outside the typical age range of 11 through 17 years for the grades studied ( $n = 51, .7\%$ ) or who could not be geocoded ( $n = 296, 4.3\%$ ), yielding a sample size of 6,544 (95.0%).

The mean self-reported age of adolescents at wave 1 was 13.12 years ( $SD = 1.04$ ). About half were male (51%) and the self-reported race/ethnicity distribution was 52% White, 37% Black, 4% Hispanic, and 7% other race/ethnicity. Averaged across all five waves of assessment, approximately 13% of adolescents reported living in other than a two-parent family and for 39% the highest education attained by either parent was reported by the adolescent to be high school or less.

### Measures

Measures included adolescent alcohol misuse, social context variables suggested by social learning and social control theories, and demographic control variables. The alcohol and social context variables were collected at all five assessments, allowing construction of time-varying measures. With the exceptions of age and high school enrollment, the demographic variables were constructed as time invariant.

**Alcohol misuse**—We constructed a scale of alcohol misuse based on eight adolescent self-report items about recent alcohol use. Items measured problematic levels of use (e.g., had 5 or more drinks in a row, gotten drunk or very high from drinking alcoholic beverages) and negative consequences associated with use (e.g., gotten into a physical fight because of drinking, did something you later regretted because you had been drinking). Each item had five response categories ranging from 0 to 10 or more times in the past three months. Because of the skewed distribution of responses, as expected for a general population sample of young people, rather than construct the scale by summing or averaging responses to the eight items we used item response theory (IRT) to construct the scale (Thissen, Nelson, Rosa, & McLeod, 2001). Because IRT models require independent cases, we randomly selected one observation per respondent from all the repeated measures. We confirmed that a one-factor model fit the data well, using the Weighted Least Squares estimator implemented in Mplus (Muthén, & Muthén, 1998-2006). We used MULTILOG software to run both the graded response model and the nominal model in a comparison to determine which provided a better fit to the data (Thissen, Chen, & Bock, 2003). The nominal model provided a substantially better fit than the graded response model to the observed proportions in the lowest response category (i.e., 0 times) for all items. In addition, even though the nominal model was unconstrained, it preserved the ordering of the response categories. Thus, we selected the nominal model. We then used the item parameter estimates to compute scale scores using the maximum a posteriori method (Thissen & Orlando, 2001). The resulting scale more nearly approximated a continuous distribution, with reduced skewness and kurtosis, compared with a summed scale.



**Social context**—We measured indicators of alcohol modeling, closeness, social regulation, and stress in each social context. Most measures were means of reduced sets of items from existing scales. Specific items were identified for survey inclusion through earlier psychometric analysis of data collected on full scales in a pilot study. Except where otherwise noted, items had either four or five response categories. Chronbach's alphas reported with the measures were averaged across the five waves.

Family context measures, based on adolescent report, were the number of current alcohol users in the family (alcohol modeling), parent-adolescent closeness (closeness), parental supervision (social regulation), and family conflict (stress). The number of drinkers was constructed from items about recent alcohol behavior asked separately for the mother, father, and siblings. Parent-adolescent closeness was measured by two sets of three questions asked separately about the mother and father, such as how close the adolescent felt toward the parent ( $\alpha = .80$ ). Parental supervision was constructed from two sets of three items asked separately for the mother and father from the Authoritative Parenting Scale (Jackson, Henriksen, & Foshee, 1998). The scale measured parental supervisory behavior, such as whether the parent had rules that the adolescent must follow ( $\alpha = .84$ ). Family conflict was measured by three items tapping fighting, throwing things, and sometimes hitting within the family ( $\alpha = .85$ ) (Bloom, 1985).

The peer measures were mean alcohol misuse among friends (alcohol modeling), mutual friends' closeness (closeness), relationship closure (social regulation), and adolescent membership in intransitive friendship triads (stress). Friends' alcohol use was based on the set of close friends and was the mean of their self-reported alcohol misuse. Peer closeness measured the mean closeness reported by mutual friends (i.e., friends who reciprocated the adolescent's nominations); thus, it measured how close these friends felt toward the adolescent. Relationship closure, based on adolescent reports, was the mean of three dichotomous items per nominated friend measuring whether the adolescent's parents had met the friend, the adolescent had met the friend's parents, and adolescent and friend's parents had met (Bearman & Moody, 2004). Higher values indicated greater parental knowledge of friends, suggesting both greater intimacy between adolescents and the possibility of more effective parental oversight and regulating influence on the peer context (Coleman, 1988). Peer stress was derived from the social network analysis (Moody, 2000; 2001) that identified intransitive triads to which adolescents belonged, where an intransitive triad was a set of three peers linked through friendship nominations such that a friend's friend was not also a friend of the adolescent. The variable was the proportion of intransitive triads among all the triads to which the adolescent belonged. Whereas transitive triads represented balanced, closed friendship circles, intransitive triads reflected unbalanced and potentially discordant relationships where an adolescent's friendships were not overlapping and thus carried the potential for stress (Bearman & Moody, 2004).

School context measures were based on data from all students in the school network. Measures were mean alcohol misuse in the network (alcohol modeling), school bonding (closeness), relative density of the school network (social regulation), and prevalence of school misbehavior (stress). School bonding was the mean of adolescents' agreement with three items, such as "students at this school are willing to go out of their way to help someone," from a scale measuring caring school communities ( $\alpha = .84$ ) (Battistich & Hom, 1997). School network relative density, identified through the social network analysis, was the proportion of possible friendship ties present in the school network; the measure adjusted for the fixed number of friend nominations (Moody, 2000; 2001). Higher values indicated greater presence of friendships linking together adolescents in the school and thus more closely knit school communities with presumed greater potential for regulating behavioral norms. School misbehavior was measured with five items from the Problem Behavior

Frequency Scale (Farrell, King, White, & Valois, 2000) that tapped frequency of school-related problem behaviors, such as skipping school and threatening a teacher. Responses were averaged across all students in the school network. Schools with high levels of student misbehavior were assumed to be a stressful environment for adolescents.

We measured neighborhood context attributes, with neighborhoods defined by Census block group, based on data from parents residing in each block group, adolescent residents, and the U.S. Census. Because parents were interviewed at waves 1, 3, and 5 only and because we operationalized time-varying measures for all social context variables, we used the same parent-based neighborhood measures at wave 2 as at wave 1, and at wave 4 as at wave 3. The measures were the mean alcohol misuse of all adolescents living in the neighborhood (alcohol modeling), mean neighborhood bonding (closeness), mean informal neighborhood social control (social regulation), and mean neighborhood disadvantage (stress). All measures were grand-mean centered.

Neighborhood bonding was based on parents' agreement with three items that measured bonding and trust among neighbors ( $\alpha=.90$ ) (Parker et al., 2001). Neighborhood informal social control was constructed from six items that assessed willingness of neighbors to step in and do something when teens were misbehaving, such as damaging property or hanging out and smoking marijuana ( $\alpha = .91$ ) (Sampson et al., 1997). Neighborhood disadvantage was based on parent agreements' with six items regarding physical and social disorder in the neighborhood, such as there being a lot of crime in the neighborhood (Ross & Jong, 2000), and five U.S. Census measures of socioeconomic disadvantage for the block group, such as percent below the poverty line and percent of households without a high school degree ( $\alpha = .84$ ).

**Demographics**—All measures were based on adolescent self-reports except for high school enrollment which was derived from school records. Age was measured continuously based on date of birth. Sex was coded so the reference group was female. Race/ethnicity was based on the adolescent's modal response across all waves of assessment and dummy coded to include White (reference group), Black, Hispanic, and other race/ethnicity. Family structure was coded as two parents in the home (reference group) versus some other composition. Parent education measured the highest education attained by either parent and coded as high school graduate or less versus more than high school graduate (reference group). Because family structure and parent education could change over the course of the study, the two variables were coded as the average across the five waves.

### Multiple Imputation

As already noted, students could enter the study at any of the five assessments and some students attrited at one or more waves. Of the 6,544 students in the analysis sample, 44.2% participated in all five waves, 18.3% participated in four waves, 15.2% in three waves, 10.9% in two waves, and 11.5% at only one wave. Adolescents missing at one or more waves compared with those continuously assessed once they entered the study were significantly more likely to be male, Black or of other race/ethnicity, live in other than a two parent household, have parents with lower education, and have higher levels of alcohol use. Of the 1,663 parents, 66.8% completed all three interviews, 20.4% completed two interviews; and 12.8% completed only the first interview. Parents who completed one or two interviews compared with those who completed all three interviews were more likely to be Black, live in other than a two-parent household, and have lower education.

So that complete data sequences were available for all cases (Allison, 2002), we used PAN, a multilevel multiple imputation program appropriate for longitudinal data, to impute five sets of missing values (Schaefer, 2001). Variables included in the missingness equation were



the demographics, alcohol misuse, and all social contextual variables at all five waves. We bounded the imputed values to the valid ranges of the data, and allowed all imputed dichotomous variables to range between 0 and 1 rather than rounding values (Allison 2005).

### Statistical Analysis

Because of the nestedness of our data and social contexts, such that repeated measures of alcohol misuse were nested within adolescents and adolescents were nested within neighborhoods and schools, we used a multilevel modeling approach (e.g., Raudenbush & Bryk, 2002). Specifically, we estimated three-level hierarchical growth models with time specified at level one, adolescents at level two, and neighborhood at level three. Four-level models cross-classified by neighborhood and school could not be estimated. We specified neighborhood rather than school at level three because of the larger number of neighborhoods than schools, because neighborhoods were largely nested within schools (in that adolescents from several neighborhoods attended the same school), and because there was significant variance in adolescent alcohol misuse between neighborhoods ( $ICC = .003$ ,  $p < .05$ ) but not schools ( $ICC = .001$ ,  $p = .18$ ).

The data were arranged in a cohort sequential design whereby data collected over approximately two and one-half years from three cohorts (i.e., cohorts enrolled at grades 6, 7, and 8) were merged to allow accelerated trajectories of alcohol misuse to be modeled over approximately six years. We used age to measure the passage of time, thereby allowing change in alcohol misuse to be modeled from age 11 through age 17 (Mehta & West, 2000; Miyazaki & Raudenbush, 2000).

We report the analysis in stages beginning with estimation of the unconditional model to determine the random components and form of the trajectory, with an *a priori* expectation of a linear model. We then tested the cohort sequential design assumption of no differences across the three cohorts in the association between age and alcohol misuse by using a likelihood ratio test to compare the unconditional model to a model that added a variable measuring cohort and the interaction between cohort and age (Miyazaki & Raudenbush, 2000). A non-significant result would suggest the appropriateness of merging data across cohorts.

We next estimated a series of conditional models, using the concepts of micro-, exo-, and mesosystems to guide model building. All models controlled for the demographic variables and, due to multicollinearity, did not include the school context measure of stress. Model 1, the microsystem model, included the three sets of variables describing the family, peer, and school contexts. The variable sets included the main effects of the four attributes in each context and the two-way within-context interactions between alcohol modeling and closeness, social regulation, and stress. Model 2, the exosystem model, added to this microsystem model the set of neighborhood variables and their within-context interactions. Three mesosystem models then added to the exosystem model the two-way between-context interactions between alcohol modeling in one context and closeness, social regulation, and stressful relations in the other context for the family and peer contexts (model 3), family and school contexts (model 4), and peer and school contexts (model 5). We constructed the interactions such that, in models 3 and 4, family characteristics moderated the relationships between adolescent alcohol misuse and peer/school alcohol modeling (e.g., family closeness moderated the relationship between adolescent and friends' alcohol misuse) and in model 5, peer characteristics moderated the relationship between adolescent alcohol misuse and school alcohol modeling. We also included the between-context interaction between the two indicators of alcohol modeling because of the risk associated with accumulated exposure (Ary, Tildesley, Hops, & Andrews, 1993).

For each conditional model, we report the set of coefficients for the fixed effects of the social context attributes and the two-way interactions between context attributes. We also report the  $F$  statistic for testing the significance of the set of variables added to each successive model. Because the social context variables were time varying, a significant effect means that the relationship between the social context variable (or interaction between context variables) and adolescent alcohol misuse was significant on average over the ages examined. For ease of interpretation, we refer throughout to each contextual attribute by the construct name (e.g., peer stress) rather than the specific indicator (e.g., intransitive friendships triads). Significant interactions were probed by plotting the regression of alcohol misuse on alcohol user models at values of the moderator variable set at the mean and one standard deviation above and below the mean (Curran, Bauer, & Willoughby, 2004).

All analyses were conducted using SAS version 9.1.3., using PROC MIXED and PROC MIANALYZE to estimate the unconditional and conditional mixed models (SAS, 2002-2003).

## Results

### Unconditional Model

A linear model with two random components, the individual and neighborhood intercepts, demonstrated significant individual ( $Z$ -score = 42.06,  $p < .0001$ ) and between-neighborhood ( $Z$ -score = 2.96,  $p < .001$ ) variation around the mean intercept for alcohol use centered at age 12. Linear models that included a random slope at the individual and neighborhood levels or at the individual level could not be estimated. The model also showed significant fixed effects such that the mean intercept for alcohol misuse was significantly different from zero ( $B = -.02$ ,  $SE = .01$ ,  $p < .05$ ) and there was significant linear growth in the mean slope ( $B = .10$ ,  $SE = .00$ ,  $p < .0001$ ) through age 17.

We compared this model to quadratic, unstructured, and spline models, each of which also included random intercepts at the individual and neighborhood levels. Based on the Bayesian Information Criterion (BIC) fit statistic, with smaller values by three points or more indicating better fit (Raftery, 1995), the linear model was favored over either the quadratic or unstructured model (linear BIC = 45570; quadratic BIC = 45573; unstructured BIC = 45615). Although the difference between the BICs for the linear and quadratic models was three points, the fixed quadratic effect was not significant and the likelihood ratio test comparing the two models was not significant. The spline model did not demonstrate sufficient improvement in model fit (BIC = 45568) to be selected.

### Test of Cohort Differences

The likelihood ratio test comparing linear models with and without the addition of a cohort variable and cohort-by-age interaction term was not statistically significant, indicating a lack of cohort effects and the appropriateness of the cohort sequential design.

### Conditional Models

**Demographic Variables**—We first examined the contributions of the demographic variables to adolescent alcohol misuse. The positive linear effect of age on alcohol misuse was significant after control for the other demographic variables ( $B = .10$ ,  $SE = .01$ ,  $p < .0001$ ). High school enrollment, the other time varying demographic characteristic, was significantly positively associated with alcohol misuse trajectories ( $B = .05$ ,  $SE = .01$ ,  $p < .0001$ ). For the time invariant variables, we examined the effects of the variables on the intercept and slope of the trajectories. Initial levels of alcohol misuse were higher only for youth whose parents had lower rather than higher educational levels ( $B = .05$ ,  $SE = .02$ )  $p < .$

05). The rate of change in alcohol misuse was slower for Black youth compared with White youth ( $B = -.06$ ,  $SE = .01$ ,  $p < .0001$ ) and faster for youth in families without two parents ( $B = .04$ ,  $SE = .01$ ,  $p < .01$ ).

**Microsystem model**—Results of the microsystem, exosystem, and mesosystem models are shown in Table 1. For the microsystem model, after adjusting for the demographic variables and all other variables in the model, all the family context variables and the two-way interactions between family alcohol use modeling and family social bond indicators were significantly associated with alcohol misuse from age 11 through 17. As expected, the indicators of family closeness and social regulation were negatively associated with adolescent alcohol misuse while family stress and family alcohol use were positively associated with adolescent behavior. As hypothesized, family closeness ( $p < .10$ ) and social regulation buffered the effect of family alcohol modeling on adolescent alcohol misuse, while family stress magnified the effect.

In the peer context, only the two-way interaction between peer social regulation and peer modeling of alcohol use was significant. In an unexpected finding, peer modeling of alcohol use was negatively associated with adolescent alcohol misuse, but greater social regulation buffered the negative effect. (The bivariate association between peer modeling of alcohol use and adolescent alcohol misuse was positive, as expected.) In the school context, alcohol modeling by all students was significantly positively associated with adolescent alcohol misuse; none of the social control variables was significantly associated with adolescent alcohol misuse.

**Exosystem model**—With the addition of the set of neighborhood variables to the microsystem model, neighbors' alcohol misuse had a significant positive effect on adolescent alcohol misuse. No other predictors or any of the interaction terms were significant. The effects of the family, peer, and school variables remained unchanged except that the interaction between peer stress and peer modeling of use became statistically significant. The negative (protective) effect of peer modeling was attenuated by higher stress.

**Mesosystem models**—For all three mesosystem models, the sets of family-by-peers, family-by-school, and peers-by-school interactions were significant additions to the exosystem model. In the family-by-peers and family-by-school models, family social regulation buffered effects of both friends' and schoolmates' alcohol misuse. In addition, both family stress and family alcohol use significantly magnified effects of both friends' and schoolmates' alcohol misuse. In the peers-by-school model, peer regulation ( $p < .10$ ) and peer alcohol misuse enhanced effects of schoolmates' modeling of alcohol use.

## Discussion

Consistent with Bronfenbrenner's ecological perspective on the importance of the multiple social contexts in which lives are embedded, attributes of family, peer, school, and neighborhood contexts uniquely predicted development of adolescent alcohol misuse from age 11 through age 17. The presence of multiple within-context and between-contexts interactions involving constructs from social learning and social control theories largely affirmed Bronfenbrenner's prediction that interactions rather than main effects will be the principal effects demonstrated in ecological research. In addition, our findings partially confirmed our specific expectation that the nature of moderation involving closeness and social regulation would vary depending on whether peers or adults were the referent, whereas stress would always exacerbate alcohol modeling effects. Overall, our findings suggest the appropriateness of an ecological approach for examining adolescent alcohol

misuse and support the need, as noted elsewhere (Cook, 2003), to draw on theory to specify the contextual attributes and joint effects examined.

We consider first the within-context findings from the family, peer, school, and neighborhood contexts in the microsystem and exosystem models. In the family and peer contexts, relationships between modeling of alcohol use by others and adolescent alcohol misuse were always moderated by the nature of social bonds. Thus, the social learning effects of modeling could not be estimated in absence of consideration of the quality of relationships. Similarly, effects of relationship attributes identified by social control theory could not be described without reference to alcohol modeling. In addition to this predominance of interactions over main effects, the nature of interactions involving family characteristics was as hypothesized. Parental supervision and adolescent-parent closeness (marginal effect) buffered alcohol modeling effects in the family, whereas family stress exacerbated family alcohol modeling effects. Several previous studies of interactions between family characteristics and family alcohol use found support for mitigating effects of a positive family environment on parent alcohol use (Farrell et al., 1995; Urberg et al., 2005; Zhang, Welte, & Wieczorek, 1999). While most prior studies focused on parent-child closeness, our findings extend the buffering effects of parenting to the supervisory domain. Parental supervision and monitoring typically have been examined only as main effects on adolescent alcohol and other substance use.

Two interactions between alcohol modeling and the social control variables characterized the peer context: peer alcohol modeling by peer social regulation and by peer stress. In an odd finding, modeling of alcohol misuse by friends was negatively related to alcohol misuse. The interactions were such that at higher levels of peer alcohol use, peer social regulation and peer stress lessened the negative modeling effect. The interactions can be interpreted as consistent with the hypothesized direction of peer effects, in that the risk for alcohol use was increased for youth exposed to higher levels of peer alcohol use and higher social regulation or higher stress compared to those exposed to higher levels of peer alcohol use and lower social regulation or lower stress. Even so, the overall negative effect of peer alcohol use (not present in bivariate analyses), although small, was opposite all expectations and evidently due to the presence of other variables.

In contrast to the family and peer findings, in the school and neighborhood contexts, no significant joint effects of social learning and social bond variables were found. Instead, alcohol modeling by others, whether schoolmates or other adolescents in the neighborhood, was the only significant predictor. It is noteworthy that these modeling effects were detected even after adjusting for friends' modeling of alcohol use. These findings extend the consistently reported association between adolescent and friends' alcohol use to other peer contexts. An implication is that while immediate friendships are central to adolescent alcohol use, the larger and more inclusive school-wide and neighborhood peer environments also clearly matter.

In the mesosystem models, most of the between-context interactions involving characteristics of family and peers, family and school, and peers and school were significant. The expected reverse relationships, depending on whether the family or peers were considered, between social regulation and modeling of alcohol misuse were found. That is, family social regulation buffered effects on adolescent alcohol misuse of alcohol modeling by the adolescent's friends and schoolmates, whereas peer social regulation amplified the modeling effects of alcohol misuse by schoolmates ( $p < .10$ ). The family findings are consistent with studies suggesting that a positive family environment, as indicated by both closeness and supervision, can mitigate negative peer effects (Brook et al., 1986; Brook et al., 1990; Marshal & Chassin, 2000). In addition, and not typically the focus of prior studies,

our findings show that the family can amplify negative peer modeling both through family stress (conflict) and family alcohol use.

While prior studies of family moderating effects are relatively few, several studies have examined mediation of family alcohol socialization factors. In particular, weak family bonds, as indicated by measures of closeness and supervision, have been shown to lead to association with substance-using peers and then to adolescent use (e.g., Kandel & Andrews, 1987; Simons-Morton & Chen, 2005). Given our conditional effects and those prior mediational findings, perhaps models of moderated mediation should be investigated (Muller, Judd, & Yzerbyt, 2005). That is, investigation could examine whether indirect effects on alcohol misuse of parenting characteristics through peer factors are moderated by attributes of other social contexts. The possibility of moderated mediation indicates the complexity of social contextual relationships and the need for research testing expanded models of relationships among contextual factors. An implication of our findings is that consideration of contingencies in contextual relationship should not be discounted in favor of examining only main effects or mediated relationships.

Taken together, our findings indicate that attributes of all social contexts are relevant to development of adolescent alcohol misuse. While all contexts were implicated in adolescent alcohol use, the family context emerged as perhaps most important in that all characteristics were associated with adolescent alcohol misuse. As well, all between-context interactions involving the family predicted adolescent alcohol misuse. In contrast to the perception that family influence wanes over adolescence, our findings suggest the enduring influence of the family throughout the adolescent age span examined.

Our findings also indicate the relevance of both social learning and social control theories to adolescent alcohol misuse. While interrelations between social learning and social control variables generally played out as expected, it is surprising that only the social learning theory variable of alcohol modeling was a significant factor in the school and neighborhood contexts. Perhaps in these more distal, less intimate environments compared to family and friendship groups, adolescents attend to what is most obviously seen - in this case, the alcohol use behavior of others. In addition, or alternatively, perhaps the level of alcohol misuse in this sample was not sufficiently serious to be sensitive to school or neighborhood social controls.

Our analyses are intended to be a specific empirical assessment of Bronfenbrenner's far-reaching perspective on the ecology of human development. The strength of our analyses rests to a great extent in our use of contextual measures that for the most part were constructed independent of our adolescent respondents. Only the measures of the family context and measure of the relationship closure in the peer context were based on adolescent reports. Use of social network analysis allowed us to operationalize peer and school context relational measures with a method specifically intended for measuring relationships. Moreover, due to the data requirements of social network analysis, the measures of the alcohol misuse of friends, schoolmates, and neighbors were based on aggregated self-reports rather than adolescent perceptions. Use of self-reports avoided the bias due to projection effects when adolescent perceptions are used to measure the alcohol use behavior of others (Bauman & Ennett, 1996). At the neighborhood level, our use of parent data and linkage of respondents to Census block groups provided measures of social processes in neighborhoods based on multiple informants. The strength of the measures provides reassurance that where expected relationships were not found, the cause is not likely due to inadequate measurement.



Other strengths of our study in the match of methods to Bronfenbrenner's conceptualization of development in context are the application of multi-level modeling to accommodate nested data, examination of developmental trajectories, and use of time-varying measures of the social context variables.

Our study has methodological limitations. While our analysis of time-varying measures demonstrated the contribution of social context characteristics to alcohol misuse averaged across all ages examined, we did not test differences at each age in the relationships between the social context variables and alcohol misuse. Another short-coming is that our statistical models, while based on longitudinal data, did not allow us to assess temporality of relationships. The models assessed the contemporaneous relationships between the time-varying social context measures and alcohol misuse at each time point assessed (modeled as age); the models did not assess whether the social context attributes at earlier ages predicted alcohol misuse at subsequent ages after controlling for prior involvement. Other statistical models (e.g., autoregressive latent trajectory models) are needed to conduct these analyses and are an essential consideration for future research.

The limitation concerning temporality is most costly in the peer context where we cannot determine whether the relationship between adolescent alcohol misuse and friends' drinking is due to the adolescent's selection of friends or to socialization by those friends. Prior research suggests that both selection and socialization are likely at work (Bauman & Ennett, 1996); indeed, the prediction from Bronfenbrenner's perspective would be that reciprocal processes exist between adolescents and peers. The question is made more complicated by the unexpected negative relationship found in our multivariable models between adolescent alcohol use and friends' alcohol use, although we note that the bivariate relationship was positive. Determining directionality in the family context is also problematic in that adolescent drinking could shape parenting practices or be a cause of family conflict (Ennett, Bauman, Foshee, Pemberton, & Hicks, 2001). Moreover, adolescents could cause their parents' drinking. At the school and neighborhood levels, directionality may flow less ambiguously from the context to the adolescent, although selection by parents into schools and neighborhoods cannot be discounted. With that caveat, our findings contribute to the literature on peer influences on adolescent drinking because exposure to peers' alcohol use at school and in the neighborhood predicted adolescent alcohol misuse net of demographic and family factors, close friends' alcohol misuse, and all other contextual variables.

Besides methodological limitations, our application of Bronfenbrenner's ecology of human development perspective is incomplete in several ways. Perhaps most important is that we did not examine reciprocity between adolescents and their social contexts. As well, we did not assess the influence on adolescent development of the macrosystem, or cultural factors. It is possible that the relationships obtained varied by the race/ethnicity or gender of the respondents or would vary compared to youth in other countries in cross-cultural comparisons. These are areas for future research.

Despite limitations, our study addresses challenges to contextual research in our use of theory to identify specific attributes of contexts and contextual interdependencies for examination. Our findings affirm Bronfenbrenner's social ecological perspective in demonstrating that adolescent alcohol misuse is socially conditioned behavior. Our findings also affirm the joint relevance of social learning and social control theories in that effects of alcohol use by others were often, although not always, conditional on the nature of social bond. Taken together, our findings support the generality that family, peer, school, and neighborhood social contexts and interdependencies within and between social contexts are significantly implicated in adolescent alcohol misuse.

## Acknowledgments

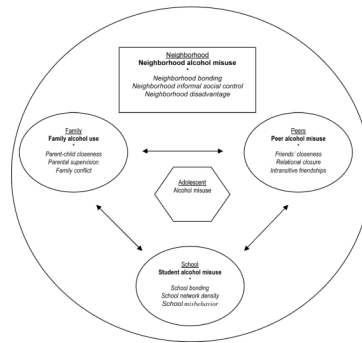
This research was supported by a grant from the National Institute on Drug Abuse (R01 DA13459). The authors thank Dr. Kate Karriker-Jaffe for geocoding assistance and Dr. James Moody for consultation on social network analysis. In addition, we thank the students, parents, and staff in the schools that participated in the study.

## References

- Akers RL, Krohn MD, Lanza-Kaduce L, Radosevich M. Social learning and deviant behavior: A specific test of a general theory. *American Sociological Review*. 1979; 44:636–655. [PubMed: 389120]
- Allison, PD. *Missing Data*. Sage; Thousand Oaks, CA: 2002.
- Allison, PD. In: Nelson, GS., editor. *Imputation of categorical variables with PROC MI*; 30th Annual SAS Users Group International Conference (SUGI 30); Philadelphia, PA. 2005; p. 113-30.
- Andrews JA, Hops H, Duncan SC. Adolescent modeling of parent substance use: The moderating effect of the relationship with the parent. *Journal of Family Psychology*. 1997; 11:259–270.
- Ary DV, Tildesley E, Hops H, Andrews JA. The influence of parent, sibling, and peer modeling and attitudes on adolescent use of alcohol. *International Journal of the Addictions*. 1993; 28:853–880. [PubMed: 8359945]
- Aseltine RH Jr, Gore SL. The variable effects of stress on alcohol use from adolescence to early adulthood. *Substance Use and Misuse*. 2000; 35:643–668. [PubMed: 10807150]
- Bandura, A. *Social learning theory*. Prentice-Hall; Englewood Cliffs, NJ: 1977.
- Battistich V, Hom A. The relationship between students' sense of their school as a community and their involvement in problem behaviors. *American Journal of Public Health*. 1997; 87:1997–2001. [PubMed: 9431290]
- Bauman KE, Ennett ST. On the importance of peer influence for adolescent drug use: Commonly neglected considerations. *Addiction*. 1996; 91:185–198. [PubMed: 8835276]
- Bearman PS, Moody J. Suicide and friendships among American adolescents. *American Journal of Public Health*. 2004; 94:89–95. [PubMed: 14713704]
- Bloom BL. A factor analysis of self-report measures of family functioning. *Family Process*. 1985; 24:225–239. [PubMed: 4018243]
- Bogenschneider K, Wu MY, Raffaelli M, Tsay JC. Parent influences on adolescent peer orientation and substance use: The interface of parenting practices and values. *Child Development*. 1998; 69:1672–1688. [PubMed: 9914646]
- Bronfenbrenner U. Toward an experimental ecology of human development. *American Psychologist*. 1977; 7:513–531.
- Bronfenbrenner, U. *The ecology of human development: Experiments by nature and design*. Harvard University Press; Cambridge, MA: 1979.
- Brook JS, Brook DW, Gordon AS, Whiteman M, Cohen P. The psychosocial etiology of adolescent drug use: A family interactional approach. *Genetic, Social, and General Psychology Monographs*. 1990; 116:111–267.
- Brook JS, Nomura C, Cohen P. A network of influences on adolescent drug involvement: Neighborhood, school, peer, and family. *Genetic, Social, and General Psychology Monographs*. 1989; 115:125–145.
- Brook JS, Whiteman M, Gordon AS, Nomura C, Brook DW. Onset of adolescent drinking: A longitudinal study of intrapersonal and interpersonal antecedents. *Advances in Alcohol and Substance Abuse*. 1986; 5:91–110. [PubMed: 3728195]
- Coleman J. Social capital in the creation of human capital. *American Journal of Sociology*. 1988; 94:95–120.
- Cook TD. The case for studying multiple contexts simultaneously. *Addiction*. 2003; 98(Suppl 1):151–155. [PubMed: 12752368]
- Curran PJ, Bauer DJ, Willoughby MT. Testing main effects and interactions in latent curve analysis. *Psychological Methods*. 2004; 9:220–237. [PubMed: 15137890]

- Elliott DS, Wilson WJ, Huizinga D, Sampson RJ, Elliott A, Rankin B. The effects of neighborhood disadvantage on adolescent development. *Journal of Research in Crime and Delinquency*. 1996; 33:389–426.
- Ennett ST, Bauman KE, Hussong A, Faris R, Foshee VA, DuRant RH, et al. The peer context of adolescent substance use: Findings from social network analysis. *Journal of Research on Adolescence*. 2006; 16:159–186.
- Ennett S, Bauman KE, Foshee VA, Pemberton M, Hicks KA. Parent-child communication about adolescent tobacco and alcohol use: What do parents say and does it affect youth behavior? *Journal of Marriage and the Family*. 2001; 63:48–62.
- Farrell AD, King EM, White KS, Valois RF. The structure of self-reported aggression, drug use, and delinquent behaviors during early adolescence. *Journal of Clinical Child Psychology*. 2000; 29:282–292. [PubMed: 10802836]
- Farrell MP, Barnes GM, Banerjee S. Family cohesion as a buffer against the effects of problem-drinking fathers on psychological distress, deviant behavior, and heavy drinking in adolescence. *Journal of Health and Social Behavior*. 1995; 36:377–385. [PubMed: 8719055]
- Farrell AD, White KS. Peer influences and drug use among urban adolescents: Family structure and parent-adolescent relationship as protective factors. *Journal of Consulting and Clinical Psychology*. 1998; 66:248–258. [PubMed: 9583328]
- Giordano PC, Cernkovich SA, Pugh MD. Friendships and delinquency. *American Journal of Sociology*. 1986; 91:1170–1202.
- Haynie DL. Delinquent peers revisited: Does network structure matter? *American Journal of Sociology*. 2001; 106:1013–1057.
- Hirschi, T. *Causes of delinquency*. University of California Press; Berkeley, CA: 1969.
- Hops H, Duncan TE, Duncan SC, Stoolmiller M. Parent substance use as a predictor of adolescent use: A six-year lagged analysis. *Annals of Behavioral Medicine*. 1996; 18:157–164.
- Jackson C, Henriksen L, Foshee VA. The authoritative parenting index: Predicting health risk behaviors among children and adolescents. *Health Education and Behavior*. 1998; 25:319–337. [PubMed: 9615242]
- Kandel DB, Andrews K. Processes of adolescent socialization by parents and peers. *International Journal of the Addictions*. 1987; 22:319–342. [PubMed: 3583481]
- Marshal MP, Chassin L. Peer influence on adolescent alcohol use: The moderating role of parental support and discipline. *Applied Developmental Science*. 2000; 4:80–88.
- Mason CA, Cauce MA, Gonzales N, Hiraga Y. Adolescent problem behavior: The effect of peers and the moderating role of father absence and the mother-child relationship. *American Journal of Community Psychology*. 1994; 22:723–743. [PubMed: 7639200]
- Mehta P, West SG. Putting the individual back into individual growth curves. *Psychological Methods*. 2000; 5:23–43. [PubMed: 10937321]
- Miyazaki Y, Raudenbush SW. Tests for linkage of multiple cohorts in an accelerated longitudinal design. *Psychological Methods*. 2000; 5:44–63. [PubMed: 10937322]
- Moody, J. SPAN: SAS programs for analyzing networks [Web Page]. 2000. URL [http://www.sociology.ohio-state.edu/jwm/soc\\_net\\_methods.htm](http://www.sociology.ohio-state.edu/jwm/soc_net_methods.htm).
- Moody J. Peer influence groups: Identifying dense clusters in large networks. *Social Networks*. 2001; 23:261–283.
- Muller D, Judd CM, Yzerbyt VY. When moderation is mediated and mediation is moderated. *Journal of Personality and Social Psychology*. 2005; 89:852–863. [PubMed: 16393020]
- Muthén, LK.; Muthén, BO. *Mplus Version 4.21*. Muthén & Muthén; Los Angeles, CA: 1998-2006.
- Parker EA, Lichenstein RL, Schulz AJ, Israel BA, Schork MA, Steinman KJ, et al. Disentangling measures of individual perceptions of community social dynamics: Results of a community survey. *Health Education & Behavior*. 2001; 28:462–486. [PubMed: 11465157]
- Perry, CL.; Kelder, SH.; Komro, K. A world of adolescents: Family, peers, schools, and the community. In: Millstein, SG.; Peterson, AC., editors. *Promoting the health of adolescents: New directions for the twenty-first century*. Oxford University Press; New York, NY: 1993. p. 73-96.

- Petraitis J, Flay BR, Miller TQ. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. *Psychological Bulletin*. 1995; 117:67–86. [PubMed: 7870864]
- Raftery AE. Bayesian model selection in social research. *Sociological Methodology*. 1995; 25:111–163.
- Raudenbush, SW.; Bryk, AS. *Hierarchical linear models: Applications and data analysis methods*. 2nd Ed.. Sage; London: 2002.
- Richter L, Richter DM. Exposure to parental tobacco and alcohol use: Effects on children's health and development. *American Journal of Orthopsychiatry*. 2001; 71:182–203. [PubMed: 11347360]
- Ross CE, Jong SJ. Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. *American Journal of Community Psychology*. 2000; 28:401–420. [PubMed: 10965384]
- Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*. 1997; 277:918–924. [PubMed: 9252316]
- SAS. SAS 9.1. for Windows. SAS Institute, Inc.; Cary, NC: 2002-2003.
- Schaefer, JL. Multiple imputation with PAN. In: Collins, LM.; Sayer, A., editors. *New Methods for the Analysis of Change*. American Psychological Association; Washington, D.C.: 2001.
- Simons-Morton B, Chen R. Latent growth curve analyses of parent influences on drinking progression among early adolescents. *Journal of Studies on Alcohol*. 2005; 66:5–13. [PubMed: 15830898]
- Thissen, D.; Chen, WH.; Bock, RD. *Multilog (Version 7)*. Scientific Software International; Lincolnwood, IL: 2003.
- Thissen, D.; Nelson, L.; Rosa, K.; McLeod, LD. Item response theory for items scored in two categories. In: Thissen, D.; Wainer, H., editors. *Test Scoring*. Lawrence Erlbaum Associates; Hillsdale, NJ: 2001. p. 141-186.
- Thissen, D.; Orlando, M. Item response theory for items scored in two categories. In: Thissen, D.; Wainer, H., editors. *Test Scoring*. Lawrence Erlbaum Associates; Hillsdale, NJ: 2001. p. 73-140.
- Urberg K, Goldstein MS, Toro PA. Supportive relationships as a moderator of the effects of parent and peer drinking on adolescent drinking. *Journal of Research on Adolescence*. 2005; 15:1–19.
- Webb JA, Baer PE. Influence of family disharmony and parental alcohol use on adolescent social skills, self-efficacy, and alcohol use. *Addictive Behaviors*. 1995; 20:127–135. [PubMed: 7785478]
- Zhang L, Welte JW, Wieczorek WF. Peer and parental influences on male adolescent drinking. *Substance Use and Misuse*. 1997; 32:2121–2136. [PubMed: 9440157]
- Zhang L, Welte JW, Wieczorek WF. The influence of parental drinking and closeness on adolescent drinking. *Journal of Studies on Alcohol*. 1999; 60:245–251. [PubMed: 10091963]



**Figure 1.** Conceptual framework of the social context of adolescent alcohol misuse based on social ecology, social learning, and social control theories. Family, peer, school, and neighborhood contexts and their relationships to each other are suggested by the ecology of human development; ovals depict microsystems, arrows depict mesosystems, and the rectangle depicts an exosystem. Characteristics of contexts in bold are derived from social learning theory (modeling of alcohol use) and characteristics in italics are derived from social control theory (closeness, social regulation, stress).



**Table 1**  
Social Context Predictors of Alcohol Misuse from Age 11 through Age 17 (N=6,544)

	Model 1	Model 2	Model 3	Model 4	Model 5
	Microsystem B (SE)	Exosystem B (SE)	Family × Peers B (SE)	Mesosystem Family × School B (SE)	Peers × School B (SE)
Family context					
Modeling	.12 (.02)****	.11 (.02)****	.07 (.02)****	.06 (.02)***	.11 (.02)****
Closeness	-.02 (.01)*	-.03 (.01)**	-.02 (.01)	-.03 (.01)^	-.03 (.01)**
Social regulation	-.04 (.01)****	-.03 (.01)****	-.01 (.01)	-.02 (.01)*	-.03 (.01)****
Stress	.03 (.01)****	.03 (.00)****	.01 (.01)	.01 (.01)*	.03 (.00)****
Closeness*model	-.01 (.01)^	-.01 (.01)^	-.01 (.01)	-.00 (.01)	-.01 (.01)^
Regulation*model	-.01 (.00)*	-.01 (.01)**	-.01 (.01)*	-.01 (.01)*	-.02 (.01)**
Stress*model	.03 (.00)****	.02 (.00)****	.02 (.00)****	.02 (.00)****	.02 (.00)****
Peer context					
Modeling	-.07 (.10)	-.49 (.10)****	-.38 (.17)*	-.47 (.10)****	-.57 (.13)****
Closeness	-.01 (.00)	-.00 (.01)	-.00 (.01)	-.00 (.01)	.00 (.01)
Social regulation	.01 (.01)	.01 (.01)	.01 (.01)	.01 (.01)	.00 (.01)
Stress	.02 (.05)	-.01 (.04)	-.00 (.04)	-.01 (.04)	-.03 (.05)
Closeness*model	.01 (.02)	-.00 (.02)	-.00 (.02)	-.00 (.02)	.00 (.03)
Regulation*model	.11 (.04)*	.12 (.04)*	.12 (.04)*	.12 (.04)*	.08 (.05)
Stress*model	.45 (.28)	.58 (.20)***	.53 (.20)*	.56 (.20)**	.34 (.25)
School context					
Modeling	.47 (.16)*	.52 (.15)**	.43 (.15)**	.03 (.20)	.13 (.18)
Closeness	-.00 (.02)	.00 (.02)	-.01 (.02)	-.01 (.02)	-.00 (.02)
Social regulation	.03 (.10)	.10 (.08)	.08 (.08)	.08 (.08)	.04 (.09)
Closeness*model	-.04 (.10)	-.06 (.08)	-.02 (.08)	.02 (.08)	-.05 (.08)
Regulation*model	-.03 (.34)	-.39 (.27)	-.32 (.27)	-.30 (.27)	-.21 (.29)

	Model 1	Model 2	Model 3	Model 4	Model 5
	Microsystem B (SE)	Exosystem B (SE)	Family × Peers B (SE)	Family × School B (SE)	Peers × School B (SE)
Social Context					
Neighborhood context					
Modeling		.67 (.03)*****	.67 (.03)*****	.67 (.03)*****	.68 (.03)*****
Closeness		-.03 (.02)	-.03 (.02)	-.03 (.02)	-.03 (.02)
Social regulation		.02 (.02)	.02 (.02)	.02 (.02)	.02 (.02)
Stress		-.00 (.01)	-.00 (.01)	-.00 (.01)	-.00 (.01)
Closeness*model		.02 (.10)	.04 (.10)	.02 (.10)	.00 (.10)
Regulation*model		.03 (.10)	.04 (.10)	.05 (.10)	.05 (.10)
Stress*model		.01 (.04)	.01 (.04)	.01 (.04)	.01 (.04)
Family*peer contexts					
Family closeness*peer model			-.07 (.05)		
Family regulation*peer model			-.14 (.05)**		
Family stress* peer model			.14 (.03)*****		
Family model* peer model			.22 (.04)*****		
Family*school contexts					
Family closeness *school model				-.02 (.05)	
Family regulation *school model				-.08 (.04)*	
Family stress * school model				.11 (.02)*****	
Family model * school model				.19 (.03)*****	
Peer*school contexts					
Peer closeness*school model					-.01 (.02)
Peer regulation* school model					.07 (.03)^
Peer stress* school model					.30 (.21)
Peer model* school model					.85 (.32)*
F <sup>a</sup>	64.62*****	64.24*****	27.73*****	19.99*****	2.97*

Note: Adolescents are nested in neighborhoods. All hierarchical growth models are computed on five imputed datasets and control for gender, race/ethnicity, family structure, parent education, and high school enrollment.

<sup>a</sup>The *F* statistic tests the significance of the variables added in each model to the previous model. The microsystem model is compared with a model including only demographic variables.

√  $p < .10$   
\*  $p < .05$   
\*\*  $p < .01$   
\*\*\*  $p < .001$